The Economics of Smoking in Russia: Evidence from the Russia Longitudinal Monitoring Survey (RLMS-HSE)

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Declaration of Authorship

I, Diana Quirmbach, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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Summary / Abstract

This thesis contributes to our understanding of tobacco consumption, one of the leading causes of premature mortality in Russia. While smoking has received less attention in the literature compared to hazardous alcohol consumption in Russia, it is increasingly the focus of government policy, as illustrated by a restrictive anti-smoking law which was passed in 2013 and which, among other things, foresees substantial tax increases, some of which have already been introduced. The few studies examining price responsiveness of smoking in Russia have identified very low price elasticities compared to those found for other countries, thus calling into question the effectiveness of tax increases as a means of reducing consumption. In this thesis we draw on 10 years of individual-level longitudinal data from the Russia Longitudinal Monitoring Survey (RLMS-HSE) and regional-level government statistics to examine the longer-term development of smoking patterns in Russia and to model the demand for cigarettes. After setting out the context of smoking in Soviet and post-Soviet Russia, which in both periods is characterised by high affordability and easy availability of cigarettes, coupled with only minimal tobacco control measures, the second part of the thesis examines patterns of smoking across the life-course over the past 6 decades and establishes some stylised descriptive facts regarding the associations of smoking with important socioeconomic and geographic characteristics. Building on this descriptive evidence, we develop an empirical model of cigarette demand in Russia, starting with a static model capturing the influence of factors such as price, income or education on consumption, and then moving to a dynamic specification that additionally accounts for the habit-forming effects of cigarette consumption. We find that price elasticities are small, but meaningful, that social factors and peer effects are more significant drivers of smoking and that smoking is strongly persistent within individuals. A key theme emerging from both the descriptive and econometric analyses is the strongly gendered nature of consumption patterns, which suggests that to successfully reduce the prevalence of smoking, policy measures should take into account the different gender norms towards smoking.

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List of Abbreviations and Acronyms

BHPS	British Household Panel Survey
CIS	Commonwealth of Independent States
CNEF	Cross-National Equivalent File
EU	European Union
FCTC	Framework Convention on Tobacco Control
GATS	Global Adult Tobacco Survey
GDP	Gross Domestic Product
HILDA	Household Income and Labour Dynamics Survey
HITT	Health in Times of Transition
HSE	National Research University Higher School of Economics
LLH	Living Conditions, Lifestyles and Health Survey
LRM	Linear Regression Model
OLS	Ordinary Least Squares
PSID	Panel Study of Income Dynamics
PSU	Primary Sampling Unit
RIP	Relative Income Price
RLMS-HSE	Russia Longitudinal Monitoring Survey of HSE
SOEP	Sozio-Oekonomisches Panel
SSU	Secondary Sampling Unit
TTC	Transnational Tobacco Company

UK	United Kingdom
US	United States of America
WHO	World Health Organisation

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Introduction

In 2009, a 35-year-old Russian man had a 57 percent risk of dying before the age of 70. This startling figure, the UK equivalent of which is 20 percent, corresponds to an annual toll of more than half a million premature male deaths, from which over 150,000 were related to smoking; stemming from the half-century during which male smoking rates have exceeded 60 percent. As a result of this excess mortality among working-age men, in 2009, Russia had the biggest gender gap in life expectancy in the world, with women on average outliving men by more than 10 years. Despite the grim picture regarding male health in Russia, there are some tentative signs of improvements in recent years prompted in part by reductions in premature male mortality, particularly with regard to alcohol-related causes. However, we can expect a further narrowing of the gender gap to be driven by a worsening of female health outcomes. Indeed, while female premature and smoking-attributable mortality are much lower compared to men, life-style changes, including the increasing uptake of female smoking over the past three decades, will likely give rise to a higher share of premature female deaths in the years ahead and will contribute to a closing of the stark gender gap in life expectancy.

Such a narrowing of the gender gap has been observed in a number of high-income (low-mortality) countries and has been attributed to life-style habits becoming more similar among men and women, with an improvement for the former, and a ‘catching up’ among the latter, particularly with regard to smoking. In Russia too, there is evidence of this pattern emerging. Over the past ten years the gender gap in life expectancy has decreased by about 1 year. Similarly, the gender gap in smoking has narrowed in the first decade of the 2000s: while in 2001 there were 4.4 male smokers for every one female smoker, this ratio had reduced to 3.6 by 2010. Unlike in the decades before however, this recent development has been predominantly driven by reductions in male smoking rates rather than increases in smoking among females.

In the face of the catastrophic health profile that Russia has developed over a number of decades, dating back to the 1960s, in more recent times, the Russian government has increased its efforts to reduce unhealthy behaviours, starting with alcohol policy in the mid-2000s, and more recently with a really rather remarkable and ambitious anti-smoking law signed by President Putin in 2013. The corner stones of this latter law are (1) a total ban on advertising, sponsorship, and promotion; (2) a ban on smoking in public buildings, restaurants, workplaces and on public transport; (3) a ban on the sale of tobacco in retail kiosks, and (4) minimum prices as well as significant tax increases. These provisions will make smoking a costlier behaviour, both in terms of money and time. However, to date, little is known about the price responsiveness of smoking in Russia. While alcohol–related mortality and consumption patterns have been studied extensively and established as the major driver behind the low life expectancy of Russian men, smoking, despite its large contribution to the high share of premature deaths, has received less attention.

The empirical literature on smoking in Russia that has emerged can be grouped into: (1) epidemiological studies whose primary aim was to derive representative measures of the prevalence of smoking and its association with demographic, socioeconomic and geographic characteristics, and focusing particularly on increases in female smoking in the transition period; (2) health economic studies of price responsiveness of smoking, focusing largely on the end of the 1990s and showing smoking to be less price responsive when compared with other countries, thus calling into question whether the planned tax increases are an effective means to reduce smoking in Russia.

The contribution of this thesis, which draws on 10 years of individual-level Russian longitudinal data (2001-2010), includes reviewing and developing both of these streams of empirical literature on smoking in Russia. The thesis is split into three parts: The first part, consisting of one chapter, sets out the context of smoking in Russia with respect to the longer-term post-war health developments, as well as the characteristics of the tobacco market and anti-smoking policies in the Soviet and post-Soviet period. One important finding emerging from this chapter is that, despite the economic and political changes in the transition period, the smoking environment since the middle of the 20th century has been consistently characterised by the wide availability and high affordability of cigarettes, alongside only minimal regulatory control of the demand for and supply of tobacco. While the entry of transnational tobacco companies (TTC) prompted a vast, and until that time unprecedented, expansion of marketing activities in the competition for market share, there is more continuity across the two periods than has so far been suggested in the epidemiological literature.

In the second part of the thesis, consisting of chapters 2, 3, and 4, we analyse the developments of smoking over the past 6 decades, and thereby contribute to the epidemiological literature on smoking in Russia. Chapter 2 introduces the Russia Longitudinal Monitoring Survey data (RLMS-HSE) as the major source drawn upon in the thesis, as well as the additional regional-level cigarette prices that we merged into the dataset. In this chapter we discuss the cross-sectional and longitudinal elements of the RLMS-HSE, including a descriptive analysis of patterns of attrition in the longitudinal element of the survey, and compare the different cigarette prices available within the RLMS-HSE and via official government statistics. The chapter makes clear the importance of treating the data and its constituent sampling frames methodically and rigorously.

In chapter 3 we start our empirical investigation by examining smoking patterns over the life-course during the second half of the 20th century, drawing on the retrospective smoking data of the RLMS-HSE. In particular, we re-examine the proposition made in the epidemiological literature that smoking rates among women in Russia only started rising with the entry of the TTCs during the transition period in the early 1990s. We find that while the increases were indeed strongest in that period, pronounced increases were already in train towards the end of the 1970s. We interpret this as suggesting that the (important) developments of the 1990s should be seen, not as the beginning of a rise in female smoking, but as the acceleration of a trend that had actually begun well before the dissolution of the Soviet Union. The successive increases in female smoking from cohort to cohort are in stark contrast to male cohort smoking patterns which have exhibited remarkable continuity over the past 6 decades, with similar patterns of smoking over the life course for successive cohorts.

Following our analysis of the longer-term developments in smoking prevalence, chapter 4 zooms into the more recent period (2001-2010) and examines the patterns of smoking with respect to key socioeconomic and geographic characteristics. This largely descriptive analysis provides further evidence on the strongly gendered nature of smoking: while the typical profile of a male smoker is similar across the country, female smoking is concentrated in large cities and shows a strong regional patterning that likely reflects the different attitudes towards female smoking across the different geographies of Russia. A second finding emerging from this chapter is that male smoking has been on a downward trend since 2007, particularly among the younger age groups, which in combination with slight rises in female smoking, has resulted in a narrowing of the large gender gap in smoking. While male prevalence remained above 50 percent in 2010, the relatively large decreases (albeit from a very high starting level) suggest that we might be witnessing the first signs of the much called-for ‘behavioural revolution’ in Russia.

In the third and final part of the thesis, consisting of chapters 5, 6 and 7, we turn our interest to the price responsiveness of cigarette demand in Russia and to what turns out to be the very challenging complexities of the econometric modelling of cigarette consumption. In chapter 5 we discuss the conceptual and empirical challenges in modelling cigarette demand based on micro-level data and review the available empirical evidence on the price responsiveness of smoking. On the empirical side, a major challenge lies in the limited-dependent variable nature of consumption data, particularly the large proportion of zero (non-smoking) observations. On the conceptual side, we know that smoking is habit-forming/addictive, meaning that cigarette consumption should be modelled within a dynamic framework to allow for intertemporal effects in consumption. We address these two challenges in turn, beginning with a static demand model that addresses the specificities of the dependent variable in chapter 6 and in so-doing updating and extending the results so far reported in the literature. Following the standard approach in the empirical literature, we adopt a two-part model that splits observed consumption into a participation (whether to smoke or not) and a consumption (how much to smoke) level decision. In line with the previous literature on cigarette demand in Russia we find that both participation and consumption are somewhat unresponsive to price. However, while small, these price elasticities might still have some sizeable effects if the government implements the tax increases as planned. In the following chapter we then move into a dynamic modelling framework, both to see whether the tenor of the results from our static model holds, and to explore to what extent habit formation is important in this context. Our dynamic specifications confirm that modelling consumption persistence is indeed important and when we do so we find that the effects of price on demand are larger than suggested by the static models of chapter 6 and elsewhere in the literature. Furthermore, our comparison in chapter 7, of the different sample specifications emphasises the importance of allowing for distinct data generating processes underlying the recording of zeroes and positive consumption values for smoking.

Finally, the health crisis, that has thwarted the economic and social development of the Russian Federation since the collapse of the Soviet Union in 1991, has primarily been a story of the appalling health behaviours that have been adopted by the Russian population. While much of this behaviour is associated with the over-consumption of alcohol and related surrogates, the consumption of tobacco related products over an extended period of time, and the recent growth of this among females, represents the second major source of mortality inducing health ‘choices’ taken *en masse* by the Russian population. Belatedly, confronting this head-on, during the last decade the Russian government has introduced ambitious, by international as well as Russian standards, policy programmes aimed at reducing the consumption of health harming substances and promoting healthier life styles. While welcome, it is still too early to assess the decisive impact of these policy programmes and particularly in the case of smoking, for which the policy package is not yet fully implemented, there is a pressing need for research establishing the likely impact of policy changes and indeed in evaluating the strengths and weaknesses of the proposals. This thesis seeks to address that need.

Part I

Background and context

In this, the first part of the thesis, we carefully situate Russian smoking within the context of its evolution during the previous 6 decades spanning both the latter decades of the Soviet period and the first 25 years of the post-Communist era. In particular we examine the economic, social, and policy environment as well as the broader health consequences of smoking and in so doing establish an important interpretative framework for the empirical analyses which follow in parts two and three of the thesis.

The decades following the Second World War provided an environment in which smoking was highly socially accepted (for men), and cigarettes were highly affordable and easily available compared to other consumer goods, while tobacco control measures were quasi non-existent. The changes on the tobacco market following the dissolution of the Soviet Union, particularly the entry of the Transnational Tobacco Companies (TTC), created a still more smoking-friendly environment where the fierce competition for market shares put downward pressure on prices and encouraged the TTCs to invest heavily in marketing in order to exploit the attractiveness of Western brands and to push their products, particularly among women. While the restrictive anti-smoking law adopted by the Russian government in 2013 provides a step-change in tobacco control policy and has, among other things, already led to significant price increases, it is important to bear in mind the long time period in which smoking was both a highly affordable and socially acceptable behaviour. The years 2001-2010, the major time period considered in this thesis, are particularly interesting since we observe both an increase in the affordability of cigarettes (due to falling real prices and rising incomes) as well as a decrease (prompted by the first round of tax increases in 2008). Given the relative absence of other tobacco control measures, this period thus provides an excellent opportunity to examine the impact of price on cigarette consumption in Russia.

1 The context of smoking in Soviet and post-Soviet Russia

1.1 Introduction

This thesis aims to contribute to our understanding of tobacco consumption, one of the major factors underlying the continuously low health outcomes in Soviet and post-Soviet Russia. It is well known that, given its level of development, Russia clearly lags behind in terms of the health achievements of its population. In 2010, life expectancy for Russian men stood at 63 years, which is not only 15 years lower than the life expectancy of UK men, but also falls short of the level of male life expectancy achieved in Russia in 1965 (Shkolnikov et al., 2013). Only with the most recent increase to 65 years did male life expectancy at birth recover to its 1965 level (Andreev et al., 2014). For women the picture looks more favourable, but despite attaining the highest level of life expectancy ever achieved with 75 years in 2013, a gap of eight years remains compared to UK women. As in other middle-income countries, mortality and morbidity are linked to chronic rather than infectious diseases in Russia and therefore health-related behaviours such as drinking and smoking take on particular importance. While the recent health economic and epidemiological literature has focused on the unprecedented mortality fluctuations since the mid-1980s, particularly in relation to alcohol consumption, smoking, which is at least as important as alcohol in terms of health effects, has received rather less attention.

Smoking is a health behaviour which has strong direct effects on own health and is a leading cause of premature mortality (a so called “modifiable risk factor”). It is linked to at least six of the eight leading causes of death worldwide: While being the leading cause of deaths from lung cancers and chronic obstructive pulmonary disease, it is a major risk factor for ischaemic heart disease (one of the leading causes of the gap in life expectancy between Russian and Western European men), cerebrovascular disease (stroke), lower respiratory infections, and tuberculosis (Himes, 2011). Smoking-attributable mortality (i.e. the share of deaths from each cause that is based on smoking exposure and related risks), makes up about one fourth of premature mortality among Russian men, compared to only 2 percent for women (Peto et al., 2012; Zaridze et al., 2002). However, given increases in female smoking in the past three decades in Russia, smoking attributable deaths will most likely rise in the next decade (Zaridze et al., 2002). Reducing smoking therefore offers a large potential for reducing premature mortality among men, and increasingly among women.

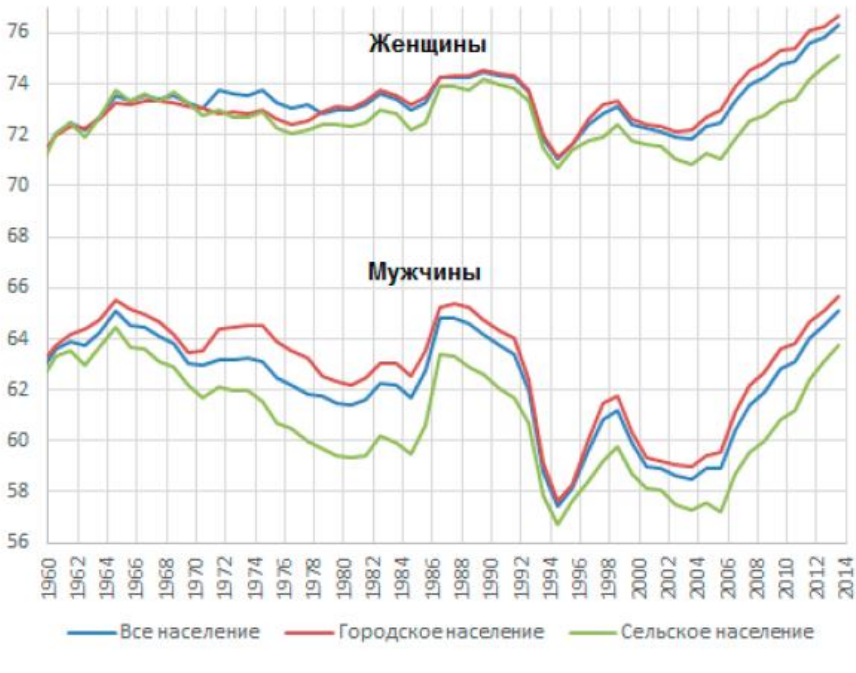
In recent years the Russian government has stepped up its efforts to reduce unhealthy behaviours and this has been particularly visible with regard to smoking. In February 2013 President Putin signed a restrictive anti-smoking law which has introduced, amongst other features (1) a total ban on advertising, sponsorship, and promotion; (2) a ban on smoking in public buildings, restaurants, workplaces and on public transport; (3) a ban on the sale of tobacco in retail kiosks, and (4) minimum prices as well as significant tax increases. While tobacco control policies such as advertising bans and restrictions on smoking in public places had already been implemented by the Soviet government, the planned tax increases, if fully implemented, will for the first time since the Second World War make cigarettes considerably more expensive relative to other consumption goods.

In light of these recent changes, it is important to understand the potential of the various provisions of the anti-smoking law to reduce tobacco consumption. Yet, to date, the literature on smoking in Russia has been mostly descriptive, typically seeking to measure the development of smoking prevalence over recent decades. Not much is known about what the response of Russian smokers will be to substantial price increases, and the few analyses that have been published focus on short time spans and/or have methodological shortcomings which can now be improved upon. The central focus of this thesis therefore lies on the influence of price increases on cigarette consumption in Russia. The following sections of this first chapter embed the empirical analyses of the subsequent chapters in the broader context of the longer-term evolution of health in Russia and the smoking environment, particularly with regard to developments in the tobacco market and tobacco control efforts by the Soviet and later Russian governments.

1.2 THE RUSSIAN HEALTH CRISIS OVER THE PAST 5 DECADES

The patterns of mortality in Russia since the mid-1960s diverged strongly from the developments in other industrialised countries and are characterised by two distinguishing features which are illustrated in Figure 1.1 below: (1) Since 1965 Russian life expectancy declined for males (lower three curves in the graph) and stagnated for females (upper three curves), which against the backdrop of continuously rising life expectancy in Western countries, has resulted in a stark life expectancy gap. For example, the gap in life expectancy between Russia and the UK widened from 3 and 1.5 years for men and women respectively in 1965, to 15 and 7 years in 2010 (Shkolnikov et al., 2013); (2) In the 1980s and 1990s Russian mortality showed abnormal fluctuations around the trend. These fluctuations started with rapid reductions in mortality during the Gorbachev, 1985-1987, anti-alcohol campaign, and were followed by dramatic increases after the dissolution of the Soviet Union (1992-1994).

Figure 1.1 Life expectancy at birth in Russia between 1960 and 2013[1]



Source: Andreev et al., 2014

[1] In the graph, the upper (lower) three curves show life expectancy for women (Russian: женщины) and men (Russian: мужчины) respectively. The blue curve represents overall life expectancy and the red and green curves life expectancy in urban and rural areas respectively.

A second period of mortality reduction lasted from 1995-1998, before being interrupted by the 1998 financial crisis which prompted another period of increasing mortality through to 2003. Since 2004, mortality rates for both genders, across all ages and causes of death have been falling, constituting the longest continuous period of health improvement since 1965. However, except for the oldest age groups, age-standardized death rates were still higher in 2010 than during the mid-1980s, when Russia reached its all-time low for most causes of death during the anti-alcohol campaign. It is not yet clear whether the recent improvements are merely another phase in a continuing cycle of fluctuations or mark the beginning of a sustained trend towards increasing life expectancy (Shkolnikov et al., 2013). This is especially so given the recent slide in living standards triggered by the rouble crisis, plunging oil prices, slowing global growth and rising domestic inflation.

In international comparisons the large gap between Russia and other industrialised countries is attributable to two broad causes of death - cardiovascular disease and deaths due to external and violent causes. Yet, the problem is not only that Russians have a higher risk of dying from these causes, but also that they die at much younger ages from most causes of death than people in countries with higher life expectancy. Thus, instead of deaths being concentrated in the oldest age groups (as is characteristic of countries which have completed the epidemiologic transition), Russian deaths are more spread out across age groups (especially for men), resulting in a high share of working-age deaths, and thus, exacerbated premature mortality. This pattern of mortality in Russia suggests that the country has not completed the second health transition. The concept of health transition was first proposed by Mésle and Vallin (2004), extending Omran's (1971) theory of epidemiologic transition in view of the life expectancy dynamics observed in Eastern Europe and sub-Saharan Africa. The first stage of health transition mirrors Omran’s concept of epidemiologic transition that describes the switch from infectious to degenerative and man-made diseases as the major causes of death, a stage which was achieved in developed countries at the end of the 1960s. As the second stage of health transition, which started in many Western European countries in the 1970s, Mésle and Vallin propose the “cardiovascular revolution”, in which the successful fight against cardiovascular disease facilitates substantial improvements in life expectancy. These improvements were not only the result of technological advances to treat cardiovascular diseases but required significant behavioural changes at the individual level with individuals taking care of their own health (Vallin and Meslé, 2004). With its centralized healthcare system and socio-cultural environment, the Soviet Union was not well equipped to facilitate such lifestyle changes, which lead to a new phase of East-West divergence in life expectancy from the mid-1960s. For Russia to complete the second stage of the health transition and close the gap towards other industrialised countries, it is frequently argued that a "behavioural revolution" is needed.

Negative health-related behaviours such as excessive alcohol consumption, smoking, a high-fat diet and lack of exercise, are deeply entrenched in Russian culture and particularly characteristic of working-age men (Cockerham et al., 2002). The Soviet environment was not conducive to individuals leading healthy lifestyles. On the one hand, the options available for engaging in healthy behaviours, such as indoor sports facilities or the offer of fresh fruits and vegetables were limited. And on the other hand, the Soviet ideology with its emphasis on the collective and low ranking of the individual fostered a passive attitude towards health, with health being viewed as dependent on the healthcare system and thus the responsibility of the state rather than the individual (Cockerham, 2009). Furthermore, the state budget relied on the income from the sale of alcohol so that, despite occasional public health campaigns, the state did not actively promote a healthy lifestyle or discourage unhealthy behaviours.

1.2.1 Health consequences of smoking

While today many countries acknowledge the negative effects of smoking on the health of their population and have stepped up their efforts to reduce the number of smokers, as is illustrated by 180 countries[2] having joined the WHO Framework Convention for Tobacco Control (FCTC) (WHO, 2013), it was only 60 years ago that evidence on the harmful effects of smoking was accepted by the scientific community and the general public. Although medical evidence relating smoking to a number of diseases had been accumulating since the end of the 18th century, it was only with the publication of five epidemiological case-control studies linking smoking to the development of lung cancer in the 1950s that proof of causality was finally accepted. This was marked by two widely publicised reports by the Royal College of Physicians of London in 1962 and by the Advisory Committee to the US Surgeon General in 1964 acknowledging that smoking was a major cause of lung cancer (Doll, 1998). Since then a substantial body of literature

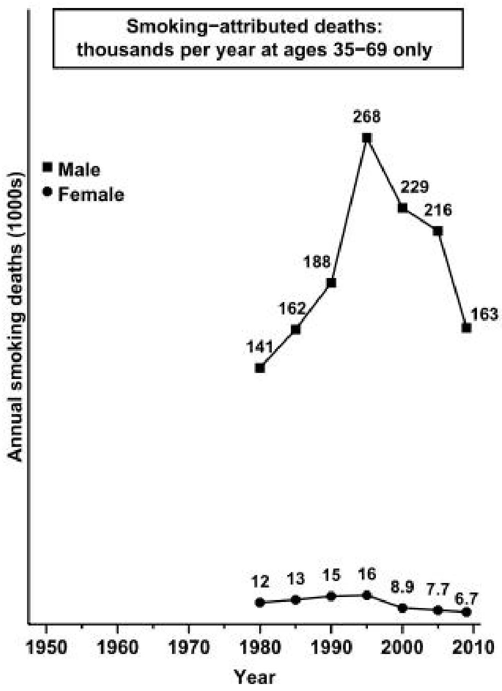
[2] As of January 2015.

linking smoking to a wide range of illnesses has developed, constituting the largest and most fully documented literature linking any behaviour to disease in humans (Chaloupka and Warner, 2000). Smoking is linked to at least six of the eight leading causes of death worldwide. While being the leading cause of deaths from lung cancers and chronic obstructive pulmonary disease, it is a major risk factor for ischaemic heart disease, cerebrovascular disease (stroke), lower respiratory infections, and tuberculosis (Himes, 2011). In addition to being linked to a range of preventable causes of death, smoking is also responsible for a number of quality-of-life reducing conditions such as vision and hearing problems, slowed healing from injuries, and increased susceptibility to certain infections (Chaloupka and Warner, 2000).

According to the WHO, 6 million people die annually from tobacco-related causes, with the highest proportion, 18 percent, of deaths attributable to smoking in high-income countries, followed by 11 percent in middle-income countries and 4 percent in low-income countries (Giovino et al., 2012). The higher relative burden of mortality in high-income countries reflects their longer history of widespread smoking, with the current mortality being reflective of smoking patterns 3-4 decades ago. This lag with which the widespread uptake of smoking manifests itself in mortality statistics is the key element of a four-stage model of the ‘tobacco epidemic’ developed by Lopez and colleagues, which can serve as a useful analytical device for looking at the development of smoking and related health outcomes over time (Lopez et al., 1994). Drawing on historical data from 30 high-income countries which cover most of the 20th century, the model distinguishes between four stages through which countries transition according to changes in smoking prevalence, consumption intensity, and smoking-attributable mortality in men and women. In the first stage, overall smoking is low and only small pockets of the male population smoke, typically city-living and well-off (prevalence <15 percent). In this stage smoking among women is usually less accepted and prevalence rates are thus very low, around 5 percent. Health effects of smoking are not yet visible. In the second stage, smoking loses its association with social distinction and the habit quickly spreads to men of all social classes, followed, with a time lag of 2-3 decades, by steep increases in female smoking. Given their ‘time advantage’, health consequences of smoking begin to show for men, with around 10 percent of male mortality attributable to smoking. The beginning of the third stage is characterised by the decline in male prevalence rates, while female prevalence still increases, until peaking at a lower rate than among men. As the more educated are on average more successful in quitting, smoking prevalence shows the typical gradient that we observe in most high-income countries today, with higher prevalence rates among individuals with lower socio-economic status. In this stage smoking-attributable mortality for males increases rapidly (reaching 25-30 percent) while the health effects for females are still comparatively low (around 5 percent). At the same time as the health consequences of tobacco start to become more visible, the social acceptability of smoking starts to decline and the ground becomes more favourable for stronger tobacco control policies. The end of the third stage is therefore marked by declines in female smoking prevalence. Finally, the fourth and last stage is characterised by falling prevalence among both genders, although at a slower rate, especially for males, than in the previous stage. Smoking prevalence then settles around 30% for women and 35% for men and is now concentrated among lower socioeconomic groups. While smoking-attributable mortality reaches its peak (around 30-35%) early in this stage for men and declines subsequently, the health consequences for females become apparent now, peaking after two to three decades. Overall, the proportion of deaths due to smoking stays at a lower level given that their cumulative exposure has typically been less than for males (they started later, quit earlier and on average smoked less intensively than men).

Most of the high-income countries are now at the end of the third or in the fourth stage of this model, having passed through stages one and two before the negative health effects of smoking came to be known in the 1950s. In many low- and middle-income countries by contrast female smoking is still in the first or second stage with prevalence rates still rising while tobacco-related (female) deaths are still low, whereas male smoking has already progressed well into the third stage. Given that male smoking rates have been above 50 percent since the 1960s in Russia, the negative health effects have become very visible, as is shown in Figure 1.2 below. Mortality attributed to smoking peaked in the early 1990s for both males and females, constituting about 40 percent of male deaths in middle age (35-69), and 6.1 percent of female deaths. Since then smoking-related mortality for males has been decreasing and accounted for 29 (22) percent of deaths in middle age (all ages) in 2009 (Peto et al., 2012). To put this into perspective, in 2005 the risk of dying from smoking in middle age was 19 percent for a Russian male compared to 6 percent in the EU15 and 8 percent in the EU27. The lower prevalence and intensity of female smoking is reflected in smoking-related deaths contributing only very modestly to mortality - 2.6 percent in middle age and 1.8 percent for all ages in 2009. However, given that smoking prevalence among younger women (25-44) has been increasing strongly compared to older cohorts, we will most likely see smoking-related deaths rising in the coming decades (Lopez, 1998; Zaridze et al., 2002).

Figure 1.2 Smoking attributed deaths 1950-2010



Source: Peto et al., 2012

It may seem surprising that smoking-attributed mortality in Russia has been falling for both men and women since 1990, although smoking prevalence rates continued to increase beyond that time. Indeed, this turns the model described above on its head because the model says that, due to the 3-4 decade lag until health effects of smoking become visible in a population, smoking-attributable mortality will be <u>rising</u> beyond the point at which smoking prevalence starts to fall. One reason for this apparently paradoxical development in Russia is related to an important cohort effect relating to those who were in their teenage years during the Second World War and the decade after. Due to the short supply of cigarettes in this period, the cohort born between 1926 and 1938 had fewer smokers, and their reaching of the age of 65 (from 1991), where age specific death rates are highest for lung cancer, produces observed decreases in smoking-attributable mortality (Shkolnikov et al., 1999). A possible alternative or complementary explanation may lie in the change of consumption patterns, from the high-tar Soviet papyrosi (20mg and above) to manufactured cigarettes which, with their lower tar-content, might have been less "deadly" and therefore have resulted in fewer smoking-related deaths. In 2009, smoking was related to 41 (3) percent of cancer related deaths for men (women), and 22 (2) percent of all-cause mortality – adding up to an overall estimate of 245,000[3] deaths attributable to smoking (Peto et al., 2012). Deaths attributed to smoking account for nearly one third of deaths in middle age (35-69) for men, compared to only 2 percent for women, with an average of 16 life years lost per death from smoking (ibid.). A World Bank report in 2005 called smoking the "single most preventable cause of disease and death in Russia" (World Bank, 2005) and suggested that health-related behaviours such as smoking and alcohol consumption may explain an important part of Russia's exceptionally large gender gap in life expectancy. Yet, given the strong increases in female smoking over the past three decades, smoking-attributable mortality among women will most likely increase in the next decade (Zaridze et al., 2002).

1.2.2 Economic consequences of smoking

In order to advocate tobacco control measures, the health consequences of smoking are frequently expressed in a monetary equivalent. The economic tool to estimate the costs of health behaviours are so-called 'cost-of-behaviour studies' which calculate the additional cost due to a certain behaviour, for example, the extra medical care cost due to smoking. Yet, although smoking is a health-related behaviour that is very clearly linked to diseases and, in contrast to other behaviours such as alcohol consumption or food intake, is never health-enhancing, estimating the causal effects of smoking on outcomes such as medical care utilisation, employment or income is complicated by the need to confront issues of reverse causation and confounding (Sloan, 2004). Thus, rather than measuring a causal effect, studies frequently provide a correlation between a behaviour and a certain outcome, e.g. the correlation between smoking and medical expenditures. With this caveat in mind the following section provides a brief overview of two approaches to measuring the cost of smoking.

The majority of studies use a cross-sectional approach to calculate the excess cost attributable to smoking in a single period (Sloan, 2004). This approach includes both the direct costs of smoking, such as expenditures on tobacco and medical care, and the indirect cost incurred through losses that are not linked to payments, such as productivity

[3] This is a conservative estimate since no deaths before the age of 35, and none from liver cirrhosis or non-medical causes, were attributed to smoking.

losses due to job absenteeism and premature mortality. Based on the prevalence of smoking in that period total cost estimates are then calculated. While this method has the merit of being simple and relatively undemanding in terms of data requirements, it ignores the dynamic nature of smoking decisions and the large delay with which the majority of smoking costs occur. Furthermore, the higher costs which smokers might incur in various dimensions at a single point in time are partially offset by their reduced lifespan compared to non-smokers. Therefore, Sloan (2004) argues for the life cycle approach as the preferable method. In his detailed study, he calculated the life cycle social cost of smoking for a 24 year-old smoker and estimated the social costs of smoking to be $40/pack of cigarettes in 2000. The largest share of this figure is made up of private costs to smokers ($33), followed by $5.50 of so-called quasi-external costs (borne by the smoker's family through increased health costs, slightly lower wages and other factors), and $1.50 external costs borne by society, calculated as the net effect of excise taxes paid for tobacco and medical care and social security received. The high internal costs arise mainly from the shortened lifespan of smokers, given that each year of life lost is valued at $100,000. While the share of external costs in the total costs calculated appears low, they lead to sizable costs for society if one adds up the total external cost of a cohort of 24 year old smokers over their lifetime ($35 billion). However, whether private costs should be included at all in cost-of-smoking studies remains an issue debated in the literature.

While we are not aware of any comprehensive cost-of-smoking studies for Russia, there are studies focusing on single types of cost. In 2003 the World Bank examined the distribution of health expenditures in Russia across various medical services and estimated that half of all health care expenditures were spent on the following four groups of health conditions: (1) Circulatory system diseases, (2) Respiratory system diseases, (3) Digestive system diseases, (4) Conditions due to external causes (World Bank, 2005). Smoking is a major risk factor for categories (1) and (2) which account for 33.9 percent of total expenditures. If we were to include the losses due to premature mortality the social costs would rise dramatically. For example, taking the estimate by Denisova (2010) of 8 years of life lost due to smoking on average for men, this would, at a value of $100,000 per life year lost, add up to $800,000 per male smoker across the life cycle.

Lokshin and Sajaia (2007) estimated that smoking has a substantial negative effect on wages for Russian men, and that the effect of smoking on wages differs by gender (Lokshin and Sajaia, 2007). Ross et al. (2008) found that the proportion that Russian households spend on tobacco declined in the past two decades, owing to both a drop in real cigarette prices and increased household incomes (Ross et al., 2008). The evolution of cigarette prices is linked to changes on the Russian tobacco market and excise tax legislation during transition, a topic we will turn to in the next section.

1.3 The Russian tobacco market and cigarette prices

The defining feature of the tobacco market in the past five decades has been the high affordability of cigarettes. In the Soviet Union cigarettes were cheap and easily available. In the two decades following the Second World War tobacco production increased strongly from 2.9 billion to 7.9 billion units average yearly production (Bokarev, 2009). This increase was facilitated by the rebuilding of tobacco factories destroyed during the war with more advanced technology which greatly improved production capacities. Overall, the tobacco industry recovered faster than other sectors of the economy. While tobacco production had struggled with the upheavals caused by civil war, collectivization and two world wars, leading to sharp drops in output and subsequent price increases, by the late 1950s the Soviet tobacco industry had stabilized and prices started falling (ibid.). However, in spite of the higher domestic production, demand for tobacco products continued to exceed supply and the Soviet government additionally had to rely on imports from Bulgaria and Cuba (Bokarev, 2009; Deber, 1981).

The domestic tobacco industry produced a wide variety of tobacco products, with an estimate of 300 brands of cigarettes available to the consumer (Deber, 1981). In contrast to other consumer goods which were often more difficult to obtain, cigarettes were widely and easily available, and even small kiosks would offer 15-25 different brands. Prices differed depending on the brand, but cigarettes were cheap and highly affordable. Per capita consumption increased strongly, from an estimated 1,059 cigarettes in 1962 to 1,786 cigarettes in 1980 (Cooper, 1982).

Yet, with the growing economic problems in the Soviet Union from the 1970s onward, the tobacco industry did not remain unaffected and domestic production started declining after reaching its peak in 1971 (Zaridze et al., 1986). Throughout the 1970s and into the 1980s the availability of cigarettes decreased steadily and by the end of the 1980s at an increasing pace. Between 1986 and 1991 production of cigarettes and farming of tobacco declined by 38 percent and imports of tobacco were down by 46 percent. By 1990 the economic crisis was so severe that the production of cigarettes had ground to a halt (Holmes, 2011). In an attempt to calm down protests by angry smokers in the major cities such as Moscow, Leningrad, Kiev and other Soviet cities (the so-called 'tobacco rebellion'), President Mikhail Gorbachev sought help from Western tobacco companies. In the summer of 1990 the American tobacco companies Philip Morris and R.J. Reynolds delivered 34 billion cigarettes in return for cash and barter goods (Rupert and Frankel, 1996; Starks, 2006). This allowed the two companies to gain a foothold in the world's third-largest tobacco market at a time when their domestic markets were shrinking. The desire to lead a Western lifestyle, against the backdrop of deteriorating quality of domestically produced cigarettes, fuelled the demand for imported cigarettes (Starks, 2006).

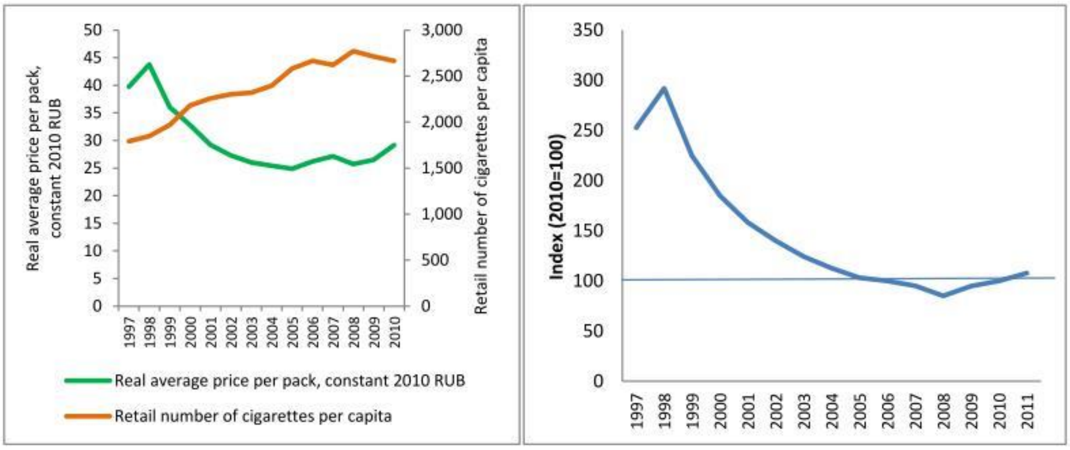
Following the dissolution of the Soviet Union in 1991 and the abolition of the state monopoly on tobacco production in 1992, the major transnational tobacco companies (TTC) invested heavily in Russia, either acquiring domestic producers or setting up their own production facilities to supply the market (Ross et al., 2008). Between 1992 and 2000, 8 percent of foreign direct investment was accounted for by the tobacco industry (ibid.). Among the former Soviet countries, Russia was by far the largest recipient of investments by TTCs, receiving more than 60 percent of total investments in this period (US$ 1.7 billion of US$ 2.7) (Gilmore and McKee, 2004). In the initial phase, foreign companies supplied the Russian market mainly through imports but once production capacities were set up cigarettes were produced domestically. By the late 1990s the strong increases in output led to an oversupply of cigarettes, which was partly diverted into exports into other countries in the Commonwealth of Independent States (CIS) and, with a number of smaller factories going bankrupt, fostered the consolidation of the cigarette market. Today Russia is the world’s largest exporter of cigarettes by volume (WHO, 2012). As a result of the structure of foreign direct investments, the Russian tobacco market is unique in that all four major transnational tobacco companies (Japan Tobacco, Philip Morris, British American Tobacco and Imperial Tobacco Group) compete for market shares. This has placed downward pressure on prices and prompted companies to invest considerable amounts into the marketing of their products. By 2011, the 4 major companies controlled nearly 90 percent of the market (Euromonitor, 2012).

Cigarette sales data vary according to the data source but share the common trend of steadily increasing sales volumes from the mid-1990s into the 2000s, from about 200,000 million units in 1995 to well over 350,000 million units in 2005 (Ross et al., 2008). While Datamonitor estimated a fall in sales volumes from 2002 onwards, Euromonitor reports a yearly volume decline of 1-2 percent beginning only in 2009 (Euromonitor, 2012; Ross et al., 2008). These changes are partly due to population dynamics but can also be attributed to higher taxation and the early beginnings of a decline in smoking prevalence towards the end of the first decade of the 2000s.

As during the Soviet period, today’s cigarette market features a wide variety of brands and is segmented into three major price categories: at 2007 prices, cigarettes in the premium category cost at least 30 roubles (US$1.10) per pack, middle-priced cigarettes sold for 10-29 roubles (US$ 0.37-1.10) per pack, and those in the low-price category could be obtained for as little as 9 roubles (US$ 0.37) or less (Ross et al., 2008). Unfiltered cigarettes, which were the main tobacco product sold in the Soviet Union but have now largely been replaced by filtered cigarettes, cost even less than the low-price filtered brands (e.g. 3.89 roubles (US$ 0.14) per pack on average in 2006). By 2010, the retail price of the biggest selling cigarette brand (Winston) was 31 roubles (US$ 1.03), high-priced Marlboro cigarettes cost 48 roubles (US$ 1.59) and the cheapest brand sold for 11 roubles (US$ 0.36) (WHO, 2011a). Since 2014, the tax increases implemented as part of the anti-smoking law from 2013 have led to more notable increases in cigarette prices: With the latest round of tax increases in January 2015, prices are expected to increase by 9 roubles on average so that a pack of cigarettes will sell at 70 roubles (Izvestia, 2014). However, the wide range of prices available allows consumers to keep consumption stable even if their disposable income decreases by "shifting down" to lower price categories. This could for example be observed following the 1998 default and financial crisis: while before the crisis the high, middle and low price segments accounted for 20, 30 and 50 percent of total sales respectively, the distribution had shifted towards the low-price end in the year 2000, with 75 percent of total sales falling on low-priced brands, and 15 and 10 percent middle- and high-priced brands respectively (Ross et al., 2008). Although measuring price elasticity of demand for cigarettes in Russia is challenging precisely because of the possibility to "switch down" rather than to adjust the quantity purchased, this shift could be taken as an indication that Russian smokers are sensitive to price, at least in terms of the quality of product they purchase, if not the quantity. With the economically stable period of the early 2000s and growing real incomes, consumption preferences have again moved towards higher-priced cigarettes, with the majority of sales in 2006 occurring in the premium (31 percent) and middle-priced (49 percent) segments, and only 20 percent in the low-priced segment (ibid.).

The fierce competition for market shares described above and the associated over-supply led to a decrease in the real price of cigarettes over the first decade of this century. Between 1998 and 2008 nominal prices for cigarettes grew more slowly than the inflation rate and, against the backdrop of rising real incomes, smoking thus became more affordable (WHO, 2012). There is evidence that the price decreases were more pronounced in the low price segment, with real prices for premium brands falling by 39 percent against 49 percent for low priced cigarettes in the period from 2000 to 2007 (Ross et al., 2008). In the same period, real prices for basic goods such as bread, milk and meat increased (ibid.). Russia is not alone in this trend however: in the first decade of the 21st century real cigarette prices of international brands such as Marlboro decreased in a number of middle- and low-income countries, including big markets such as China, India, and Indonesia (Eriksen et al., 2012). Figure 1.3 below shows the development of average real prices, sales and affordability of cigarettes between 1997 and 2010 in Russia. As can be seen in the left panel, from 1998 onwards the average real price of a pack of cigarettes (measured in constant 2010 roubles) dropped sharply, from 45 roubles in 1998 to 25 roubles in 2005. Over the same period, annual per capita sales rose from about 1,700 to 2,500 cigarettes. From 2008 onward, the situation reversed and real prices have been rising due to yearly increases in excise taxes on tobacco, accompanied by slight decreases in per capita sales. Nevertheless, real prices remain well below their 1998 peak. Individuals’ consumption decisions are, however, not only determined by prices but also by the resources available to them. Therefore, prices alone are an insufficient indicator of the affordability of cigarettes.

Figure 1.3 Prices, sales and affordability of cigarettes



Source: WHO calculations based on Euromonitor International Ltd 2012, IMF World Economic Outlook and World Bank data.

* Affordability index: Average real cost of buying 100 packs of cigarettes divided by real per capita GDP

Source: WHO, 2012

The affordability index, shown in the right panel, links cigarette prices with incomes (expressed as real per capita GDP), by calculating the relative income price (RIP) of cigarettes. The RIP is defined as the proportion of per capita GDP required to purchase 100 packs of cigarettes. Thus, the higher the RIP, the less affordable are cigarettes since a larger share of per capita GDP is required to purchase 100 packs of cigarettes, and vice versa. To compare the development of cigarette affordability over time the RIPs have been indexed to 2010. Thus, if the curve lies above the 100 mark, the RIP in that year was higher than in 2010 (and thus cigarettes were less affordable), and if it lies below the 100 mark, the RIP in that year was lower than in 2010. From the graph we can see that from 1998 onwards cigarettes became more affordable in Russia, with affordability peaking in 2008. Since 2009 the RIP has been increasing but remains low compared to the 1998 level, with cigarettes being more than twice as affordable in 2010 as in 1998. Also, in international comparisons, Russia occupies the top rank in terms of the affordability of cigarettes. In a comparison of cigarette prices and affordability in 15 low- and middle-income countries, Russia occupied the top rank with regard to affordability of cigarettes (Kostova et al., 2012). In this study, which was based on data from the 2009 Global Adult Tobacco Survey (GATS) carried out by the WHO, Russia was the only country where the ratio of cigarette prices to income was below one percent.

Russia had adopted a complicated mixed excise tax system on cigarettes, consisting of both a specific and an ad valorem tax, with a minimum specific tax and differentiating between filtered and unfiltered cigarettes (WHO, 2010). However, since January 2012, the tiered system was abolished and unified rates for filter and non-filter cigarettes are now applied (WHO 2012). In addition to the excise tax, a VAT of 18 percent of (pre-VAT) retail price is levied. Between 2008 and 2012 the total tax share in the retail price of the most popular brand (Winston - a medium-priced brand) increased from 30.4 to 40.5 percent (WHO, 2013). This increase was largely due to increases in the specific excise tax, whose share in the final retail price nearly doubled. While this development is moving Russia in the right direction, Russia has a lot of ground to make up before it reaches the WHO recommended level of 70 percent share of taxes in the final retail price. Apart from increasing government revenue, excise taxes constitute an important lever for the government to make cigarettes less affordable in Russia.

1.3.1 Anti-smoking legislation in Russia

While the developments of the 1990s and early 2000s might convey the impression that tobacco control is unknown in Russia, in the past century public health officials have made several attempts to reduce smoking. As such it seems that the economic system of the Soviet Union, where all the essential levers like education, media, agriculture, manufacturing, importing and distribution of tobacco were under the centralised control of the government, could have provided more favourable conditions for enacting tobacco control measures than was the case in Western capitalist societies (Deber, 1981). Yet, in spite of the ambitious efforts of public health officials during the past century, the successful implementation of anti-smoking measures was consistently constrained by economic interests, with economic stability and government revenue being prioritised over concerns about public health. Two examples of larger efforts to curb smoking were the anti-smoking campaigns of the 1920s and the 1970s (Starks, 2006). Both campaigns followed a period when advances in industrial production of cigarettes and increasing standards of living had made cigarettes more affordable for large parts of the population and thus saw the greatest increases in the prevalence of smoking in Russia (ibid.).

Apart from the prohibition on smoking between 1634 and 1696 where smoking was sanctioned with brutal punishments such as slitting of the nostrils, exile to Siberia or even the death penalty, the first (civilised) systematic attempt to limit smoking was undertaken by Nikolas Semashko, first Health Commissar of the Soviet Union, in late 1920 (Starks, 2006). In his ambitious ten-point plan "On the Fight with Smoking Tobacco" Semashko proposed a comprehensive set of measures that were unmatched in any other country at that time, and in parts were even more restrictive than the latest anti-smoking law signed by President Putin in February 2013. The plan envisaged reducing smoking through an attack along three fronts - production, access and image of smoking. To limit supply, he proposed to restrict the land for tobacco tillage, forbid private tobacco factories and ban foreign imports. In terms of access, sale of tobacco products to people under 20 years of age was to be prohibited, and, due to concerns about the effects of smoking on reproduction, only a limited amount of tobacco was to be sold to men aged 20-35 and women of all ages. Furthermore, smoking was to be banned from all public buildings and from places where children might be present. While the concern about the health effects of smoking was shared by public health advocates throughout the world at that time, Semashko's plan of an all-out ban stood out. His proposal also occurred at a time when, due to the disruptions of the world and civil wars, tobacco was in short supply and extremely expensive, which had caused many Russians to quit, not for health reasons but out of necessity. This might have increased the likelihood of success of the ban had it been implemented. However, Semashko was unable to push through his plan due to fierce opposition in the full Soviet of People's commissars, where (especially) economic organisations attacked the plan (Starks, 2006).

In the following decades industry interests took precedence over health and there was little by way of anti-smoking measures. More than half a century later, in the 1970s, the worsening of the demographic situation initiated another period with more favourable conditions for tobacco control. In 1977, the Soviet government issued a decree which was in many respects similar to Semashko's ten point plan (Starks, 2006). A few additions reflected developments of the time, such as the ban of all advertising elements from cigarette packaging and the inclusion of health warnings to deter smoking. Furthermore, producers were required to develop cigarettes with a lower content of harmful substances (Soviet cigarettes contained tar values of 20mg and above), and unfiltered cigarettes were to be produced in lower amounts. In 1980, the decree on "Measures for the Intensification for the Fight with Smoking" confirmed many of the propositions of 1977 as well as a list of concrete measures to implement. Although many of the provisions regarding restrictions on sale and access to tobacco were not implemented, the economic crisis contributed its part to decreasing the availability of cigarettes during the 1980s.

In the confusion over the status of Soviet-era legislation, tobacco control legislation weakened in the early transition period (Gilmore and McKee, 2004; Twigg, 2008). Advertising, the most important tool for tobacco companies in their quest for market shares, increased exponentially and it was estimated that by the mid-1990s tobacco adverts covered half of all billboards in Moscow, and three-quarters of plastic shopping bags (ibid.). Although the government in 1993 attempted to restrict advertising of tobacco (and alcohol), a compromise put forward by the tobacco industry's lobbying organisation "The Coalition for Objective Information" suggested restricting advertisements to the evening hours and thus significantly watered down the content of the law (Starks, 2006; Twigg, 2008). A second attempt was made with the law "On Advertising" in 1995 based on a presidential decree that sought to ban tobacco advertising completely. However, the Duma only passed the law with significant amendments which were negotiated with the tobacco industry, which again only resulted in a very weak law, whose enforcement was even weaker given that it was based on the industry's voluntary code of conduct. However, since 2004 several amendments of the law have finally led to the prohibition of advertising on the radio, television, as well as in cinemas, print media, and on billboards (Twigg, 2008).

Another round of law making followed in the early 2000s with the federal law "On Restriction of Tobacco Smoking", which stipulated a number of restrictions on sales (e.g. banning sales from vending machines and in quantities of less than 20, and increasing the legal purchase age to 18 years) and required minimal health warnings to be placed on cigarette packages (Ross et al., 2008). In sum, although the government tried to re-introduce a number of tobacco control measures and a handful of laws were passed during the transition period, enforcement was weak and successful implementation was often curtailed by industry interests. While in Soviet times, public health officials lost the battle for more stringent anti-smoking laws against more powerful ministries such as agriculture, finance or economic development, in the post-Soviet period they have had to face down both other ministries and the powerful tobacco industry.

Facing well-publicised demographic crisis, in recent years the Russian government has stepped up its efforts to address the unhealthy lifestyles of its population and these efforts have been particularly visible with regard to smoking. In 2008 Russia joined the WHO Framework Convention for Tobacco Control (FCTC) and thereby committed to implementing an extensive set of tobacco control measures by 2015 (RIA Novosti, 2013).

Following from this, the government in 2010 approved the National Anti-Tobacco Policy Concept for 2010-2015, which stipulated a range of measures - including gradual increases in tobacco taxes in order to increase prices to the average price level in the WHO European region - to reduce the overall prevalence of smoking by 10-15 percent by 2015 (WHO, 2011b). In February 2013, President Putin signed a restrictive anti-smoking law which, among other features, resulted in (1) a total ban on advertising, sponsorship, and promotion; (2) a ban on smoking in public buildings, restaurants, workplaces and on public transport; (3) a ban on the sale of tobacco in retail kiosks, and (4) minimum prices as well as significant tax increases. Table 1.1 below lists the control measures suggested by the FCTC and the corresponding article in the Russian anti-smoking law.

Table 1.1 Anti-smoking legislation according to FCTC

Type of tobacco control measure (demand reduction measures)	Corresponding provision in Russian anti-smoking law from February 2013
1. Monitoring of tobacco use and prevention	Article 20: Monitoring and evaluation of effectiveness of measures undertaken
2. Protecting people from tobacco smoke	Article 12: Smoking ban in public places, on public transportation, in restaurants and workplaces
3. Offering help to quit tobacco use	Article 17: Smoking cessation advice and treatments offered via the healthcare system
4. Warning people about the dangers of tobacco	Article 15: Informing the population about the harms of smoking
5. Enforcing bans on tobacco advertising, promotion and sponsorship	Article 16: Ban of tobacco advertising, promotion and sponsorship
6. Raising taxes on tobacco	Article 13: Price and tax measures aimed at reducing the demand for tobacco

If the government follows through with raising taxes until reaching the average price level in the WHO European region, cigarettes will for the first time in the past six decades become comparable to international price levels. In 2014, the excise tax on tobacco increased by 45 percent to 800 roubles per 1000 cigarettes plus 8.5 percent of the retail price. For the years 2015 and 2016 another 20 and 25 percent increase respectively has been advised (Government of the Russian Federation, 2013). However, in order to reach the stated goal of raising prices to the average price level in the WHO European region, the mean excise tax would have to increase to 3000 roubles per 1000 cigarettes, or 60 roubles per pack of the most sold brand – a four-fold increase from the current 15 roubles per pack (ibid.), and more than the current final retail price of economy brands.

According to the WHO, price increases through excise taxes are the most effective means for reducing smoking. In a recent study by Maslennikova et al. (2013) the authors simulate the long-term effects of the various tobacco control policies in Russia. With regard to taxes they calculate that, if the Russian government followed the WHO recommendation of increasing cigarette taxes to 70 percent of the retail price, this measure alone would reduce smoking prevalence to 30.6 percent (15.1 percent) for males (females) by 2055 (Maslennikova et al., 2013). These numbers are based on a conservative measure of price elasticity of demand (-.1 to -.2). However, the potential effectiveness of tax increases depends not only on price responsiveness of demand, but also on supply-side factors like smuggling as well as the possibility to switch down to cheaper cigarettes or other forms of tobacco. While increases in the specific excise tax disproportionately affect economy brands as they are levied per 1000 pieces rather than as a percentage of the price, they reduce the possibilities for adjusting quality of consumption rather than quantity. A more effective tool, however, would be the setting of an absolute minimum price for cigarettes. Such a proposal was brought forward in September 2014 by a deputy for the party United Russia, who proposed a bill to introduce a minimum price of 55 roubles per pack of cigarettes (US$ 1.3 in September 2014) in order to limit the potential for ‘switching down’. Given that 40 percent of cigarettes sell at a price below 44 roubles per pack, this would have led to quite stark changes in the tobacco market and would have predominantly affected domestic producers who dominate the market for economy brands (Bodner, 2014). The bill was, however, not approved by the Duma, potentially due to concerns about protecting the domestic industry, as well as protests by smokers. As concerns circumvention of price rises through smuggling, the customs union with Belarus and Kazakhstan could potentially undermine Russian tax policy. Cigarette prices are about 30 percent lower in those two countries (Kravchenko, 2013), making illicit imports into Russia a lucrative business. As of now, there is no agreement on unified excise duties on products such as alcohol and tobacco in order to avoid grey schemes.

The experience of Russia’s neighbouring country Ukraine provides an interesting case study with regard to the effects of excise tax increases. Between August 2008 and December 2010 the Ukrainian government issued a series of unprecedented excise tax increases, totalling 405 percent in nominal terms (Ross et al., 2011). While tobacco companies initially protected consumers from price rises due to tax increases and inflation, they changed their strategy in 2009 which resulted in price increases of 65 percent in nominal and 39 percent in real terms between January 2009 and December 2010 (ibid.). Sales fell by 13 and 15 percent in 2009 and 2010 respectively. Based on aggregate price and sales data Ross et al. (2011) calculate a (relatively modest) long-run price elasticity of -0.28 and find no impact of price on demand in the short run (Ross et al., 2011). One of the major limitations of this study is the reliance on sales data which might understate true consumption due to illicit trade, and most importantly does not allow us to draw conclusions with regard to micro-level changes such as smoking cessation and per capita reductions in consumption. As a middle way between state-level sales data and longitudinal micro-level data, Krasovsky (2013) analyses smoking prevalence between 2005 and 2010 based on aggregate data of the annual household survey conducted by the State Statistics Service of Ukraine.[4] While prevalence decreased over the entire time period, he finds that the sharpest decrease (-3.2 percentage points) occurred between 2008 and 2010, and attributes this finding to the combined effect of the sharp tax increases and economic recession which considerably reduced the affordability of cigarettes (Krasovsky, 2013). Moreover, he finds the effects on prevalence to be greatest among young and less affluent respondents.

The history of tobacco control in Russia should perhaps caution against the potential success of Russia's latest anti-smoking initiatives. Indeed, as a Russian saying goes: "The draconian nature of the Russian law is softened by the non-obligatory nature of its implementation" (Holmes, 2011). However, given that Russia joined the WHO FCTC - an international treaty that legally binds Russia to implementing a number of control measures - in September 2008, there is hope that this external commitment will work as an effective means to contain industry (and political) influence. Furthermore, prior to its implementation, overall public support for the law was relatively high. In a survey of 1200 adults in 93 rural and urban settlements in December 2010 carried out by the New

[4] The State Statistics Service does not publish the datasets but only provides the aggregate data through reports.

Economic School and Quirk Global Strategies, 80 percent of respondents, and 63 percent of smokers, were in favour of laws to reduce tobacco consumption (Denisova, 2011). 70 percent supported price increases, and even larger majorities favoured stronger health warnings on cigarette packs (91 percent), a ban on tobacco advertising (86 percent), funding for tobacco prevention (85 percent), and prohibition of smoking in public places and workplaces, including restaurants and bars (82 percent) (ibid.). However, in the Health in Times of Transition survey carried out between March and May of the same year in all countries of the Commonwealth of Independent States (CIS), support for tobacco control among the 3000 respondents surveyed in Russia was lower. Only 37 percent supported a total ban of smoking in restaurants and bars, two thirds were in favour of price increases and 70 percent endorsed stronger health warnings on cigarette packages (Roberts et al., 2012b). In a survey carried out in July 2014 (after the implementation of most of the provisions of the law) by the All-Russian Public Opinion Research Center, 90 percent of respondents were aware of the law. However, while support for individual tobacco control measures was generally high (between 60 and 80 percent), 56 percent did not believe the law would reduce smoking in the country (VTsIOM, 2014).

1.4 Conclusion

This chapter set out to describe the smoking environment in Russia. We started by exploring the longer-term health developments in Russia since the 1960s and placed smoking in the context of this prolonged 'health crisis'. Given the extremely high levels of smoking among men, reducing the number of smokers offers a large potential for improvements in male longevity. Given our particular interest in the effects of the recently implemented tax increases, the third section traced developments on the Russian tobacco market since the Second World War and concluded that cigarettes were highly affordable and easily available in both Soviet and post-Soviet Russia, though this is likely to change if the Russian government follows through with its stated goal of reaching the average price level of the WHO European region. Seeking to assess the potential success of the latest anti-smoking law, we reviewed previous efforts of tobacco control in the fourth section. Although the Soviet government made several attempts at reducing smoking, such as bans on advertising and on smoking in public places, and frequently launched public health campaigns against tobacco, these efforts were thwarted by economic motives and the importance of alcohol and cigarette sales for government revenue.

Similarly, the effective lobbying of transnational tobacco companies successfully undermined tobacco control in the first 20 years after the dissolution of the Soviet Union. The restrictive anti-smoking law adopted in 2013 marks a step-change in tobacco control, particularly with regard to tax measures. With the exception of the tobacco crisis in the 1980s, Russians have been used to cigarettes being cheap and widely available. Since 2014 this situation changed in two respects: (1) the first round of tax increases led to a not inconsiderable increase of roughly 9 roubles per pack of cigarettes, and (2) the sale of cigarettes in small kiosks has been banned. This imposes a higher cost on smokers both in terms of money and time. Also, in addition to public buildings and on public transport, smoking is banned in restaurants as well. With these changes in the smoking environment we would expect cigarette consumption to decrease if Russian smokers are sensitive to price. However, since a number of policy measures enter into force at the same time, it will be difficult, and perhaps impossible, to disentangle the effects of price increases from the effects of bans on advertising or smoking in public places including restaurants. This thesis examines smoking patterns between 2001 and 2010 based on micro-level data from the Russia Longitudinal Monitoring Survey of HSE as well as price data provided by the State Statistics Service Rosstat. In chapters 6 and 7 we estimate the price responsiveness of cigarette consumption, making use of tax increases which were implemented from 2008 onwards, independent of, and thus unaffected by, other tobacco control measures. The following chapter provides a detailed description of the data used in the thesis.

Part II

Descriptive evidence and the stylised facts

Having established the context of smoking during the past 6 decades, in part II of the thesis, we start our empirical investigation by examining the evolution of smoking over this longer time period as well as establishing some stylised facts on the association of smoking with important socioeconomic and geographic characteristics in the first decade of this century. First, in chapter 2 we introduce the two data sources used in the thesis – the Russia Longitudinal Monitoring Survey of HSE (RLMS-HSE) and the regional cigarette price data provided by the State statistics service Rosstat.

In chapter 3 we then draw on the retrospective smoking data provided by the RLMS-HSE to examine smoking patterns across the life-course for different birth cohorts. Our particular interest in this analysis is the timing of the increases in female smoking prevalence which, in contrast to wisdom currently prevailing in the literature, we argue predates the transition period and the arrival of the TTCs in Russia. Building on this finding, we suggest some nuanced explanations for the increasing uptake of smoking among young Russian women.

Chapter 4 then looks more closely at smoking patterns in the first decade of the 2000s. In line with the findings from chapter 3, we find smoking to differ most strongly by gender, with smoking rates among men on average 3 times higher than among women. While for men smoking decreased across all age groups starting around 2007/2008, female smoking trends are more diverse across age groups, although the decreases among younger women are suggestive of a downward trend. Among both genders we observe a steep educational gradient similar to Western European countries, with smoking being least prevalent among those with the highest level of education. While male smoking patterns are similar across geographic criteria, female smoking prevalence shows considerable diversity across regions and settlement patterns, with smoking rates being highest among women in Moscow and St. Petersburg which likely reflects different cultural and social norms.

2 The data

2.1 THE RUSSIA LONGITUDINAL MONITORING SURVEY

2.1.1 INTRODUCTION

The main source of data used in this thesis is drawn from the Russia Longitudinal Monitoring Survey of HSE (RLMS-HSE)[5], downloadable free of charge for registered users from the RLMS-HSE website. [6] The RLMS is a large-scale, nationally representative series of household surveys designed to monitor the effects of reforms on the health and economic welfare of individuals and households in Russia, conducted by the National Research University Higher School of Economics (HSE) and ZAO "Demoscope" in Moscow, together with Carolina Population Center, University of North Carolina at Chapel Hill and the Institute of Sociology RAS. Each autumn, the survey collects rich information on a range of socioeconomic, demographic, health status as well as behavioural and attitudinal indicators for approximately 10,000 individuals, as well as detailed data on expenditures, income, and service utilisation at the household-level. The individual and household data are complemented with community-level data providing information on the infrastructure in the community and community-specific prices.

While conducting household surveys based on a nationally representative sample of the population is a challenging task in every country, Russia in several respects brings unique challenges: It is the world's largest country in terms of surface, covering one tenth of the world's landmass, spanning 9 time zones, and with large parts of the territory providing hostile climatic conditions. Its ethnically heterogeneous population (the country is home to 160 different ethnic groups and indigenous peoples) as well as complex residential patterns such as dormitories and communal apartments further complicates the task of drawing a nationally representative sampling frame. In addition, social research was

[5] The official abbreviation of the survey is RLMS-HSE. For simplicity we will refer to it as RLMS in the rest of the thesis.
[6] See http://www.cpc.unc.edu/projects/rlms-hse/data.

largely restricted during the Soviet period, and with the exception of so called "micro-censuses" carried out by the State statistics agency Goskomstat there have been no surveys based on large-scale probability samples in Russia or the Soviet Union, and even these monitoring systems were breaking down with the dissolution of the Soviet Union.

Since its initiation, in 1992, 22 survey rounds of the RLMS have been collected. These are divided into two phases, with each phase based on a distinct, nationally representative sample: Phase I consists of rounds 1 to 4, carried out in September 1992, February 1993, August 1993, and November 1994. In this phase the major aim of the survey was to draw a true probability sample representative of the population at the national level, while working within the limited operational capacity of Goskomstat (resulting for example in a smaller number of primary sampling units than desirable). In the second phase of the survey starting with round 5 in late 1994, the RLMS switched collaborators and the emphasis shifted from institution building and training to providing timely and high quality information. The phase II data are based on an entirely new sample which, while smaller than the phase I sample, is based on nearly double the number of primary sampling units to enhance representativeness of the data (38 as compared to 20 in phase I). Since 1994, data have been collected yearly with the exception of 1997 and 1999 where the survey could not be conducted due to lack of funding, resulting in a total of 17 survey rounds available from phase II. Given their different sampling frames and procedures, the data from phase I and II cannot be compared and in the thesis we use data from phase II only. Furthermore, because of high attrition the Moscow and St. Petersburg samples were completely replaced in round 10 (2001), and the observations from the previous rounds dropped from the cross-sectional sample. To avoid comparability problems for Moscow and St. Petersburg before and after 2001, we restrict the analyses to rounds 10 to 19.

2.1.2 Sampling strategy

Phase II of the RLMS used multi-stage probability sampling to obtain a nationally representative sample of the non-institutionalised population. A list of 2,029 raions (administrative subdivisions of the Russian Federation) served as primary sampling units (PSU), from which Moscow city, Moscow oblast, and St. Petersburg were selected with certainty as self-representing strata. The remaining raions were then divided into 35 equal-sized strata according to geographical and socioeconomic criteria, and one raion per strata was selected using "probability-proportional-to-size", meaning that for each stratum the probability for a raion to be selected was directly proportional to its population size. The final sample consists of 38 PSUs (the three self-representing strata Moscow city, Moscow oblast, and St. Petersburg plus one raion from the remaining 35 strata). While the target sample size was 4,000 dwelling units, a total of 4,718 dwellings were drawn into the sample in order to account for an estimated non-response rate of 15 percent. Of those, 940 dwelling units were selected from the three self-representing strata, and in general oversampling was concentrated in large urban areas, where the highest non-response rate was expected. Each PSU was then divided into urban and rural substrata and the target sample size was allocated proportionately to both strata. In the absence of consolidated lists of households or dwellings in each of the 38 PSUs, in an intermediary stage secondary sampling units (SSU) were created by stratifying the PSU into urban and rural sub-strata, with the target sample size allocated proportionately to urban and rural SSUs. That is, if 30 percent of the population in a PSU was rural, 30 of the 100 households allocated to that PSU were drawn from villages. Interviewers then visited each selected dwelling up to three times to secure interviews with all household members. For the purpose of the survey, 'household' designates a group of people living together in a common dwelling and sharing income and expenditures. If the interviewer identified more than one household living together in a dwelling, he or she selected one household randomly.

The survey collects data at levels providing three frames of analysis: (1) individual-level data; (2) household-level data; and (3) community-level data. For the individual-level data, interviewers administer a questionnaire to each member of the household – adults (and children aged 14-18 years with the consent of their parents) answer the adult questionnaire, and for children below the age of 14 an adult member of the household answers a child questionnaire.[7] The individual questionnaires provide information on a person's socio-economic and demographic characteristics as well as a range of health status, behavioural and attitudinal indicators. Since the survey collects data from each of the household members, the RLMS yields a true probability sample for both individuals and households (Heeringa, 1997). For the household-level data, one member of the household is asked questions that pertain to the entire family, such as household

[7] While in theory data should therefore be collected for each individual in a household, in practice very young children and elderly did not receive interviews in all cases http://www.cpc.unc.edu/projects/rlms-hse/data/documentation/individualdata.

expenditures, income and living conditions. Since identifying the 'household head' is problematic, interviewers are instructed to talk to the person "who has the best knowledge of the concerns and affairs of the family and of its present income and expenditures" (RLMS household questionnaire). Finally, for the community-level data, interviewers collect information on the demographic composition, infrastructure and food prices for each of the 166 sites (i.e. the secondary sampling units) where the survey is conducted.[8]

The RLMS is designed as a repeated cross-section survey, with repeated visits each round to a fixed national probability sample of dwelling units. The 'repeated sampling of dwellings' sampling strategy means that during each round interviewers return to the dwellings of the original 1994 sampling frame and interview all household members residing in the dwelling (if they can be contacted within 3 visits), so that the dwelling itself rather than the household is followed over time. Together with annual replenishments of dwellings to compensate for attrition this strategy maintains cross-sectional representativeness of the sample for each round. While the main aim of the survey is to provide nationally representative cross-sections, there is also a component of the sample which is followed in the true longitudinal sense, regardless of the dwelling unit. To this end, interviewers gather the new addresses of the individuals/who moved out of a dwelling of the original sampling frame and make up to three attempts to contact them at their new address. In the dataset, individuals who moved out of the representative sample but were followed-up at their new address are recorded as 'movers'. Thus, although the survey is not a true panel survey by design, it is possible to construct a longitudinal sample by linking individuals and households who participate in at least two rounds of the survey in either the representative or follow-up sample of the survey.[9] Since the full sample of respondents consists of representative and follow-up elements, the researcher has to be careful in defining the analytical sample. If one intends to use the representative cross-sectional sample, one needs to exclude all individuals who are recorded as movers in the dataset, i.e. individuals who move out of the representative sampling frame but are followed up in later years will form part of the representative sample only for those years where they resided in a dwelling of the representative sampling frame. If, by contrast, one wants to construct a longitudinal sample, one needs

[8] The questionnaires for each round are available at http://www.cpc.unc.edu/projects/rlms-hse and http://www.hse.ru/org/hse/rlms.

[9] With both cross-sectional representative and longitudinal elements, the sample design of the RLMS can be classified as a split panel (Smith et al., 2009).

to keep the movers in the sample, but exclude entrants into the sample after the first survey year used. For example, to construct a longitudinal sample for individuals aged 15 and above for the years 2001-2010, one takes the 2001 representative sample and then for subsequent rounds excludes annual replenishments as well as those individuals who turn 15 after 2001. In the following two sections we will examine the differences in sample composition between the full (annually replenished), representative, and longitudinal samples of the RLMS, but first we examine response patterns and attrition.

2.1.3 Response patterns and attrition in the different samples

Table 2.1 details the round-by-round sample size for the full (replenished) sample, separately for individuals above and below the age of 15.[10] While on average, changes in the sample size range between -3 and +3 percent, larger replenishments took place in rounds 15 (2006) and 19 (2010), with the latter replenishment increasing the sample size from 13,991 to 21,284 individuals. As can be seen from Table 2.2 below, the representative sample makes up 73 percent of the full sample pooled across rounds, with the lowest shares in the years preceding the two large replenishments.

Table 2.1 Round-by-round sample size of the full RLMS sample

Round	Year	Individuals aged 15+	Annual change	Individuals aged <15	Annual change	Individuals total	Annual change
10	2001	9,967		2,153		12,120	
11	2002	10,372	4.06%	2,151	-0.09%	12,523	3.33%
12	2003	10,521	1.44%	2,133	-0.84%	12,654	1.05%
13	2004	10,554	0.31%	2,095	-1.78%	12,649	-0.04%
14	2005	10,245	-2.93%	1,992	-4.92%	12,237	-3.26%
15	2006	12,516	22.17%	2,174	9.14%	14,690	20.05%
16	2007	12,210	-2.44%	2,307	6.12%	14,517	-1.18%
17	2008	11,767	-3.63%	2,259	-2.08%	14,026	-3.38%
18	2009	11,727	-0.34%	2,264	0.22%	13,991	-0.25%
19	2010	17,628	50.32%	3,656	61.48%	21,284	52.13%

[10] The RLMS distinguishes between adults and children in the statistics displayed on the website. As per official definition, children can answer the adult questionnaire from age 14 onwards with the consent of the parents, and thus individuals aged 14 and above theoretically count as adults. However, in practice some parents still fill in the child questionnaire for children aged 14 and older. Therefore, if one separates the sample between individuals below and above the age of 14, the numbers are not consistent with the adult-children distinction in the official RLMS statistics.

Round	Year	Individuals aged 15+	Annual change	Individuals aged <15	Annual change	Individuals total	Annual change
Total		117,507		23,184		140,691	

Table 2.2 Share of the representative and follow-up samples in the full RLMS sample

All ages

Round	Year	Representative sample[11]	Share of full sample	Follow-up sample	Share of full sample	Total
10	2001	9,304	77%	2,816	23%	12,120
11	2002	9,209	74%	3,314	26%	12,523
12	2003	9,060	72%	3,594	28%	12,654
13	2004	8,979	71%	3,670	29%	12,649
14	2005	8,352	68%	3,885	32%	12,237
15	2006	10,711	73%	3,979	27%	14,690
16	2007	10,349	71%	4,168	29%	14,517
17	2008	9,874	70%	4,152	30%	14,026
18	2009	9,578	68%	4,413	32%	13,991
19	2010	16,808	79%	4,476	21%	21,284
Total		102,224	73%	38,467	27%	140,691

As with any longitudinal survey, users of the RLMS need to pay attention to missing data due to attrition. While unit non-response (i.e. the complete absence of an interview from a sampled household or individual) is a problem common to all surveys, attrition is a problem specific to longitudinal surveys since following respondents over several survey rounds means that individuals who participated in at least one round can drop out in later rounds, thus giving rise to more complex structures of nonresponse (Lugtig, 2014). Nonresponse can be permanent (so called absorbing state or monotone attrition) or

[11] This comprises all the observations of individuals residing in a dwelling of the representative sampling frame. However, to obtain the correct representative sample one needs to drop individuals who left the representative sample in round 10 but returned to the survey after round 10. This affects 698 observations, leaving a correct representative sample of 101,526 observations.

temporary (non-monotone attrition), meaning that individuals return to the survey after skipping one or more interviews, and it can be due to non-traceable and refusal cases.[12] While refusal, non-contact and inability to respond can lead to non-response in any type of survey, additional reasons due to the repeated interviews in longitudinal surveys are absence of commitment, panel ‘fatigue’, and shocks such as serious illness or death, moving, or changes in the composition of the household (Lynn, 2009). The cumulative effect of individuals dropping from an initially representative sample in each round can lead to a severe loss of sample size and makes sample selection bias a more acute challenge in longitudinal surveys (Gerry and Papadopoulos, 2015).

A first impression of participation and attrition across the ten survey rounds can be gleaned from Table 2.3 which shows the number of individuals moving into and out of the survey on a round-by-round basis, irrespective of whether the movements take place in the representative or follow-up samples. We can see that the relatively stable size of the full sample is due to the combined effect of the number of people moving into the sample – either in the form of annual replenishments or as respondents returning into the sample after missing one or several rounds – being either slightly short or in excess of the number of people moving out of the sample. For example, in 2003 the full sample comprised of 12,654 individuals. Of these, 10,885 individuals were respondents remaining in the survey from the previous year, 965 individuals were added to the survey to maintain cross-sectional representativeness for that year (replenishments), and 804 individuals returned to the sample after missing one or more rounds (temporary attritors). With the exception of the years with major replenishments, returning temporary attritors account for the majority of movements into the sample, a point to be explored in more detail below. The relatively high share of temporary attrition (between 6 and 12 percent of the sample in each year) is partly due to the follow-up efforts of the survey.[13]

[12] Some authors reserve the term attrition for permanent drop outs and use wave non-response for individuals who return to the survey. In this thesis, we will not follow this approach, instead distinguishing between permanent and temporary attrition.

[13] For example, an individual might be recorded as having moved out of the dwelling that forms part of the representative sample in round 12, but follow-up efforts might only be successful in round 15, leading to the respondent being a temporary attritor in rounds 13 and 14.

Table 2.3 Movements into and out of the full RLMS sample

All ages

Round	Year	Total	Participating next round	Attriting next round	Replenish -ments per round	Total without inmovers*	Returning into survey	Total
10	2001	12,120	10,578	1,542	0	12,120	0	12,120
11	2002	12,523	10,885	1,638	1,944	12,522	1	12,523
12	2003	12,654	10,789	1,865	965	11,850	804	12,654
13	2004	12,649	10,782	1,867	797	11,586	1,063	12,649
14	2005	12,237	10,411	1,826	220	11,002	1,235	12,237
15	2006	14,690	12,474	2,216	2,960	13,371	1,319	14,690
16	2007	14,517	12,196	2,321	289	12,763	1,754	14,517
17	2008	14,026	12,276	1,750	131	12,327	1,699	14,026
18	2009	13,991	12,256	1,735	155	12,431	1,560	13,991
19	2010	21,284	.	.	7,638	19,894	1,390	21,284
Total		140,691						140,691

* inmovers are individuals returning to the survey after skipping one or several rounds (i.e. temporary attritors)

While Table 2.3 provides some insight into the participation patterns for the survey as a whole, this does not allow us to draw any conclusions with regard to response patterns at the individual level since it does not follow one sample of individuals over time. Table 2.4 digs deeper into the nature of attrition from the longitudinal sample for individuals aged 15 and above. As a reminder: the longitudinal sample is obtained by taking the representative round 10 sample and then following this sample over time, excluding subsequent entrants into the sample (i.e. replenishments as well as individuals turning 15 after 2001). The round-by-round attrition rate is around 7 percent on average, but declines over time following an initial spike at 14 percent in 2002. This is not an unusual phenomenon, since after a major replenishment the least committed respondents can be expected to drop out first (Gerry and Papadopoulos 2015). Over the 10 survey rounds, 24,532 person-years are lost due to attrition, corresponding to a cumulative drop-out rate of 32 percent and leaving a pooled longitudinal sample of 53,378 observations (32,001 females/ 21,377 males). While the RLMS is *a priori* more likely to have higher rates of attrition given the dwelling-based nature of the sampling strategy, these figures are not out of line compared to other established household panel surveys which follow the household rather than the dwelling, such as the British Household Panel Survey (BHPS, now ‘Understanding Society’), the US Panel Study of Income Dynamics (PSID), the Australian Household Income and Labour Dynamics survey (HILDA), and the German Socio-economic Panel Study (SOEP). For example, in the BHPS about 60 percent of the original sample is left after 10 years (Jones et al., 2006; Noah Uhrig, 2008), and in the PSID 69 percent of the original (1968) sample were interviewed in 1978 (Moffit et al., 1999).

Table 2.4 Attrition from the longitudinal sample

Individuals aged 15 and above

			Cumulative		Round-by-Round		Reason for attriting			
Round	Year	Individuals 15+	N° of attritors	Attrition rate	N° of attritors	Attrition rate	Moved	Died	Other/ split	Don't know
10	2001	7,791								
11	2002	6,684	1,107	0.142	1,107	-0.142	0.019	0.012	0.006	0.105
12	2003	6,117	1,674	0.215	567	-0.085	0.028	0.022	0.010	0.155
13	2004	5,651	2,140	0.275	466	-0.076	0.038	0.031	0.013	0.193
14	2005	5,223	2,568	0.330	428	-0.076	0.045	0.039	0.013	0.233
15	2006	4,940	2,851	0.366	283	-0.054	0.048	0.045	0.011	0.261
16	2007	4,627	3,164	0.406	313	-0.063	0.054	0.051	0.010	0.291
17	2008	4,262	3,529	0.453	365	-0.079	0.064	0.059	0.010	0.321
18	2009	4,134	3,657	0.469	128	-0.030	0.064	0.064	0.011	0.331
19	2010	3,949	3,842	0.493	185	-0.045	0.069	0.071	0.011	0.343

Note: The longitudinal sample is obtained by taking the representative round 10 sample and then following this sample over time, excluding subsequent entrants into the sample (i.e. replenishments as well as individuals turning 15 after 2001)

Looking at the causes of attrition as recorded by the interviewer, the main reason for dropping from the survey falls in the “Don’t know” category. This category captures a diverse set of reasons: First, in cases where the complete household was absent in the subsequent survey round (i.e. could not be contacted within 3 visits), there is no one present to provide information and thus the reason for non-participation cannot be elicited (e.g. death, moving out of the dwelling, split of household, refusal). Similarly, if the remaining individuals of a household do not want to disclose information regarding the reasons for departure of previous household members, this also gets reported in the “Don’t know” category. Furthermore, attrition could result from failure to locate households at their new address, no contact at the new address or refusal of the household to participate.[14]

As mentioned earlier, a particular feature of the RLMS is the relatively high share of temporary attrition, meaning that respondents return to the survey after skipping one or several rounds. Table 2.5 below details the patterns of attrition in the longitudinal sample:

Table 2.5 Response patterns in the longitudinal sample

Individuals aged 15 and above

		Longitudinal sample with gaps		Longitudinal compact sample	
Label	Pattern	Frequency	Percent	Frequency	Percent
Always in	1111111111	3,079	39.52	3,079	39.52
First round only	1000000000	784	10.06	1,107	14.21
First two rounds only	1100000000	495	6.35	745	9.56
First three rounds only	1110000000	432	5.54	646	8.29
First four rounds only	1111000000	345	4.43	537	6.89
First five rounds only	1111100000	273	3.50	398	5.11
First six rounds only	1111110000	286	3.67	394	5.06
First seven rounds only	1111111000	273	3.50	398	5.11
First eight rounds only	1111111100	178	2.28	227	2.91
First nine rounds only	1111111110	260	3.34	260	3.34
1 round missing, there at end	1-0-1	439	5.63		
>1 round missing, there at end	1-00-1	431	5.53		
Missing rounds, not there at end	1-0-1-0	516	6.62		
Total		7,791	100.00	7,791	100.00

Note: The longitudinal sample is obtained by taking the representative round 10 sample and then following this sample over time, excluding subsequent entrants into the sample (i.e. replenishments as well as individuals turning 15 after 2001). The "longitudinal sample with gaps" includes temporary attritors, whereas the "compact longitudinal sample" treats all attrition as permanent and therefore excludes individuals who return to the survey after skipping one or several rounds.

While 40 percent of the sample participated in all 10 survey rounds ("always in"), 43 percent of respondents left the sample permanently (so-called absorbing state attrition),

[14] According to the RLMS website, refusals are much more common than the inability to trace movers. Another important reason in the "Don't know category" is the inability to contact the household within 3 visits. While it is possible to distinguish between refusals and no-contacts, in most cases it is not possible to establish whether the refusal or no contact refers to an old or a new household residing in the dwelling, http://www.cpc.unc.edu/projects/rlms-hse/data/documentation/faq.

and 17 percent were temporary attritors. Of the temporary attritors, 11 percent were interviewed in the last round but had missed one or several rounds in between, and another 6 percent had missed several rounds and were missing in the last round. Although individuals returning to be surveyed help to preserve sample size, it is not clear how these respondents should be treated, especially since they are likely to differ from both respondents permanently dropping from the survey and respondents who participate continuously. One solution would be to treat all attrition as permanent and drop individuals from the sample once they miss one round, leading to the so-called compact longitudinal sample. This means distributing individuals in the bottom three rows of Table 2.5 across the upper parts of the table, e.g. an individual who participated in rounds 10 and 11 and then returned in rounds 18 and 19 would appear in the "First two rounds only" row, with observations for rounds 18 and 19 being deleted. The compact sample approach would result in a loss of 4,609 observations in the pooled longitudinal sample.

When using the longitudinal sample in regression models, one needs to understand whether attrition from the survey is non-random, and if so, whether this leads to bias in the estimates. Non-random attrition can cause sample selection bias if the reasons for dropping out depend on unobservable characteristics that are also correlated with the dependent variable of interest, i.e. in our case, with smoking status and cigarette consumption. For example, a higher rate of time preference (higher degree of impatience) might both increase the propensity to drop out of the survey (due to opportunity cost of participating in the interview) and the propensity to smoke. Gerry and Papadopoulus (2015) examine the nature of attrition from the longitudinal element of the RLMS and test whether non-random attrition causes bias in econometric analyses of self-rated health determinants. They find that attrition is non-random and, similar to other longitudinal studies (Watson and Wooden, 2009), related to age, gender, health, marital status, labour market activity, region of residence and settlement type (Gerry and Papadopoulos, 2015). While inverse probability weighted and unweighted estimates are similar in their example, they caution that this does not necessarily imply the absence of any bias but could also mean that the bias works in the same direction and can therefore not be detected in the regression framework. Using weights to correct for attrition therefore only has a limited role and researchers need to carefully identify the longitudinal sample (e.g. how to treat temporary attritors), examine the response patterns within that sample, and pay attention to missing variables that are not related to attrition (ibid.). We will discuss the issue of attrition and missing data in more detail within the dynamic cigarette demand regressions in chapter 7.

2.1.4 Descriptive statistics of the samples

Table 2.6 compares the key descriptive statistics for the full, representative and longitudinal samples of the RLMS which, in addition to giving a broad overview of the characteristics of the samples, provides some more detail about the nature of attrition in the longitudinal sample. In both the full and representative sample the highest share of observations is in 2010, owing to the major replenishment referred to earlier. Naturally, the opposite holds true for the longitudinal sample which has the largest share of observations in 2001 and then gets shaped by attrition in subsequent rounds. The Moscow & St. Petersburg region is about 4 percent smaller in the longitudinal sample, reflecting the higher rates of attrition and difficulties of tracing respondents in this region. This is the product of the different sampling strategy in Moscow and St. Petersburg, rather than being driven by city size per se since the share for large urban centres (cities larger than 500,000 inhabitants) is nearly equal in the representative and longitudinal samples. Females are slightly overrepresented in all samples, but more strongly in the longitudinal sample, which is in line with the common finding that women tend to be more committed (i.e. attrit less) in longitudinal surveys (Watson and Wooden, 2009). While in most longitudinal surveys those with children tend to have a lower propensity to attrit, the share of households without children, and correspondingly with those with one or two household members, is slightly higher in the RLMS longitudinal sample. However, this could simply be due to the fact that the respondents in the longitudinal sample are older than in the other samples. With regard to education and type of occupation, the samples are relatively similar, with the exception of a higher share of people without occupation in the longitudinal sample, again reflecting that they are older and possibly retired. In summary, despite the more complicated design features of the longitudinal element of the RLMS and the country-specific challenges, the patterns of attrition in the survey are similar to other established household panel surveys. The robustness of the data is also reflected by the addition of the RLMS to the Cross-National Equivalent File (CNEF) containing population panel data from Australia, Canada, China, Germany, Great Britain, Korea, Switzerland and the United States.[15]

Table 2.6 Key descriptive statistics for the different samples of the RLMS

Individuals aged 15 and above	Full, replenished sample	Representative sample	Representative sample with survey weights	Longitudinal sample
Year				
2001	8.48	8.97	8.69	14.60
2002	8.83	8.92	8.56	12.52
2003	8.95	8.80	8.41	11.46
2004	8.98	8.76	9.01	10.59
2005	8.72	8.22	8.36	9.78
2006	10.65	10.70	10.88	9.25
2007	10.39	10.22	10.37	8.67
2008	10.01	9.75	9.86	7.98
2009	9.98	9.46	9.49	7.74
2010	15.00	16.19	16.37	7.40
Region				
Moscow & St. Petersburg	12.42	11.94	12.13	8.36
Northern & North Western	6.42	6.17	6.22	6.01
Central & Central Black Earth	17.95	18.00	17.92	18.42
Volga-Vyatski & Volga Basin	17.40	16.54	16.50	18.74
North Caucasian	13.77	14.78	14.72	15.58
Ural	13.91	13.90	13.93	15.17
Western Siberian	8.85	9.48	9.46	8.39
Eastern Siberian & Far Eastern	9.28	9.19	9.12	9.32
Settlement type				
City >500,000	33.46	32.39	33.01	28.87
City 50,000-500,000	28.36	28.55	29.15	28.86
Rural & Town <50,000	38.19	39.05	37.84	42.27
Gender				
Female	57.42	58.06	54.34	59.95

[15]Further information is available at: http://www.human.cornell.edu/pam/research/centers-programs/german-panel/cnef.cfm..

Individuals aged 15 and above	Full, replenished sample	Representative sample	Representative sample with survey weights	Longitudinal sample
Male	42.58	41.94	45.66	40.05
Age				
15-24	18.61	17.96	19.87	11.16
25-34	19.34	15.70	17.65	15.30
35-44	16.35	15.91	18.04	17.11
45-54	17.01	18.11	16.44	20.06
55-64	11.85	13.00	11.33	14.00
65 plus	16.73	19.19	16.52	22.36
Number of household members				
1	9.81	10.49	9.45	11.52
2	23.94	24.92	23.56	26.52
3	27.50	24.86	25.77	24.67
4	20.64	20.56	21.56	19.76
5+	18.12	19.17	19.66	17.51
Number of children				
0	47.54	50.81	48.44	53.66
1	31.22	28.46	29.91	27.15
2	12.89	12.17	12.98	11.58
3+	3.36	3.29	3.42	3.24
Marital status				
Single	21.13	22.13	24.36	15.60
Married	57.61	55.49	55.35	60.38
Divorced	8.89	8.80	8.58	8.77
Widowed	12.08	13.26	11.38	15.09
Education				
University	18.42	18.15	18.27	17.70
Tec & Med	20.17	20.09	19.60	20.73
HS + vocational training	13.29	12.35	12.97	12.97
Basic + vocational training	6.24	6.13	6.08	6.89
High School (11 years)	20.62	21.18	21.69	20.01
Basic (8 years)	20.34	21.22	20.51	20.92
Occupation				
Managerial & Professional	21.24	20.18	20.59	20.25

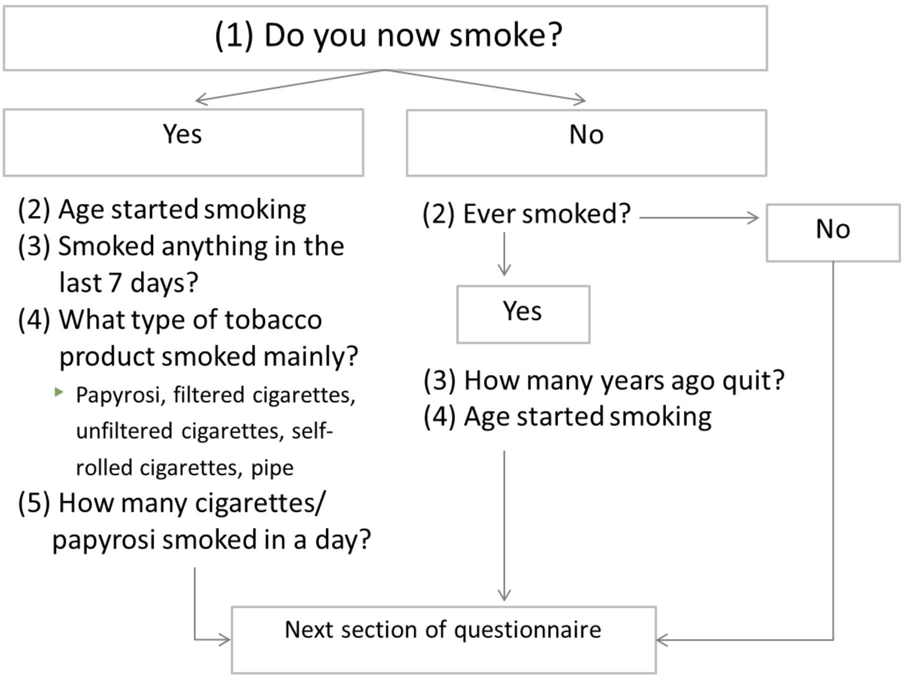
Individuals aged 15 and above

	Full, replenished sample	Representative sample	Representative sample with survey weights	Longitudinal sample
Non-manual	9.59	8.83	8.92	9.13
Manual	16.83	15.76	17.16	16.19
Unskilled	6.78	6.44	6.47	6.42
No Occupation	45.50	48.74	46.80	47.96
Observations	117,507	86,843	86,843	53,378

2.2 RLMS DATA ON SMOKING

The RLMS adult questionnaire features a battery of questions on health-related behaviours such as alcohol consumption, smoking, diet and exercise. For smoking, questions on both contemporaneous tobacco consumption and smoking history are included. Figure 2.1 below illustrates the schedule of smoking questions in the questionnaire. Depending on whether individuals state that they are currently smoking or not, they receive a different set of questions. Those who report themselves as current smokers are asked a number of questions on current consumption as well as the age at which they started smoking. Respondents who say they are not currently smoking are asked whether they have ever smoked, and if so, at which age they started and how many years ago they quit.

Figure 2.1 Schedule of smoking questions in the RLMS adult questionnaire



Source: Based on RLMS adult questionnaires years 2001-2010

In addition to the questions on present and past smoking from the individual questionnaire, in the household module of the survey, each household also reports their expenditure on tobacco in the last seven days as well as the number of packs purchased. Furthermore, the community questionnaires provide information on the lowest and highest price of domestic and imported cigarettes per pack which are collected by the interviewers in the settlements (secondary sampling units) where the survey is conducted.

Overall, the RLMS provides a very rich dataset on smoking which so far has been relatively under-used in addressing smoking in Russia.

2.2.1 Missing data on smoking

Survey data generally contain errors and missing values, which can arise in different stages of the survey process. During the data collection respondents may give a wrong answer (intentionally or not), not know or simply refuse to answer, leading to errors and missing data. Similarly, interviewers might ignore 'skipping' instructions, thereby altering the schedule of questions in the questionnaire. For example, if the skipping instruction regarding smokers and non-smokers is ignored, non-smokers would be asked a series of questions regarding tobacco consumption and would likely appear as non-consuming smokers, rather than non-smokers. In addition, errors can be introduced during the data entry phase when the data are transferred from the questionnaires to a computer system. Finally, data editing such as coding of free text answers or translating from Russian to English constitutes another source of potential error.

As can be seen from Table 2.7 Missing data on smoking by gender below the data on smoking are largely complete, with missing values accounting for 0.01 to 1.44 percent of observations.

Table 2.7 Missing data on smoking by gender

Individuals aged 15 and above	Missing data (in %)	
Question	Males	Females
Do you smoke now?	0.31	0.3
In the last 7 days have you smoked anything?	0.56	0.39
Have you ever smoked?	0.87	0.46
When did you start smoking? How old were you then?	15.92+7.33 (6.39)	15.42+6.89 (6.36)
How many years ago did you quit smoking?	6.39	7.29
What type of tobacco do you mainly smoke?	0.15	0.14
How many cigarettes/papyrosi do you usually smoke in a day?	1.44	1.37

Based on the pooled representative sample for 2001-2010, using the survey weights provided by the RLMS

2.2.2 Inconsistent reporting of smoking status across rounds

Individuals who participate in the survey in more than one round are asked about their current and previous smoking on a repeated basis (10 times for the 3,079 respondents present in the sample during the entire 10-year period). Thus, in addition to checking for the consistency of answers within one year (e.g. an individual claiming to be a non-smoker should not report having smoked in the last 7 days), it is also important to examine whether there are inconsistent reporting patterns across years. Given the different sets of questions for smokers and non-smokers/former smokers illustrated in Figure 2.1 above, inconsistent answers within one survey round would indicate that interviewers did not stick to the skipping instructions in the questionnaire. For example, individuals who report being non-smokers should not be asked whether they smoked in the past 7 days and therefore should have a missing value in the dataset. Non-smokers should, however, be asked whether they smoked previously and if so, how many years ago they quit. With repeated observations on current and previous smoking for one individual, inconsistent reporting patterns can arise through conflicting answers in different years. For example, an individual self-reports as being a current smoker in 2001 but in subsequent rounds claims to have never smoked, which is in conflict with the reported data for 2001. Similarly, an individual consistently reports not smoking in all years, but switches between claiming to have ever smoked before and to have never smoked before. These types of inconsistencies affect 9.85 and 11.73 percent of individuals for females and males respectively.[16] While inconsistent reporting of former smoking status will not affect the regression results of chapters 6 and 7 as these draw on current smoking status only, they might impact the life-course analysis in chapter 3.

2.3 Regional cigarette price data

One of the key interests of this thesis lies in the influence of price on cigarette consumption. In the demand models of chapters 6 and 7 we would ideally want to include

[16] There are 311/422 observations for females/males where individuals reported being a smoker in an earlier round but in subsequent rounds claim to have never smoked. In 778/683 cases for females and males respectively, individuals reported that they used to smoke, but in subsequent rounds they claim to have never smoked. Similarly there are 722/679 observations where individuals said they never smoked before in an earlier round, but in subsequent rounds report that they did smoke before, although they in no round reported to be a smoker (this could imply smoking briefly between surveys, rather than being an error *per se*).

the cigarette prices faced by each individual in our sample. In the RLMS two types of cigarette prices are available: (1) The RLMS household questionnaire features questions on the number of cigarette packs purchased in the past 7 days and the amount of roubles spent on tobacco, which allows us to calculate the average price per packet purchased; (2) the community modules provide the lowest and highest price for a packet of both a domestic and a foreign brand of cigarettes, collected by the interviewers in one store on the survey site. In addition to leading to a severe loss of sample size since about 30 percent of the values for the household tobacco expenditure variables are missing[17], the first approach is also fraught with a serious conceptual drawback given the large potential for reporting error. As the expenditure data are reported by one person within the household the extent of reporting error depends on how well-informed the individual is about the purchases of other household members, both in terms of expenditure and amount purchased. While reporting error might not be so severe for goods which are typically bought in bulk for the whole household (e.g. sugar or flour), cigarettes tend to be purchased separately by each consumer and at frequent intervals, making it unlikely that one person has accurate information on the tobacco purchases of all household members.

Furthermore, even if measurement error was negligible, self-reported cigarette prices are likely to be endogenous when estimating individual-level cigarette demand (IARC, 2011). For example, all other things being equal, heavier smokers are more likely to purchase cheaper brands, to look for lower-priced stores, and to engage in tax-avoiding strategies, so that using self-reported prices will likely lead to biased (overestimated) estimates of price elasticities. Thus, in order for prices to be considered exogenous in the demand model, we need to draw on data at a higher level of aggregation where feedback from individual demand to observed price is less likely. The RLMS community-level prices could therefore be a solution; however, they have four major drawbacks. First, the use of a convenience sample consisting of one store per site to collect the prices means that, although the questionnaire instructs interviewers to choose a store where the observed families usually shop and avoid stores with substantially higher price levels, the observed prices may not be representative of the average price level of all retail outlets on the site. This problem is more acute in urban settings with a high density of retail

[17] This concerns individuals who smoke, meaning that in each round about 30 percent of current smokers have either a missing value for cigarette expenditure (5-7 percent) or report zero cigarette expenditure (20-22 percent) despite being smokers.

outlets and potentially larger price differences between stores. Second, given that the reported prices reflect the two extreme points of the price distribution (minimum and maximum), they do not provide a reliable picture of the average price level in the store and are strongly influenced by outliers at the upper end. Third, comparing of prices over time is difficult since different cigarette brands in different stores may be recorded each year. As a result, it is difficult to discern a price trend over time, with prices fluctuating erratically across rounds, in part due to variation in brand and store types. Finally, the community-level prices are incomplete for 38 out of 166 sampling sites, so that this approach would also lead to a considerable loss of sample size.[18]

In light of the disadvantages of the price data available in the RLMS, in this thesis we instead draw on regional cigarette prices which are publicly available via the State statistical agency Rosstat.[19] Rosstat provides the average, nominal price per pack for unfiltered domestic cigarettes, as well as domestic and foreign filter cigarettes for each of the 83 subjects of the Russian Federation (commonly referred to as 'regions'). Since filtered cigarettes are the predominant type of tobacco product consumed, occupying 94.8 percent of the market in 2010 (Korolev, 2011), we compiled the prices for filtered domestic and foreign brands of cigarettes and merged them into the RLMS dataset.[20] [21] The reason for distinguishing between domestic and foreign (in both the RLMS and Rosstat price data) is that domestic cigarette brands are typically in the low and mid-price segment whereas foreign brands fall predominantly into the premium price segment. Therefore, combining domestic and foreign brands into one average price would provide an upward-biased measure of the average price level. To obtain real prices, the nominal Rosstat prices were deflated using the inflation index provided by the RLMS. As noted in chapter 1, real cigarette prices have been increasing since 2008 as a result of the adoption of a new tax regime and several tax increases. The increases, for prices within

[18] In theory, it would be possible to recover the missing prices by taking one site for which prices are complete in all rounds within each primary sampling unit (PSU), and assume these prices hold for all of the sites within the PSU. This approach presupposes that prices across sites within one PSU are relatively similar so that the prices for one site provide a reasonable proxy of the price level in sites where prices are missing. This might be problematic, however, if prices vary depending on the size of a settlement, for example, prices in cities.

[19] See http://www.fedstat.ru/indicators/start.do.

[20] Regional cigarette prices are only provided from the year 2003 onwards. However, the corresponding price indices are reported starting in 2002, which allows prices for 2001 and 2002 to be obtained via backward calculation.

[21] The RLMS is conducted in 38 of the 83 subjects of the Russian Federation (corresponding to the number of PSUs). That is, while the RLMS community prices are measured for each of the 166 sites (SSUs), the Rosstat prices are measured at a higher level of aggregation and correspond to the 38 PSUs.

our sample regions, are confirmed in Figure 2.2 and Figure 2.3 below. Since the price rises were mainly due to increases in the specific excise tax, the increases were larger for the domestic (usually cheaper) brands relative to the foreign ones.

Figure 2.2 Real price of domestic cigarette brands

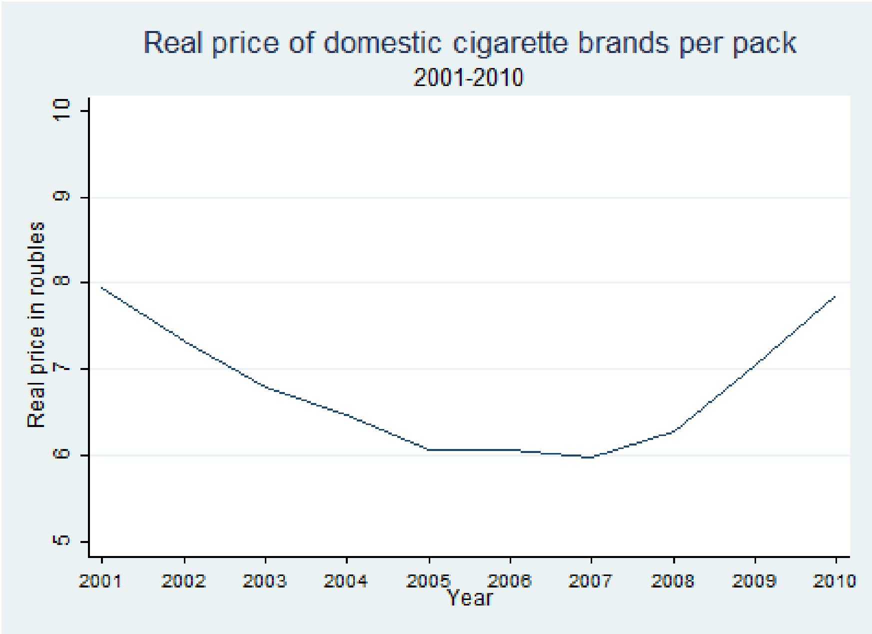
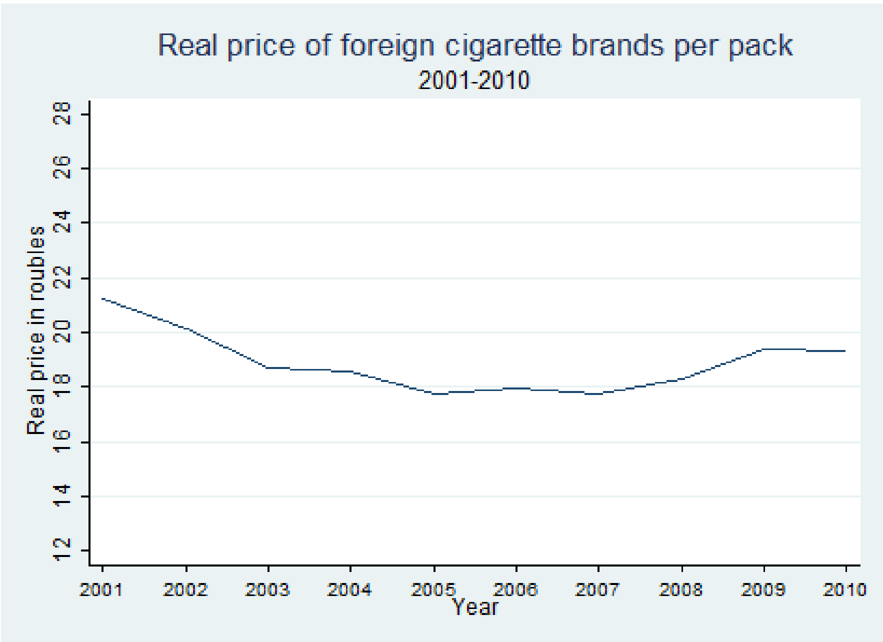
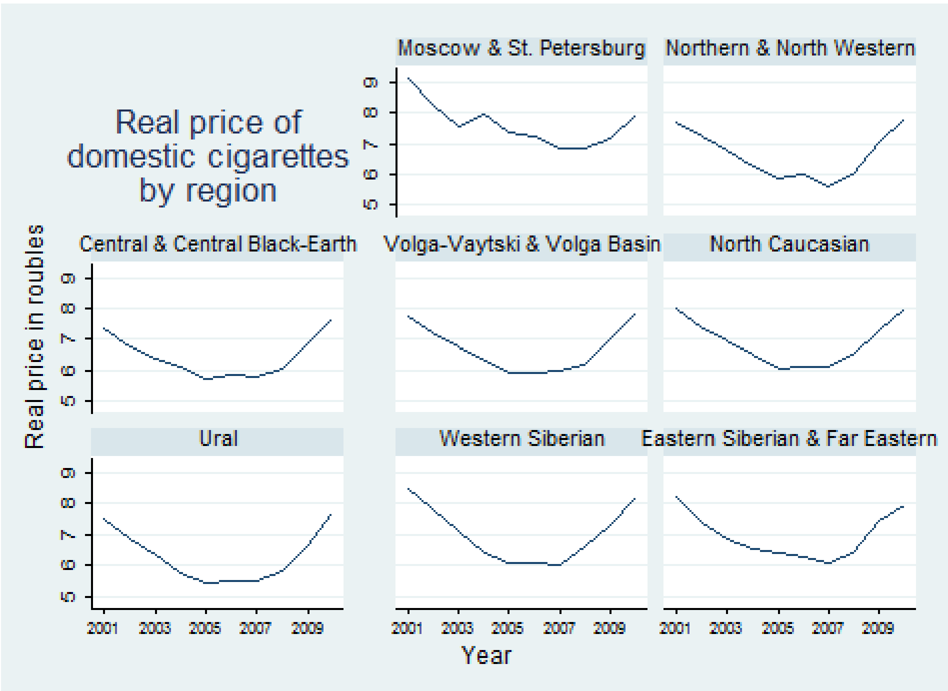


Figure 2.3 Real price of foreign cigarette brands



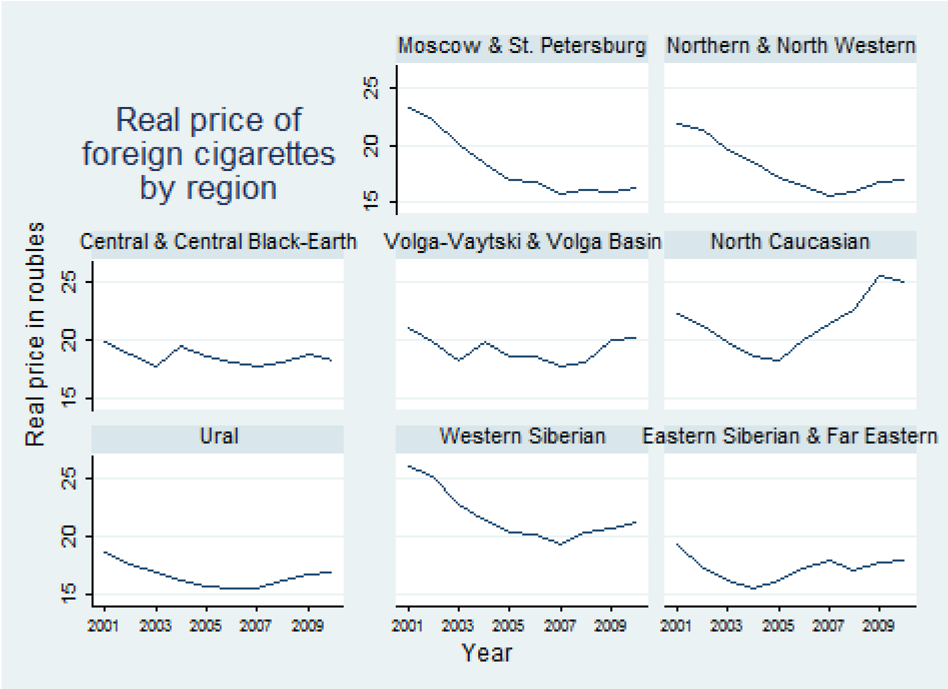
For domestic cigarettes, the price level is relatively similar across regions, with real prices being highest in Moscow and St. Petersburg. Both the decline in real prices between 2001 and 2007 and the subsequent increases from 2008 are more pronounced outside of Moscow and St. Petersburg. Foreign cigarettes show larger price variations across regions and diverging trends over time, with a particularly strong fall between 2001 and 2007 in Moscow and St. Petersburg, as well as in the North & North Western and Western Siberian regions. In the North Caucasian region by contrast, real prices rose steeply from 2005 onwards. Since 2008, prices seem to be on the rise in all regions, albeit this is not as pronounced as for domestic cigarettes.[22]

Figure 2.4 Real price of domestic brands by region



[22] The trends by region are based on subjects of the Russian Federation where the RLMS is actually conducted. For example, the North Caucasus data includes Krasnodarskij Kraj, but not Ingushetia or Dagestan.

Figure 2.5 Real price of foreign brands by region



Given that the Rosstat prices report the average price level within one region (i.e. subject) of the Russian Federation, while the RLMS prices measure the range of cigarette prices in one shop on the survey site, a direct comparison of the prices is impossible. However, one way to see whether the Rosstat prices correspond to the prices within the smaller geographical units of the survey sites is to check whether the Rosstat average falls within the price range indicated by the RLMS, see Table 2.8 below. For 11 percent of observations, the Rosstat price for domestic cigarettes is lower than the lowest price recorded in the RLMS. This concerns predominantly rural settlements in the North Caucasian and Central Black-Earth regions and might indicate that the Rosstat prices underestimate the price level in rural regions. At the upper end of the price range for domestic cigarettes, 7 percent of the Rosstat prices exceed the highest price recorded in the RLMS, again mostly in rural areas.[23] For foreign cigarette brands, 24 percent of Rosstat prices are lower than the lowest price in the RLMS, while 12 percent of prices fall outside the upper limit of the RLMS price range. Thus, 18 (36) percent of Rosstat

[23] The concentration of discrepancies in rural areas is in line with the fact that the Household Budget Surveys that form the basis for the price data reported by Rosstat are only collected in urban areas, so that for rural survey sites our price measures are likely to be underestimated.

prices for domestic (foreign) cigarettes are outside the range of observed RLMS community-level prices, with two-thirds of the discrepancies at the low end, which suggests that, if anything, for this sample the Rosstat prices are biased downwards compared to the RLMS prices and with less variation given the more aggregated nature of the regional prices. In our empirical analyses, we therefore interpret the impact of price on cigarette consumption as reflective of lower bound estimates.

Table 2.8 Comparison of Rosstat and RLMS cigarette prices

Rosstat prices outside RLMS price range	**Difference in %**
Domestic cigarette brands	
Rosstat < RLMS low price	10.85
Rosstat more than 10% < RLMS low price	8.61
Rosstat > RLMS high price	7.16
Foreign cigarette brands	
Rosstat < RLMS low price	23.97
Rosstat more than 10% < RLMS low price	23.10
Rosstat > RLMS high price	12.43
Rosstat prices within RLMS price range	
Domestic cigarette brands	
Rosstat more than 100% < RLMS high price	61.02
Rosstat more than 1000% < RLMS high price	1.43
Foreign cigarette brands	
Rosstat more than 100% < RLMS high price	44.97
Comparison of Rosstat and RLMS average prices	
Domestic cigarette brands	
Rosstat < RLMS average price	81.23
Rosstat more than 10% < RLMS average price	76.21
Foreign cigarette brands	
Rosstat > RLMS average price	18.70
Rosstat more than 10% > RLMS average price	12.65

Based on the pooled representative sample for 2001-2010

As concerns the distribution of Rosstat prices that fall within the RLMS price range, for about 60 percent of the sample the highest price for domestic cigarettes is more than twice the Rosstat price, which is what we would expect to see given that domestic brands tend to fall in the lower part of the price distribution. Accordingly, the average RLMS price calculated based on the minimum and maximum prices also exceeds the Rosstat price for the majority of sites (81 percent). For imported cigarettes the differences are less pronounced, with 45 percent of the high RLMS prices exceeding the Rosstat price by more than a factor of 2, which is also in line with the idea that foreign brands typically serve the medium and premium price segments of the market.

2.4 CONCLUSION

In this chapter we introduced the RLMS as the major source of data for this thesis. In the first section we discussed the sampling strategy and different samples of the RLMS, and examined in more detail response patterns and attrition from the longitudinal element of the RLMS. In spite of the obvious problems with conducting a good panel survey in a country like Russia, the RLMS provides one of the few household panel surveys in the world for a middle income country and given its longevity and reputation it is now one of the established core resources of the CNEF. Furthermore, notwithstanding the necessarily more complicated design features of the survey, the patterns of attrition in the RLMS are in line with comparator surveys, other things being equal. In the second section we have shown that the survey provides a very rich dataset on smoking which so far has been relatively under-used in addressing the important issue of smoking in Russia. Since a key interest of the thesis lies in the effect of cigarette prices on consumption and in light of the problematic nature of the cigarette prices collected by the RLMS, a small but important contribution of the thesis is to merge the regional price data provided by Rosstat with the RLMS data. But before turning to the econometric demand analyses in the third part of the thesis, the next two chapters provide an important descriptive analysis of smoking patterns in Russia, in terms of both longer-term developments that cover the Soviet and post-Soviet period, and in terms of a detailed examination of smoking patterns in the first decade of the 2000s.

3 Life-course smoking patterns and the evolution of smoking over time

3.1 Introduction

In the 1990s, a period of rapid social, economic and political change, the prevalence of smoking among both men and women in Russia increased. While the increases among men were remarkable given the very high base level of over 50 percent participation, the steeply rising prevalence among women was of particular concern to public health officials, given the potential for further increases and associated health consequences in a population already experiencing a severe health crisis. The recent epidemiologic literature argues that the increases in smoking are a result of the transition process and can be attributed particularly to privatisation and the arrival of transnational tobacco companies in Russia (Bobak et al., 2006; Gilmore et al., 2004; Perlman et al., 2007; Roberts et al., 2012a). Specifically, they suggest that smoking among females only started rising with the entry of transnational tobacco companies (TTC) who targeted women in their marketing strategies. Most of this literature draws on representative cross-sectional surveys from the 1990s and early 2000s and shows a steep rise in female smoking from single digit rates to prevalence rates of around 20 percent. However, smaller non-representative surveys from the Soviet period already showed female smoking rates of between 7 and 20 percent, calling into question the 'stylised fact' that smoking prevalence was in fact as low as we have been lead to believe at the start of the 1990s. This being so, it may also be the case that we need to refine our understanding of the factors underlying the observed health behaviour changes among women and reconsider it in terms of broader cultural shifts rather than merely as a product of transition and the related changes in the tobacco market. However, the fragmentary data from the Soviet period preclude an analysis of smoking patterns pre-dating the 1990s. In this chapter we therefore revisit the question of whether the increases in female smoking really were a transition related, post-Soviet phenomenon. We do so by drawing on an as yet entirely unexploited source of evidence in the form of retrospective smoking data collected by the RLMS. Based on this retrospective data we create life-course smoking histories which allow us to examine prevalence rates over the past eight decades and thus connect the Soviet and post-Soviet period for the first time.

The rest of the chapter proceeds as follows: The second section reviews the available empirical evidence on smoking prevalence in Soviet and post-Soviet Russia and summarises the explanations for the increases in female smoking proposed in the epidemiologic literature. In the third section we introduce the data and discuss the construction of life-course smoking histories. The fourth section presents the results of the smoking histories regarding long-term smoking patterns among men and women in Russia and in particular we identify the starting point for the uptick in female smoking prevalence. In the fifth section we offer some more nuanced explanations for the observed patterns of female smoking over time.

3.2 Empirical evidence on smoking patterns in Soviet and post-Soviet Russia

While for many Western high-income countries data on smoking prevalence and intensity as well as smoking-related mortality are available for most of the 20th century, enabling scholars to compare the evolution of smoking over time, the analysis of long-term smoking patterns in countries of the former Soviet Union is hampered by the lack of representative data for the Soviet period. Since population surveys were quasi non-existent in the Soviet Union there are very few sources of information on the prevalence of smoking prior to 1990, usually in the form of small-scale, non-representative surveys or data from medical studies. For the post-Soviet period, in contrast, there are a number of representative surveys which monitor the effects of economic transition on the economic well-being and health of the population. Table 3.1 below provides an overview of the data on smoking prevalence from various sources in the Soviet and post-Soviet period. While data from representative cross-sectional surveys in the 1990s and early 2000s provide more reliable estimates of smoking prevalence, they still cannot be compared directly to the fragmentary evidence from the Soviet period, thus still preclude the analysis of long-term trends in smoking. In order to get a sense of changes in prevalence over time based on data from a one-off cross-sectional survey, one approach is to examine differences in current and former smoking across age groups, based on the assumption that individuals of all cohorts take up the habit in their teenage years.

Table 3.1 Data sources on smoking prevalence in Soviet and post-Soviet Russia

Publication (author, year)	Data source	Sample size	Prevalence (%)	
			Men	Women
Soviet period				
Deber (1981)	Poll taken in Moscow by the Central Institute of Health Education, 1975	-	60	9.3
Cooper (1982)	- Referring to various small-scale surveys	-	44-69	10
	- Data from a multifactorial intervention trial for coronary heart disease, men aged 40-59 in 6 major Soviet cities	15,000	48.2	
Zaridze et al. (1986)	Report for the WHO International Agency for Research on Cancer	-	35-80	10
Molarius et al. (2001)	WHO Monitoring Cardiovascular Disease project (MONICA), conducted in Moscow and Novosibirsk in 1984-1986 and 1992-1995	2,630	40-60	3-13
Forey et al. (2002)	Smoking statistics for 30 economically developed countries during the 20th century, compilation of individual surveys for USSR as a whole	-	50-65	5-20
Post-Soviet period				
McKee et al. (1998)	New Russia Barometer, 1996 Age ≥ 18	1,599	63.0	14.0
Gilmore et al. (2001)	Living Conditions, Lifestyles and Health (LLH) survey, conducted in in 8 countries of the former Soviet Union. Fieldwork in Russia in autumn 2001. Age ≥ 18	4,006	60.3	15.4
Bobak et al. (2006)	New Russia Barometer, 2004 Age ≥ 18	1,591	64.0	15.0
WHO GATS Russia (2009)	WHO Global Adult Tobacco Survey Age ≥ 15	11,406	60.2	21.7
Roberts et al. (2012)	Health in Times of Transition (HITT) survey, follow-up project of the LLH survey carried out in the same countries during 2010. Age ≥ 18	3,000	53.3	16.1

As concerns evidence from the Soviet period, (Deber, 1981), referring to a poll taken by the Central Institute of Health Education in Moscow, reports that 9.3 percent of women smoked in 1975 (Deber, 1981) and that, according to officials at the USSR Ministry of Public Health, smoking is becoming increasingly popular with women and is beginning at an earlier age. Similar figures are given in Cooper (1982), with smoking among women in the younger age groups approaching the one third mark, which leads the author to conclude that "the emerging pattern of cigarette use is remarkably similar to the experience of Western industrialised countries" (Cooper, 1982). In the first analysis of the post-Soviet period, (McKee et al., 1998), drawing on data from the New Russia Barometer in 1996, find current smoking rates among women aged 18-34 to be twice as high as in women aged 35-54, who in turn have more than double the smoking rate of women above age 55. This strong cohort effect is confirmed in the larger cross-sectional surveys from the Living Conditions, Lifestyles and Health (LLH) and Health in Times of Transition (HITT) projects in 2001 and 2010, as well as in the WHO Global Adult Tobacco Survey (GATS) (Gilmore et al., 2004; Roberts et al., 2012a; WHO, 2009).

A second approach to tracking the evolution of smoking prevalence is to compare prevalence rates between representative surveys taken at different points in time, albeit this inevitably restricts the time frame to the post-Soviet period. Two studies which compared (i) two surveys of the New Russia Barometer (Bobak et al., 2006), and (ii) the LLH and HITT surveys (Roberts et al., 2012a), failed to show a statistically significant increase in female smoking in the transition period, which might be due to small sample sizes and/or the limited comparability of the surveys. While the RLMS is an excellent source to compare changes over time, there is only one study to date which has drawn on this data source to analyse the development of smoking in post-Soviet Russia. Using 10 years of the RLMS (1992-2003) Perlman et al. (2007) find that: (i) the overall prevalence of smoking increased among both men and women, the latter experiencing increases between 1992 and 2003 from 6.9 to 14.8 percent; (ii) while for men the increases were significant only for those aged 35-54, among females significant and more pronounced increases occurred in all age groups except for those above the age of 65; (iii) smoking is less prevalent among individuals with higher education, with the increases in smoking being more pronounced among the least educated, particularly among women; (iv) among men the share of smokers is higher in rural areas, whereas for women the opposite holds true, with women in Moscow & St. Petersburg being 6 times more likely to smoke in 1992; (v) the mean age of smoking uptake remained stable at between 15 and 18 years for different cohorts of male smokers, whereas among women the mean starting age decreased from cohort to cohort.

While providing a more complete picture of the development of smoking in the post-Soviet period than the one-off cross-sectional surveys, the analysis by Perlman and colleagues has important limitations. First, the authors combine data from the first and second phase of the RLMS, which due to differences in sampling strategy is not appropriate and the authors of the RLMS strongly recommend not doing so. Second, they ignore a 100 percent replenishment of the Moscow and St. Petersburg samples in 2001, which means that the response rates before and after 2001 are not comparable for Moscow and St. Petersburg. Third, they use the full (non-representative) cross-sectional samples. While this does not automatically invalidate the findings, it requires a more cautious interpretation. For example, the sharp increases in female smoking that they report are partly due to irregular increases between 1993 and 1994, as well as between 2000 and 2001, which are precisely the years where the comparability of the data is affected by the changes in the sample referred to above. Furthermore, the prevalence rates in 1992 and 1993 seem very low in view of the evidence, cited above, from the Soviet period estimating prevalence of around 10 percent towards the end of the 1970s (Cooper, 1982; Deber, 1981; Forey et al., 2002; Zaridze et al., 1986).

In summary, the empirical literature on smoking prevalence drawing on surveys from the post-Soviet period shows a strong cohort effect of smoking among women, with prevalence rates rising from cohort to cohort, and more strongly so in the 1990s. However, in the interpretation of these findings, the studies tend to cut off the pre-1990 developments and focus their attention on the transition period and the activities of TTCs in Russia (Gilmore et al., 2004; Perlman et al., 2007). While we do not dispute the fact that the marketing activities of TTCs will have played an important role in female smoking patterns, we believe it is important to see the developments of the 1990s in the wider context of cultural change from the late 1970s, rather than simply as a transition phenomenon. Furthermore, the combination of fragmentary Soviet and representative, cross-sectional post-Soviet data does not provide solid evidence as concerns the timing of the increases in female smoking. To achieve this, we propose a life-course analysis drawing on the data of the RLMS. Therefore, in this chapter, we draw on an as yet unexploited source of evidence in the form of retrospective data on smoking collected by the RLMS. Although the second phase of the RLMS only dates back as far as 1994, the survey includes questions on retrospective smoking such as age at smoking initiation and cessation, which allows for the construction of life-course smoking status for each respondent. Based on the smoking histories one can examine the smoking status over the life course for different birth cohorts, which provides evidence on the prevalence of smoking in different time periods – a possibility which has not been exploited so far in the RLMS. We turn to the construction of smoking histories in more detail in the following section.

3.3 DATA AND EMPIRICAL APPROACH

In this section, we exploit the RLMS data on retrospective smoking in order to examine smoking patterns through the life course across different cohorts. The construction of life-course smoking histories has two aims: (1) to examine whether smoking patterns (starting age, prevalence rate, quitting rate) differ for different birth cohorts, and (2) to verify whether increases in female smoking pre-date the transition period.. The analysis is based on the pooled, replenished for the years 2001-2010 sample (i.e. containing both the representative and follow-up samples).

Before we discuss the construction of the smoking histories in more detail, Table 3.2 below shows the share of smokers and former smokers by birth cohort and gender in the replenished sample. The data on current and former smoking for females confirm the age gradient that has been found in the previous literature, with the biggest jump (ignoring the youngest cohort) in current smoking prevalence occurring between women born in the 1950s and the 1960s, which given a mean starting age of 20 years among women in the sample means those who started smoking in the 1970s and 1980s.

Table 3.2 Share of current and former smokers by birth cohort

Individuals aged 15 and above	Males	Females
Share of current smokers overall	57.45	14.6
Share of current smokers by birth cohort:		
1990s	25.83	8.07
1980s	53.06	20.71
1970s	66.41	25.47
1960s	70.20	21.76
1950s	64.46	13.15

Individuals aged 15 and above	Males	Females
1940s	55.55	6.68
1930s	37.13	0.99
1920s and earlier	21.16	0.83
Share of former smokers overall	15.89	7.25
Share of former smokers by birth cohort:		
1990s	6.90	7.24
1980s	10.04	15.39
1970s	11.47	16.43
1960s	13.09	10.97
1950s	16.42	6.64
1940s	24.30	3.85
1930s	34.87	1.23
1920s and earlier	34.87	1.36
Mean age at initiation (current & former smokers)	16.73	20.35

Based on the full (replenished) RLMS sample for 2001-2010, using the survey weights provided by the RLMS.

3.3.1 Construction of life-course smoking data

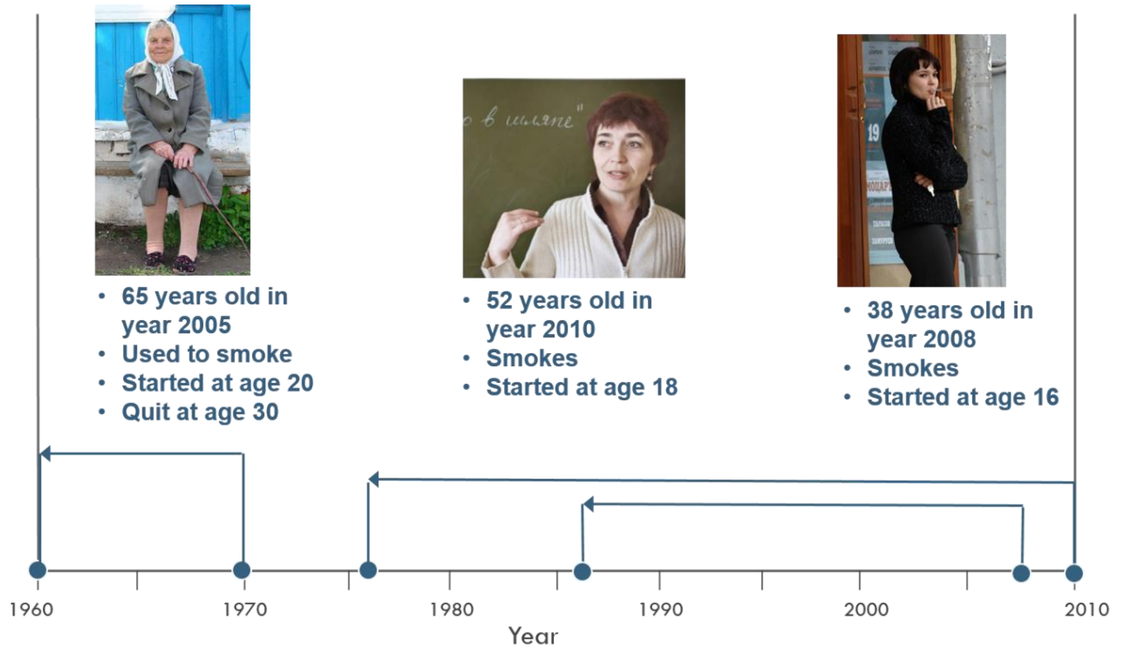
In addition to questions about current smoking status and daily tobacco consumption, the RLMS features two retrospective questions on smoking initiation and cessation: (1) both current and former smokers are asked the age at which they started smoking, and (2) former smokers are asked how many years ago they quit. By combining the data on current and retrospective smoking with the date of birth of the respondent and the year of the survey, it is possible to construct an indicator of 'life-course smoking status', which captures whether or not an individual smoked in each calendar year in which she was alive.[24] To create the dataset with life-course smoking status we took the full, replenished sample for 2001-2010 and expanded the dataset by creating additional calendar years according to the age of each individual, i.e. if an individual was 80 years old in 2010, the earliest calendar year for her is 1930.[25] Based on the start age, and combination of start

[24] To create the life-course dataset I drew on do-files provided by the project "Cross-national Research on Life-course smoking" at Ohio State University (Kenkel et al. 2003). The files can be found under http://smoking-research.ehe.osu.edu/data-and-codes/.

[25] To expand the dataset backwards in time we need to have one observation per individual only. Therefore, we used the data from the last available year for each respondent.

and quit age for former smokers, we then created a life-course smoking indicator that captures whether or not an individual smoked in a particular year of life from birth through to the last year in which she is observed. With this approach we expand the initial dataset from 28,442 observations (15,823 females/12,619 males) to 1,238,349 observations (721,490 females/516,859 males).[26] To help illustrate what the data shows, Figure 3.1 below shows examples of the life-course smoking data for three hypothetical respondents.

Figure 3.1 Construction of life-course data



The 38-year old woman on the right in Figure 3.1 reports in round 17 (2008) that she is currently smoking and that she started when she was 16 years old. Thus, we know that she started in 1986 and she will be recorded as a smoker for all of the years from 1986 to 2008. The 65 year-old woman on the left told us in round 14 (2005) she is not currently smoking, but started to smoke when she was 20 and quit when she was 30, so she will be recorded as a smoker for each year between 1960 and 1970.[27]

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[26] See Appendix 1 for the key descriptive statistics of the initial sample and the expanded sample for the life-course analysis.
[27] This is based on the assumption that between her reported starting and quitting age, she smoked continuously, so does not take account of temporary quits.

The viability of this approach rests crucially on the reliability of the self-reported retrospective information. One indicator of the reliability of retrospective information on smoking is the extent to which repeated measures of current and previous smoking yield the same result. That is, if an individual reports to be smoking in 1980, what is the probability that she reports to have smoked 10 years ago when surveyed in 1990? To assess the quality of retrospective smoking data, Kenkel et al. (2003) examined the degree of agreement between contemporaneous and retrospective measures of smoking status over a time window of 20 years in four longitudinal datasets from the US. They found retrospective information to provide reasonably valid measures of life-time smoking status but cautioned that the usefulness of retrospective data on smoking status depends on the research question to be answered (Kenkel et al., 2003a). In this chapter we are specifically interested in the approximate time period of increases in female smoking rates, rather than the exact starting ages. Given this research question, the retrospective data on smoking status should provide reasonably reliable measures of smoking status. However, given that the agreement between retrospective and contemporaneous measures declines with time, the data are likely to be more accurate for younger respondents, for whom the time passed since smoking initiation is shorter than for older respondents. Furthermore, given the differential mortality of smokers, data from respondents over the age of 70 will underestimate prevalence, particularly for Russian men (Christopoulou et al., 2011).

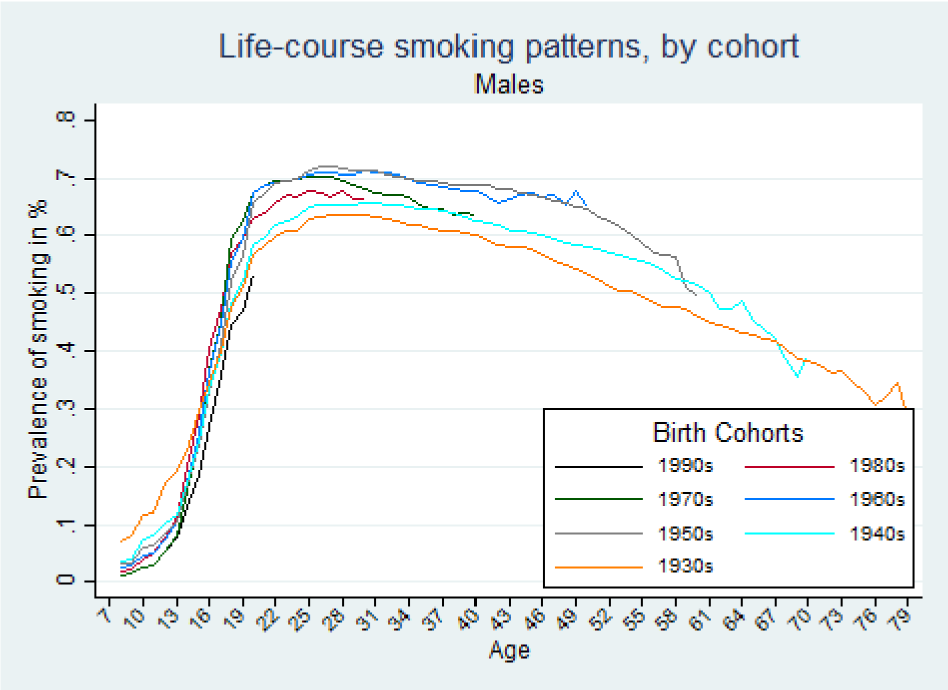
Moreover, as we noted in chapter 2, individuals are inconsistent in their reporting habits, i.e. some individuals report their former smoking status inconsistently, stating in some years that they had previously smoked, but reporting in later years that they had not. Since our life-course dataset, and thus our life-course smoking status variable, is based on the last available year for each individual, inconsistent reporting of former smoking status will lead to the smoking prevalence in our dataset to be underestimated. That is, individuals who either smoked or reported to be former smokers in earlier rounds[28], but claim in their last round that they never smoked will (wrongly) be marked as never-smokers and thus not appear as smokers in any year. These inconsistencies affect 8.6 and 6.6 percent of individuals for males and females respectively.

[28] There are 311/422 cases for females/males where individuals reported being a smoker in an earlier round but in subsequent rounds claim to have never smoked, and 778/683 cases for females and males respectively, where individuals reported that they used to smoke, but in subsequent rounds they claimed to have never smoked.

3.4 Results

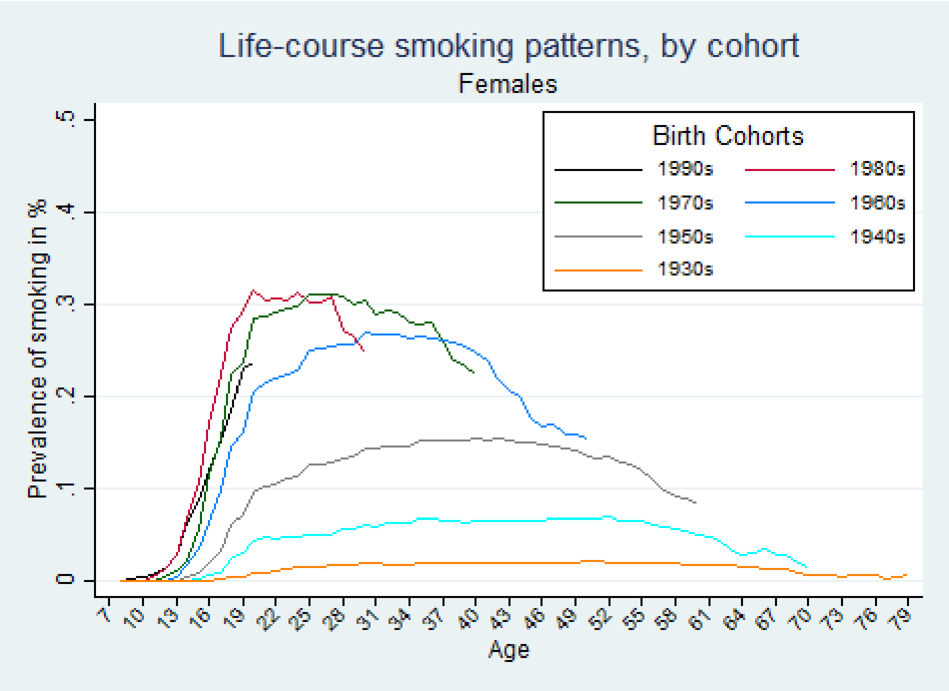
With the expanded data set containing the additional calendar years of smoking status we can now examine trends in smoking prevalence across the life-course and over time for different birth cohorts. As expected from the evidence presented in section 2, Figure 3.2 and Figure 3.3 show that, for men, smoking rates across the life-course are similar for different cohorts, while female smoking patterns differ markedly between cohorts. The different cohort patterns between men and women have been observed in other countries as well, though they are often more pronounced in low- and middle income countries, such as China (Kenkel et al., 2009), due to the stronger social norms prevailing against female smoking. According to the RLMS sample, the large majority of men in all cohorts took up smoking between the ages of 13 and 20, with prevalence peaking at around 70 percent in the early 20s, and staying above 60 percent well into the 50s for the 1950 and 1960 birth cohorts. The lower curve for the oldest cohort (1930s), where smoking rates drop as low as 30 percent in later life, should be interpreted with care since, as mentioned above, it has been shown that smoking rates of Russian men above the age of 70 are distorted by the differential mortality of smokers and thus fewer smokers still being alive in the older cohorts (Christopoulou et al., 2011). Figure 3.2 also shows evidence that survivorship bias might matter at earlier ages, with the 1940 cohort (men in their 60s) showing a similar pattern to the preceding cohort.

Figure 3.2 Life-course smoking by birth cohorts (males)



The persistence of the smoking habit beyond the age of 50 for the majority of male smokers distinguishes Russia from high-income countries like the US or the UK, where prevalence rates start falling from the mid-30s onwards (Kenkel et al., 2003b). However, life-course smoking patterns of Russian men are similar to those of Chinese men who also show high prevalence rates sustained over 3-4 decades (ibid.).

Figure 3.3 Life-course smoking by birth cohort (females)



In contrast to males, female smoking patterns across the life-course are marked by generational divides, with smoking prevalence increasing with each successive cohort. While for women in the oldest cohort smoking prevalence stays below 3 percent throughout the entire period, Figure 3.3 above shows stochastic dominance of the younger cohorts, meaning that the prevalence of smoking increases from cohort to cohort. In all cohorts, the big surge in smoking prevalence takes place in the 16-25 year old range, although the starting ages get younger from cohort to cohort. In the 1970 and 1980 cohorts prevalence peaks at 30 percent, suggesting that during the late 1980s and 1990s, when these younger age groups were in the vulnerable age range for initiation, female smoking rates underwent sharp increases.

However, to see more precisely how smoking rates have changed over time, figures Figure 3.4 and Figure 3.5 switch from a life-course to a calendar perspective (with year instead of age plotted on the x-axis). Figure 3.4 confirms the stability of male smoking patterns since the Second World War. In contrast to females, the 1960s, 1970s, and 1980s seem to yield a steeper uptake in smoking than the 1990s (the graph shows weak evidence of stochastic dominance).

Figure 3.4 Smoking prevalence over time, by birth cohort (males)

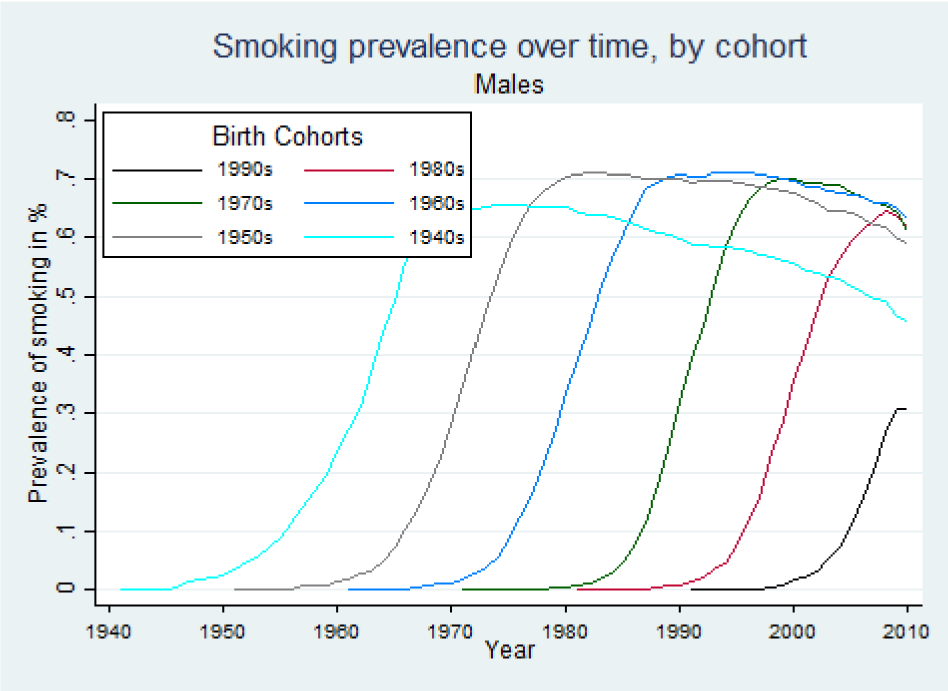
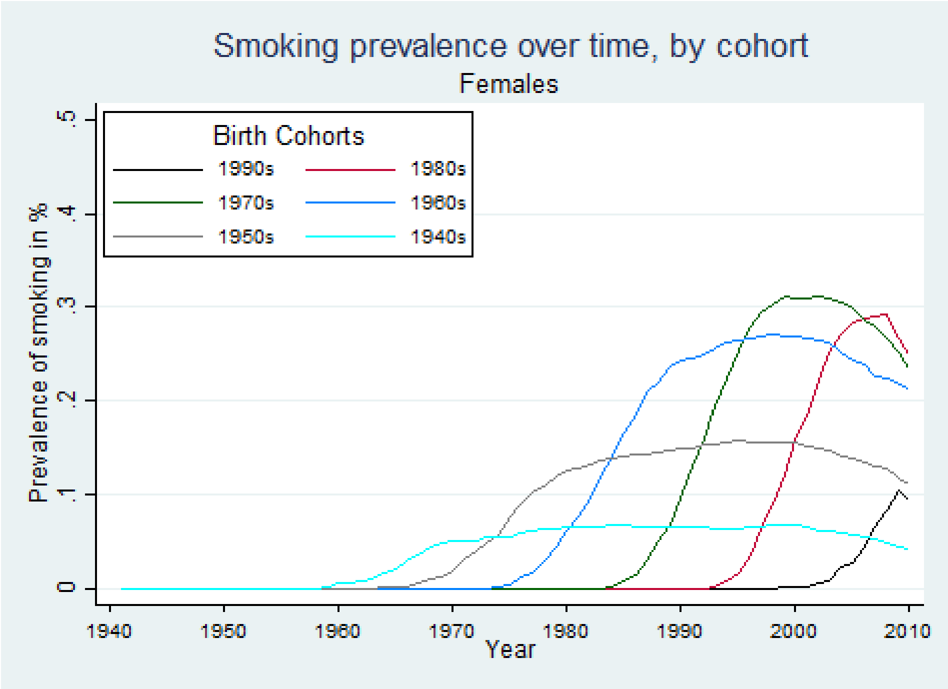


Figure 3.5 shows that, among females, the biggest surge in smoking prevalence occurred between the late 1980s and early 1990s in the cohort of women born in the 1970s. However, we already observe a similarly pronounced increase starting in the late 1970s among women born in the 1960s, where prevalence rates shoot up to nearly 30 percent, compared to around 15 percent in the preceding birth cohort. This suggests that the ‘turning point’, when women started taking up the habit at an increasing rate lies well before the transition period and the arrival of transnational tobacco companies in Russia. This observation is the central claim and contribution of this chapter and provides an important alternative to the existing narrative regarding the female uptake in smoking. It is worth noting though that the peak in prevalence rates in the 1950, 1960, and 1970 cohorts all occur in the early/mid 1990s, suggesting that the transition environment

provided an additional 'push' to smoking rates among women who were beyond the 'traditional' starting age of the early 20s.

Figure 3.5 Smoking prevalence over time, by birth cohort (females)



3.5 Discussion

Building on our finding that the increase in female smoking largely pre-dated the transition period, in this section, we examine the more general phenomenon of pronounced gender differences in smoking, and in the Russian context, particularly the reasons for the (relative) persistence of the habit among men into older age as well as the potential reasons for rising smoking rates among women from the 1980s.

In the previous chapter we introduced the Lopez model that describes the differential adoption of smoking by gender and socioeconomic characteristics, and the subsequent smoking-related mortality. In 2010, a revised version of the model was proposed, among others by the main author of the original model, out of the recognition that the 2-3 decade lag with which the model predicts female smoking to increase compared to men is too restrictive and not applicable to many low and middle-income countries where we see high prevalence rates as well as high smoking-attributable mortality among men, but still low levels of both indicators among women (Thun et al., 2012). Rather than defining the four stages in terms of comparative levels of smoking prevalence and smoking-attributable mortality in men and women, they suggest in their revised model to describe the stages separately by gender since it is difficult to predict when female smoking will rise. That is, a country could be in the final stage for male smoking, but still in the second stage with regard to female smoking. The low prevalence and lagging behind of female smoking is typically driven by social taboos that label smoking as an unfeminine behaviour. Increases in female smoking are thus associated with the breaking away from such cultural traditions, often facilitated by social, economic and political transformations associated with globalisation.

One potential explanation for the strongly gendered nature of smoking in Russia comes from the sociological literature which has focused on the normative influences of negative health-related behaviours within the context of the long-term deterioration/stagnation of health outcomes in Russia. Cockerham (1999, 2009) argues that negative health lifestyles such as excessive alcohol consumption, smoking, a high fat diet and lack of exercise are shaped both by cultural traditions and material circumstances and differ along the three key dimensions of gender, age and class (Cockerham, 2009, 1999). In his view the entrenched pattern of negative health lifestyles among men originates in peasant and working class culture which put a certain set of normative demands on male behaviour, for example, drinking as long as one is able to. Cockerham sees the working-class tradition of heavy episodic drinking as a structural constraint on individual choice in that norms and group dynamics ‘force’ men to drink if they want to belong to a certain group. While such norms might not be as strong for smoking, the strong association between drinking and smoking links tobacco consumption to the social norms of male behaviour described above. The working-class lifestyle explanation also accommodates the lower consumption of alcohol and cigarettes among females and argues that, while considered the social norm for men, drinking and smoking were not considered an acceptable behaviour for women (Cockerham, 2009).

A qualitative study by Abbott et al. (2006) based on interviews, focus groups and essays conducted within the 2001 *Living Conditions, Lifestyles and Health* (LLH) project sheds further light on the gender norms in health behaviours in Russia. According to the study, respondents regarded smoking as a normal behaviour for men and rarely referred to smoking as being bad for health (Abbott et al., 2006). Drinking and smoking were seen as habitual and natural elements of daily life and a way to cope with stress, which was also reflected in the fact that the majority of male respondents both drank and smoked.

Female respondents by contrast reported drinking, but relatively few of them reported smoking. There are, however, sources that report increases in negative health behaviours among females already in the Soviet period, see for example (White, 1996).

Further evidence on the normative influences on smoking behaviour in both Soviet and post-Soviet Russia comes from data collected for an oral history project. The data, based on interviews with people born between the 1910s and 1980s living in four major Russian cities and two rural sites, suggest that developing a relationship with smoking (whether positive or negative) was a near-universal childhood experience in Russia from the late 19th century onwards (Kelly, 2009). Despite the long time period spanned, the individual accounts are remarkably consistent across time and point to a starting age of smoking between fourteen and eighteen years. The interviews also give interesting insights into the attitudes and social acceptance of smoking in 20th century Russia. For example, while adults disapproved of children's smoking, they at the same time considered it inevitable that they would one day become smokers. This resulted in a kind of "normative doublethink" where smoking was regarded both as socially "normal" and medically "harmful to health" (ibid.). In general, attitudes to smoking were shaped by the fact that tobacco was cheap and widely available and that there were few social or moral prohibitions on its use in most public places. However, smoking decisions were strongly influenced by gender roles. Whereas smoking was a sign of manliness for boys and thus socially encouraged, female smokers were considered to be unfeminine, and public smoking by women was thus rarely observed.

Several authors suggest that the increases in alcohol and tobacco consumption among women may be a sign of changing gender norms, where younger cohorts of females engage in traditionally 'un-feminine' behaviours as a way to express their individuality and exert personal agency, or to make a statement against the masculine-dominated social order of the Soviet period (Hinote et al., 2009a, 2009b). Among young Russians, Western cigarettes were seen as relatively inexpensive status symbols (Gilmore, 2009), and compared to other consumer products cigarettes were widely and easily available. Thus, while the desire to "Westernize" made cigarettes attractive to men and women alike, smoking might have carried additional symbolic meaning for women in their quest to strip off existing gender roles and lead a modern lifestyle. This is by no means a new explanation since, throughout the history of tobacco in Russia, smoking served as a marker of gender and status, with tobacco consumption being associated with the modern, forward-thinking, revolutionary, and the young (Romaniello and Starks, 2009, p. 4).

Another factor that might have contributed to the rise in female smoking towards the end of the 1970s is the arrival of a new product – machine-rolled cigarettes, and specifically Bulgarian cigarettes exported into the USSR by Bulgarian state monopolist Bulgartabac. Bulgartabac produced cigarettes with American Technology from Philip Morris and based on American blends which, while more addictive and carcinogen-laden, were milder in taste compared to Russian cigarettes, and surely compared to the traditional Russian papyrosi (Neuburger, 2009). While the traditional papyrosi without filter might have been too rough in taste, the aesthetic turn to filtered cigarettes, and particularly the milder Bulgarian cigarettes might have 'made' cigarettes a product for women.

3.6 Conclusion

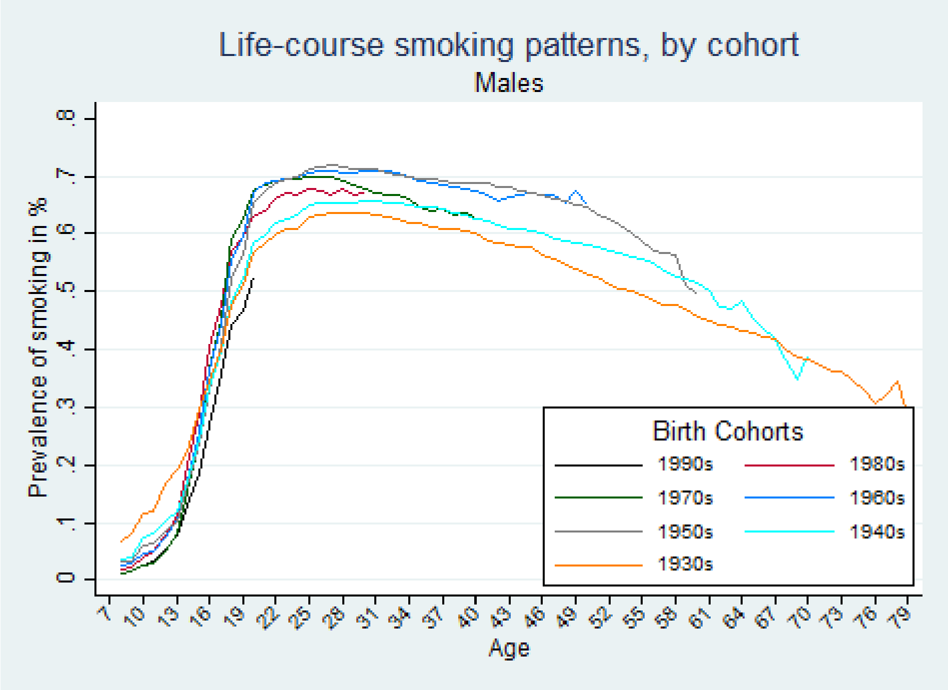
In conclusion, it seems that rather than simply 'inducing' higher smoking rates, from the traditional low base, the transition environment with its new forms of marketing of cigarettes and decline in real prices provided impetus to a pre-existing trend of increasing popularity of smoking among women. While we do not doubt that the marketing strategies specifically targeted at women did have an impact on female smoking, we maintain that it should be seen as an 'accelerator" that unlocked existing behavioural patterns within the cohorts of women at vulnerable ages for taking up the habit: On the one hand by making smoking a socially acceptable and desirable behaviour for modern women, and on the other hand by increasing the availability and affordability of cigarettes. Already, prior to transition, smoking was seen as a sign of a Western lifestyle that attracted young men and women, so that the marketing efforts by TTCs fell on fertile ground which in combination with falling real prices in the struggle for market share created favourable conditions for increasing demand. This does not reduce the significance of the aggressive marketing mechanisms to recruit female smokers in Russia. By contrast, a better understanding of the ways in which tobacco companies exploited existing cultural changes to propagate a positive image of cigarettes and create contexts that encourage smoking initiation might also help design interventions to reduce their attractiveness and promote cessation.

CHAPTER 3 APPENDICES

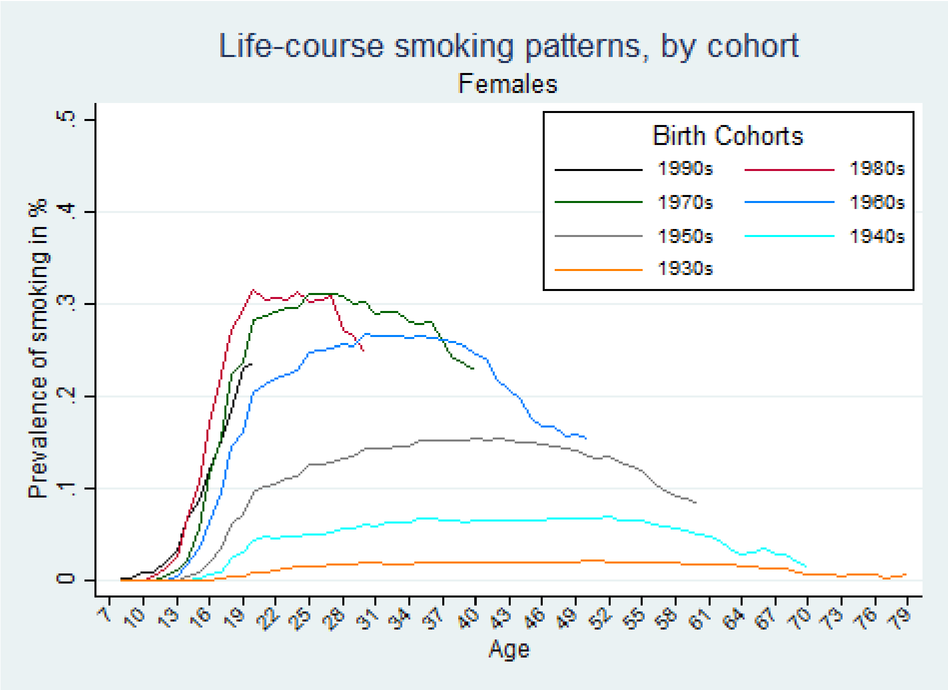
3-A Sample composition for the replenished and life-course samples

Individuals aged 15 and above	(1)	(2)	(3)	(4)
	Replenished 2001-2010 sample	Life-course sample based on replenished 2001-2010 sample	Represen-tative 2001-2010 sample	Life-course sample based on representative 2001-2010 sample
Gender				
Female	55.63	58.26	56.14	58.77
Male	44.37	41.74	43.86	41.23
Age				
15-24 years	19.07	8.80	18.79	8.42
25-34 years	20.26	13.59	17.63	11.51
35-44 years	15.42	13.91	15.04	13.26
45-54 years	15.46	17.60	16.18	17.95
55-64 years	12.74	17.31	13.66	18.08
65 plus years	16.70	28.78	18.35	30.77
Region				
Moscow & St. Petersburg	14.42	15.01	11.94	14.19
Northern & North Western	6.83	6.37	6.17	6.28
Central & Central Black Earth	17.36	17.90	18.00	18.34
Volga-Vyatski & Volga Basin	15.29	15.69	16.54	15.07
North Caucasian	13.32	13.04	14.78	13.80
Ural	13.39	13.13	13.90	13.24
Western Siberian	9.25	9.10	9.48	9.35
Eastern Siberian & Far Eastern	10.15	9.77	9.19	9.72
Education				
University	20.82	20.76	20.75	20.62
Technical, medical, pedagogical and art colleges	20.12	21.19	20.43	21.49
Complete secondary + vocational training	13.01	11.82	12.27	11.19
Incomplete secondary + vocational training	5.54	6.13	5.38	5.97
Complete secondary (11 years)	20.37	17.35	20.89	17.59
Incomplete secondary (8 years)	18.95	21.75	19.13	22.20
Observations	28,442	1,238,349	21,911	979,907

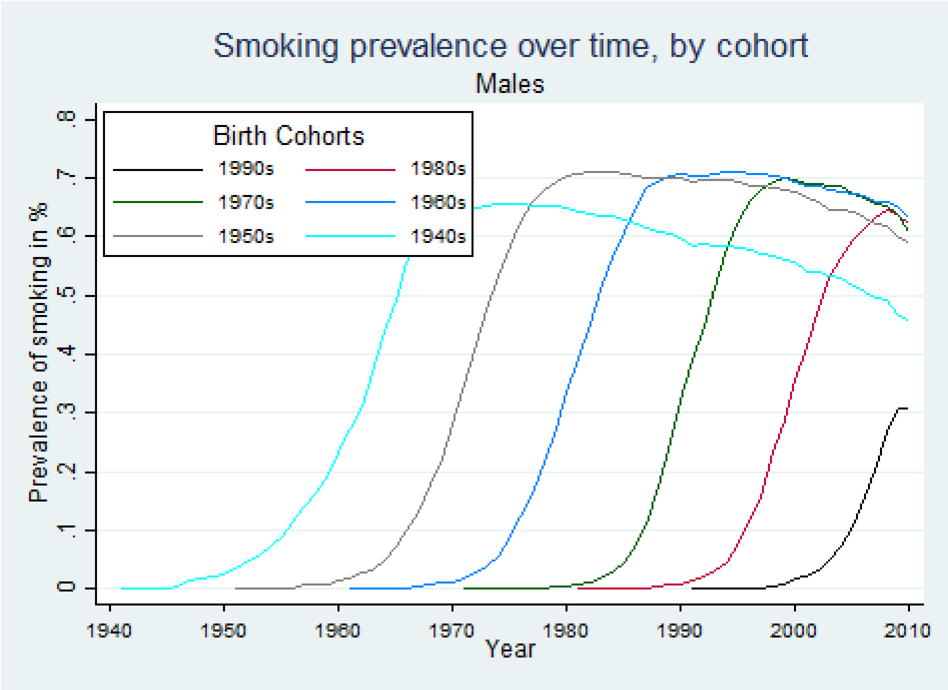
3-B Life-course smoking based on representative sample (males)



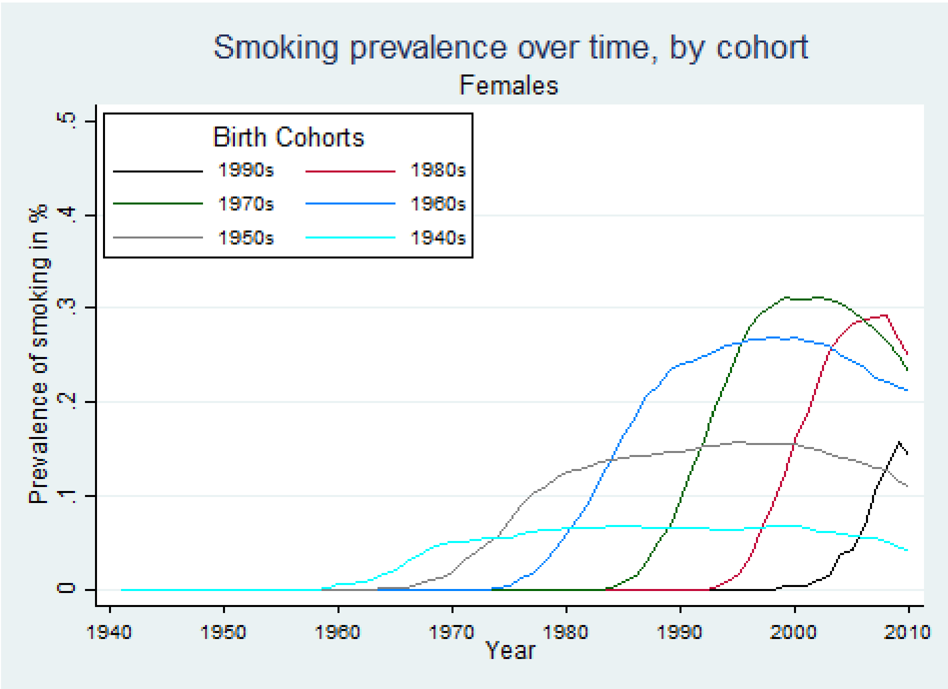
3-C Life-course smoking based on representative sample (females)



3-D Smoking prevalence over time based on representative sample (males)



3-E Smoking prevalence over time based on representative sample (females)



4 RLMS evidence on smoking patterns between 2001 and 2010

4.1 Introduction

In the previous chapter we explored patterns of smoking across the life-course and over time based on retrospective reports of smoking status from round 17 (2008) of the RLMS. Among other things, the analysis has highlighted the strongly gendered nature of smoking in Russia, with female rates having increased from cohort to cohort, and more strongly so from the 1980s onwards. Taking this finding as our departure, we now draw a more fine-grained picture of smoking patterns in the first decade of the century (2001-2010). We start by analysing the association of smoking with key socioeconomic characteristics such as age, region, settlement type and education, separately for men and women. Changes in bivariate associations of smoking status can be clouded by compositional changes of the sample (e.g. if a larger share of respondents has university education in 2010 than in 2001, this might lead one to mistakenly conclude that smoking has increased among people with higher education). Therefore, we also explore the associations for constant 2001 population shares. While for men, decreases in smoking between 2001 and 2010 are confirmed across all the associations, a different pattern emerges for women, where we see both increases and decreases, with the differences in prevalence rates according to age, region, and settlement size decreasing, and the educational gradient becoming steeper. Building on these associations, section 4 presents the socioeconomic profile of a smoker by comparing the characteristics of smokers to their non-smoking counterparts. The profiles confirm the gender differences, with male smokers being on average older than non-smokers, married or divorced, having a lower income and living in a medium-sized city in the Ural or Siberian regions, whereas female smokers are considerably younger than non-smoking women, are more likely to be single, have a higher income and live in Moscow and St. Petersburg.

4.2 RLMS EVIDENCE ON SMOKING BETWEEN 2001 AND 2010

Table 4.1 below provides a first snapshot of smoking in the RLMS. As expected from the findings in the previous chapter, smoking is much more common among men than among women, with overall prevalence for the whole period being four times higher for males (57.5 percent) than females (14.6 percent). However, the gap has decreased between 2001 and 2010 due to a relatively sharp drop in prevalence among men in 2010 and a slight increase in female smoking. Male smokers are on average 4 years older than female smokers (40 vs. 36 years), they start smoking about three years earlier (16.6 vs. 19.4 years), and they smoke more intensively (17 cigarettes per day compared to 11 cigarettes for females).

Table 4.1 Snapshot of smoking in the RLMS in selected years

Individuals aged 15 and above

	2001		2004		2007		2010		All years	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Smokers (%)	60.2	13.8	58	14.6	58.1	15.2	53.7	14.7	57.5	14.6
Current age (years)	39.3	35.5	40.2	35.3	40.4	36	39.9	36.8	40	35.9
Age started (years)	16.8	19.9	16.6	19.4	16.5	19.3	16.6	19.3	16.6	19.4
N° cigarettes	16.3	10.1	16.7	12.2	16.9	11.3	17.3	11.6	16.8	11.2
Observations	3,262	4,517	3,209	4,391	3,721	5,152	5,909	8,143	36,318	50,328

Based on the representative samples for 2001, 2004, 2007 and 2010, with "all years" based on the pooled representative sample for 2001-2010, using the survey weights provided by the RLMS

The following sections present evidence on current smoking by age, region, settlement type and education, separately for both genders, based on the representative cross-sectional sample and using the survey weights provided by the RLMS.

4.2.1 SMOKING PREVALENCE BY AGE

As can be seen from Table 4.2 below, overall prevalence of smoking among males fell below 60 percent during the survey period - from 60.2 percent in 2001 to 53.8 percent in 2010. Female smoking, by contrast, still increased - from 13.8 percent in 2001 to 14.8 percent in 2010. For men, the reductions have been strongest in the age range 25-44 (where prevalence was also highest with 71.6 and 71.2 percent in 2001), dropping by almost 10 percentage points in each group. The reductions in these two groups have not been distributed evenly across years: Except for a 3.3 percentage points drop in 2003 among the 25-34 year-olds, prevalence in both groups was fluctuating until 2007 and only from 2008 onwards did a decreasing trend set in. A large part of the reduction occurred in 2010 with a reduction of 4.2 (4.6) percentage points in the 25-34 (35-44) age bands compared to the previous year. In the two youngest age groups the share of smokers declined steadily across rounds, decreasing by about 8 percentage points to 16.8 and 50.8 percent respectively in 2010. In the older age groups changes in smoking have been less pronounced. In the 45-54 age range the percentage of smokers fluctuated between 65 and 69 percent until 2009 before falling to 62.5 percent in 2010. Similarly, the share of smokers among men aged 55-64 varied between 54 and 62 percent and since 2009 declined more clearly, arriving at 53.1 percent in 2010.

Table 4.2 Smoking prevalence by age

Individuals aged 15 and above

Age (years)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Males:										
15-17	24.2	27.7	26.9	25.1	22.7	23.8	20.4	17	16.3	16.8
18-24	59.4	60.1	58.5	58	56.6	56.2	55.5	52.6	50	50.8
25-34	71.6	70.7	67.4	67.2	67.2	68.3	66.6	66.4	65.7	61.5
35-44	71.2	73.7	72.9	72.7	73	71.3	71.4	68.4	65.6	61
45-54	68.6	69	64.6	64.4	65.1	67.3	66.6	65.2	65.2	62.5
55-64	54.4	55.8	59.9	58.5	56.5	61.6	61.2	59.8	56	53.1
≥ 65	33.1	34.8	34.8	35.9	34.3	34.9	33.5	31.6	30.3	30.9
Total	60.2	61.2	59.5	58	57.3	58.6	58.1	56.6	55.2	53.7
Females:										
15-17	8	4.5	6.6	6.7	5	3.1	3.7	4.6	3.8	5
18-24	19.8	21.4	20.4	22.6	20.3	22.5	21.3	20.2	18.5	19.8
25-34	27.9	29	27.7	27.3	26.9	26.4	27.8	26.6	26	23.1
35-44	17.9	17.4	20.9	22.3	23.5	26.4	26.1	25.4	26	23.7
45-54	14.3	14.8	12.1	14.2	13.9	14.8	14.4	14.2	12.6	14.7
55-64	4.1	4.8	6.5	6.8	8.7	8.7	8.9	9.7	9.8	9.1
≥ 65	1.7	1	1.1	1.3	0.6	0.8	1	1.2	1.2	1.1
Total	13.8	13.8	13.9	14.6	14.2	15.2	15.2	15	14.8	14.8

Based on the representative samples for each year, using the survey weights provided by the RLMS

Among men aged 65 and older there are considerably fewer smokers – the prevalence rate here is less than half of the rate among middle-aged men, fluctuating between 33 and 36 percent until 2007 and then declining slowly to 30.9 percent in 2010. The comparatively low prevalence in the oldest age group illustrates the differential mortality of smokers, resulting in fewer male smokers still being alive at age 65 and above. As a result of the replenishment in 2010 the average age of the sample falls, which explains the slightly larger fall in overall smoking. In sum, smoking prevalence among men is decreasing; a trend which for most age groups began around the year 2006-7.

For females, trends are more diverse across the age groups, showing both increasing and decreasing trends: The strongest increases in smoking occurred in the 35-44 age bracket where prevalence rose by 8.5 percentage points, from 17.9 percent in 2001 to 26.4 percent in 2006, and then slightly decreased in subsequent rounds, falling to 23.7 percent in 2010. The second largest increase occurred in the 55-64 age group, where smoking increased steadily from 4.1 percent in 2001 to 9.8 percent in 2009. Among the 25-34 year-olds, prevalence (at 27.9 percent in 2001) fluctuated between 26 and 29 percent and only in 2010 decreased to 23.1 percent. In the remaining age groups the share of smokers fluctuated without a discernible trend.

It seems interesting that smoking increased the most in age groups 35-44 and 55-64 given that the average starting age for women in the sample is 19. However, the increases could be the effect of cohorts with a larger prevalence (initiation) rate moving into these age bands during the survey period. Due to the set-up of the RLMS as a repeated cross-section, individuals who remain in their original dwelling and are re-interviewed in each round will appear up to 10 times in the representative sample. For example, a female smoker who is 28 years old in the first year (2001) will be 37 years old in 2010. Accordingly, she will appear in the 25-34 age group until 2007 and then move up into the next age band from 2008 onwards. Regarding the increases in the 35-44 age group, this would lend support to the argument that female smoking increased strongly in the 1990s since those women who were in the 'vulnerable' age category (16-22) for starting to smoke in 1990, were between 27 and 33 in 2001 and would therefore move into the 35-44 age band in subsequent years. According to this logic, among women aged 35-44 the prevalence of smoking should be higher among those who moved up into this age group after 2001. Conversely, among 25-34 year-old women we would expect those who did not move up to have a higher prevalence.

And this is exactly what we see: among women who moved into the 35-44 age category after 2001 the share of smokers is between 5 to 10 percentage points higher than among those who did not move, with the maximum prevalence among those who moved up being at 30 percent during the years 2004 through 2006.[29] The same holds true for the 55-64 age group, with a difference of 2-4 percentage points between those who moved up and those who did not. For all other age groups, women who moved into the age group after 2001 have a lower prevalence. The increases among women aged 35-44 and 55-64 confirm the finding from the previous chapter that smoking among females increased towards the end of the 1970s/beginning of the 1980s and, more strongly, during the 1990s.

4.2.2 Ever-smoking by age

As the RLMS does not only ask about contemporaneous but also past smoking behaviour, we can also examine the share of people who have ever smoked in the different age groups, that is those who claimed to be either currently smoking or to have smoked in the past. The age distribution of ever-smokers, shown in Table 4.3 below, reinforces the decreasing trend in male smoking. Among men aged 35-64, the share of ever-smokers reached as high as 86 percent, whereas in the younger age groups (18-34) it stayed between 60-80 percent. For females, ever-smoking by age group illustrates increases in initiation in the beginning of the 1980s (as seen most clearly in the prevalence of ever-smokers exceeding 30 percent in the 35-44 age group), as well as the stronger increases in the beginning of the 1990s, with about 40 percent of women having ever-smoked in the 25-34 age group. Comparing the relative shares of current and former smokers by gender, one can conclude that females give up smoking at a higher rate than males, with nearly one third of female ever-smokers aged 25-44 being ex-smokers, whereas only 10-15 percent of men of the same age are ex-smokers.[30]

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[29] See table 4-A in the appendix.
[30] See table 4-B in the appendix.

Table 4.3 Ever-smoking by age

Individuals aged 15 and above

Age (years)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Males:										
15-17	43.8	41.9	41.8	37.5	32	33.4	27.8	28.7	21.3	22.3
18-24	72.4	72.3	67.4	67.2	64.2	64.2	64.4	60	60.2	58.6
25-34	81.7	81.4	76.6	77.9	78.4	77.9	77.7	76.3	77.7	74
35-44	84.1	85.4	86	84	85.9	83.9	85.9	82.9	80.9	75.7
45-54	82.5	82.5	81.7	80.3	81	82.5	81.9	79.8	79.9	79.9
55-64	80.3	81.8	84.1	82.5	78.7	82.9	82.3	80.7	78.3	75.3
≥ 65	73.9	75.1	73.6	72.2	72.4	72.4	71.6	68.8	68.8	66.1
Total	77.2	77.3	75.7	74.4	73.7	74.4	74.6	72.5	71.8	69.7
Females:										
15-17	18.9	15.4	15.9	16.9	10.2	8.6	10	11.2	11.2	10.5
18-24	34.6	35.7	38	37.9	32.7	34.7	32.6	29.8	27.3	30.8
25-34	41.3	39.6	41.1	41.6	39.3	39.3	41.4	40.8	37.9	35.3
35-44	25.9	27.7	29.9	32.1	31.3	34.1	35.1	34	36.2	34.5
45-54	20	20.6	18.6	20.1	20	21.8	21.1	21.5	19.9	21.7
55-64	6.1	6.8	9.3	10.2	12	13.1	13.7	14.3	15	13.2
≥ 65	3.3	1.8	2.5	2.2	1.6	2.1	2.1	2.6	2.5	3
Total	21.3	21.1	22.1	22.4	20.8	22.3	22.5	22.3	22.2	22.4

Based on the representative samples for each year, using the survey weights provided by the RLMS

It is worth noting, with regard to Table 4.3, that there is a seemingly perplexing downward trend in the incidence of 'ever smoking' within the same cohort. There are three basic reasons why in general we would not expect ever-smoking rates to be the same within cohort over time: (i) People are inconsistent in their reporting habits, i.e. some individuals report their former smoking status inconsistently, stating in some years that they had previously smoked, but reporting in later years that they had not (see the discussion of chapter 2, section 2.2.2); (ii) the sample is cross-sectional and so the sample composition differs over time. However, while this latter point implies that we would not expect the numbers to be the same, it doesn't explain the systematic downward trend suggested by table xxx and xxx; (iii) Gerry and Papadapoulos (2015) showed that, as with other longitudinal household surveys, there is health and age related attrition in the RLMS, so the panel element of the representative sample is likely to disproportionately lose the unhealthy and the young (age 25-40), and in these groups there are accordingly disproportionately higher numbers of ever smokers. While the evidence from Gerry and Papadapoulos (2015) suggests that such attrition is unlikely to affect the regression results of chapters 6 and 7, it is likely to be part of the reason for the apparent declines in ever-smoking over time.

While point (iii) above would imply a detailed econometric study beyond the scope of this thesis, we do explore points (i) and (ii) in a little more detail. Tabulating the ever-smoking rates by birth cohort rather than according to age categories and removing the inconsistently reported observations almost entirely eliminates the decline between 2001 and 2009 (see Table 4.4). We note though that the year 2010, corresponding to a substantial resampling and expansion of the survey, still exhibits a marked decline. These offer potential lessons and areas of further research to better understand the changing profile and quality of the data composition over time, but we are confident that these nuances within the data are not qualitatively important for our econometric analysis.

Table 4.4 Ever-smoking by birth cohort

Individuals aged 15 and above

Birth cohort	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Males:										
1990s					21.7	25.9	21.3	27.1	29.1	34.2
1980s	58.9	63.5	60.9	63.3	64.4	67	69.6	70.9	73.6	71.5
1970s	82.5	83.8	82.6	84.6	84	85.7	85.5	84.4	84.1	77
1960s	88.2	88.5	88.7	88.9	88.4	88.4	89.8	88.5	88.3	81.8
1950s	84.7	85.8	86.9	84.3	87.2	87	87.8	87.1	86.2	81.4
1940s	85.8	87.3	88.1	86.5	86.8	86.2	86.3	83.4	82.1	75.9
1930s	79.1	78.7	80.2	77.9	77.1	78.8	78.8	76	75.9	70.8
1920s					73.6	65.2	67.7	62.6	65.3	60.4
1920s and earlier	75.6	75.7	75	73.1						
Females:										
1990s					2.1	4.8	6.6	8.3	10.3	17.2
1980s	23.3	25.5	25.1	26.3	25.9	30.9	32.5	32.4	32.9	33.5
1970s	37.2	36.4	36.4	38.5	37.8	34.1	38.2	34.7	35	33.6
1960s	27.4	27.3	27.4	26.5	25.6	27.4	26	24.3	25.3	26.7
1950s	16.8	17.2	15.5	16.6	16.2	17	16.5	16.2	15.2	15.5
1940s	9.9	9.6	9.2	8.2	8.6	8.1	7.9	8	7.3	7.1
1930s	2.3	1.3	1.3	1.3	1	1.1	1.2	1.5	1.4	1.9

Individuals aged 15 and above

Birth cohort	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1920s					1.1	1	1.2	0.7	0.8	0.9
1920s and earlier	2.6	1.9	1.9	1.7						

Based on the representative samples for each year, dropping individuals who report their former smoking status inconsistently over time.

The very low prevalence of current smoking among females above working-age (55 years) in combination with this age group constituting more than one third of the female sample reduces the overall female smoking rate, i.e. women above 55 contribute little to the numerator (number of smokers) but a lot to the denominator. Given their large share in the sample, the female cohort effect may distort prevalence rates tabulated against geographic and socioeconomic characteristics. Furthermore, although male smoking rates are similar across cohorts, the differential mortality of smokers also lowers the smoking rate among men above working-age. Since individuals typically start smoking during their teenage years, and quit in middle age, the working age population is of particular interest in empirical analyses of smoking behaviour. In the following sections we therefore focus our view on working-age individuals, which in Russia implies men aged 15-59 and women aged 15-54. For each table, the results for the larger sample (age 15 and above) can be found in the appendix to this chapter.

4.2.3 Smoking prevalence by region

Table 4.5 shows the prevalence of smoking across 8 geographic regions of the Russian Federation.[31] While in a country as vast and regionally diverse as Russia the regional dimension is always of particular interest, one has to keep in mind that the RLMS aims to be representative of the population at the federal but not at the regional level. Therefore, the following figures need to be interpreted with caution. In 2001, smoking among men was lowest in the North Caucasian region (57.5 percent), followed by Moscow & St. Petersburg (57.8 percent) and the Central & Central Black Earth region (61.1 percent). The highest prevalence was observed in Western Siberia (69.1 percent) and the North &

[31] Note: these are not the 8 federal districts which were created by President Putin in 2000. The RLMS regions are based on the 12 economic regions which divide the subjects of the Russian Federation into groups according to economic development and potential, similar climatic, ecological and geological conditions as well as similar living conditions of the population (the survey is conducted in 8 of these regions, therefore the RLMS has 8 regions).

North Western region (66.9 percent). During the 10 year period, the share of smokers decreased in all regions. The greatest decrease was in the Western Siberian region, falling by 10.4 percentage points from 69.1 percent in 2001 to 58.7 percent in 2010. The Caucasus and Ural regions follow with 8 and 7 percentage point decreases. In the remaining regions, the share of smokers declined between 5.9 and 6.9 percentage points. In the Moscow & St. Petersburg, North & North Western, Caucasus and Siberian regions the declines have been particularly strong since 2008.

Table 4.5 Smoking prevalence by region

Working-age individuals (males aged15-59 / females aged 15-54)

Region	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Males:										
Moscow & St. Petersburg	61.1	63.9	58	60.9	57.6	61.2	57.4	56.3	61.9	54.4
Northern & North Western	66.9	72.1	65.9	64.1	68.6	70.2	67.9	67.1	66.2	61.2
Central & Central Black Earth	62.1	61.3	63.3	60.9	60.4	61.4	63.1	60	57	55.1
Volga-Vyatski & Volga Basin	65.5	64.7	63.9	64.3	63.7	62.9	64.3	64.4	60	59.4
North Caucasian	57.5	64.1	55	53.5	56.2	55.9	51.9	50.2	45.5	49.5
Ural	65.8	65.4	65.7	63.2	62.8	65.8	64.1	60.3	60.8	58.9
Western Siberian	69.1	65.5	64.4	63.8	59.7	63.5	67.3	68.7	63.7	58.7
Eastern Siberian & Far Eastern	64.5	66.5	67.1	67.9	67.1	66.8	67.7	66.3	64.2	58.6
All regions	63.7	64.8	62.6	61.9	61.3	62.7	62.0	60.4	58.5	56.4
Females:										
Moscow & St. Petersburg	38.6	37.4	36.4	36.7	36.7	36.9	34.5	31.4	30.5	32.5
Northern & North Western	30.3	32.9	27.9	32.9	31.8	35.2	35.6	33.5	32.7	30.7
Central & Central Black Earth	21.1	17	18.3	20.8	19.3	18.9	19.9	19.5	17.9	18.4
Volga-Vyatski & Volga Basin	8.7	9.4	9.7	9.6	10.7	10.2	12.2	13.4	13	11.3
North Caucasian	7.7	7.4	9.4	10.1	9.2	14.2	12.8	11.1	10.6	10.8
Ural	14.5	15.9	15.8	17.5	18.5	19.3	20.2	18.4	20.2	19.4
Western Siberian	16.1	16.6	19.5	19	20.4	21.8	21.5	24.1	20.2	20.9
Eastern Siberian & Far Eastern	19.3	21.4	22.5	25.3	24.3	26.3	26.2	27.4	27.9	26.7

Working-age individuals (males aged15-59 / females aged 15-54)

Region	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
All regions	18.7	18.8	18.9	20.2	19.9	21.3	21.2	20.6	20.1	19.7

Based on the representative samples for each year, using the survey weights provided by the RLMS

For females, regional differences in prevalence are more pronounced. In 2001, the share of smokers in Moscow & St. Petersburg (38.6 percent) was 5-6 times higher than in the regions with the lowest prevalence rates (the southern regions of the North Caucasus and the Volga-Vyatski & Volga-Basin regions). The North & North Western region ranked second after Moscow with 30.3 percent, and the remaining regions varied between 14.5 and 21.1 percent. Between 2001 and 2010 smoking prevalence increased in all regions except for Moscow & St. Petersburg and Central & Central Black Earth.[32] The increases were greatest in the Asian part of Russia with the Eastern Siberian & Far Eastern region leading with a 7.4 percentage points increase, followed by the Ural region at the border between European and Asian Russia (4.9 percentage points increase), and Western Siberia (4.8 percentage points). While increased compared to 2001, female smoking remains uncommon in the Volga and North Caucasian regions with about 11 percent of women smoking in 2010. In the North & North Western region smoking fluctuated between 27.9 and 35.6 percent throughout the period. While the rank order of regions remains the same, with female smoking being concentrated in the North Western and Eastern regions, there is evidence that it is less Moscow-centric and has begun to ‘move east’.

4.2.4 Smoking prevalence by settlement size

The regional variations in smoking will among others reflect differences in culture/religion, economic development and settlement patterns, which in turn influence the lifestyle and values present in a community. The type and size of the settlement will play a role for smoking in that the environment of a large city with its large tobacco bill boards will exert a different influence on young people (i.e. those vulnerable to starting smoking) than a small rural community of 1,000 inhabitants. In the RLMS we can distinguish between different settlements according to: (1) the official (administrative)

[32] About ¼ of the sample in Central & Central Black Earth is located in Moscow oblast.

classification into urban, urban-type and rural settlements, and (2) the population size. The category urban-type refers to so-called ‘settlements of urban type’ (Russian: посёлок городско́го ти́па), a term which was introduced in the Soviet Union and replaced the term for town. It usually designates localities which meet certain criteria in terms of urban infrastructure; however, these criteria may differ from region to region since the decision of whether a settlement is granted the status of urban-type is under control of the regions. In the Soviet era, urban-type settlements were typically the more ‘artificial’ types of towns created for industrial purposes. In the dataset, the population size in urban-type settlements ranges from a mere 2,617 to 30,000 inhabitants, while the largest rural settlement comprises 36,066 people. For example, in Moscow oblast in the Central & Central Black Earth region, we find settlements with 12,731 inhabitants which are classified as urban, whereas in the North Caucasian region a number of rural settlements exceed this number.[33] Therefore, as an alternative to the administrative distinction into urban, urban-type and rural, Table 4.6 shows the prevalence of smoking by settlement size[34], defined as (1) urban areas larger than 500,000 inhabitants, (2) cities between 50,000 and 500,000 inhabitants, and (3) small towns of up to 50,000 inhabitants and rural settlements.[35] Given that the two federal cities Moscow and St. Petersburg are quite distinct from the other big urban areas in the country, we also repeat the results for these two cities from the previous table.

Table 4.6 Smoking prevalence by settlement size

Working-age individuals (males aged15-59 / females aged 15-54)

Settlement type	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Males:										
Moscow & St. Petersburg	*61.1*	*63.9*	*58*	*60.9*	*57.6*	*61.2*	*57.4*	*56.3*	*61.9*	*54.4*

[33] Given the different levels of economic development, a 12,731 community in Moscow oblast may of course have a more urban environment than the larger community in the North Caucasus region.
[34] Smoking prevalence according to the administrative divisions is shown in table A-6 in the appendix.
[35] This classification is based on the work of Russian economic geographer Natalia Zubarevich, who developed an economic classification of the Russian regions using a centre-periphery model, which explains socioeconomic variations by geographic factors, that is, according to their position in a hierarchy of settlements from the most modernised large cities to the rural periphery. In her “4 Russia” typology, Russia 1 represents the large, post-industrial cities with populations above 500,000 inhabitants , Russia 2 are smaller industrial towns and cities varying between 50,000 and 500,000 inhabitants, Russia 3 are the rural and semi-urban populations, including the towns of urban-type, and Russia 4 is what she calls “under-developed Russia” – the pre-industrial republics of the northern Caucasus and, to a lesser extent, southern Siberia (the Tyva and Altai areas) (Zubarevich, 2013). Our classification is based on the first 3 Russia, with the fourth category being captured by our regional indicators.

City>500k	61.7	61.5	59.7	61.4	59.8	62.5	60.6	59.6	57	55.1
City 50-500k	66.9	65.9	64.9	63.5	63.1	63.5	64.1	62.4	62.8	60.5
Towns <50k & rural	62.7	66.9	63.2	61	61.2	62.2	61.7	59.4	57	54.7
All types	63.7	64.8	62.6	61.9	61.3	62.7	62.0	60.4	58.5	56.4
Females:										
Moscow & St. Petersburg	*38.6*	*37.4*	*36.4*	*36.7*	*36.7*	*36.9*	*34.5*	*31.4*	*30.5*	*32.5*
City>500k	24.9	26	26	28.6	27.4	27.8	27	26.1	24.3	25.6
City 50-500k	20.2	19	19.4	20.5	19.8	23.6	23.8	23.2	23.4	21.5
Towns <50k & rural	11.1	11.4	11.6	12.1	14.8	12.1	13.5	12.7	13.4	13.6
All types	18.7	18.8	18.9	20.2	19.9	21.3	21.2	20.6	20.1	19.7

Based on the representative samples for each year, using the survey weights provided by the RLMS
City>500k: City with more than 500,000 inhabitants
City 50-500k: Cities with 50,000 to 500,000 inhabitants
Towns <50k & rural: Towns with less than 50,000 inhabitants and rural settlements

Similar to the regional distribution, prevalence rates by settlement size show more variability for females than for males. Among the latter, the share of smokers was highest in medium-sized cities of 50,000-500,000 inhabitants (66.9 percent in 2001), followed by rural areas (62.7 percent). Over the 10-year period the strongest decrease in prevalence occurred in rural areas, where smoking was at 54.7 percent in 2010 (an 8 percentage point decrease compared to 2001) and thus lower than in large cities.

While for males the prevalence rates for Moscow and St. Petersburg are close to prevalence rates in other large cities, the two federal cities show a very distinct profile for female smokers. In 2001, 38.6 percent of working-age women in Moscow smoked, compared to 24.9 and 20.2 percent respectively in other large and medium-sized cities, and only 11.1 percent in rural areas. Through the combined effect of decreasing prevalence in Moscow and St. Petersburg and increases in prevalence in the other settlement types, most notably rural areas and medium-sized cities, smoking rates converged slightly across rounds.

4.2.5 Smoking prevalence by education

In addition to demographic and environmental influences such as age and the living environment, smoking behaviour is also related to an individual's educational background. According to the Lopez model of the evolution of smoking presented in the first chapter, we would expect smoking to be more widespread among the more educated and wealthier individuals in the beginning stages when overall prevalence is still relatively low, whereas in the later stages we would expect to see the typical socioeconomic gradient with smoking being concentrated among the less educated and poorer strata of the society. As can be seen from Table 4.7 below, smoking among both men and women shows the gradient typical of the latter stages in Russia. The table ranks educational categories from the highest to lowest educational attainment. Thus, the categories 'University' and 'Tec & Med' can be considered as the categories with the highest level of formal education, followed by the two categories with some type of vocational training - either after completing primary ('Primary+Voc') or secondary education ('Secondary + Voc'). The two categories with the lowest educational attainment are 'Secondary' (equating to 11 years of schooling) and 'Primary' (8 years).

In 2001, prevalence was lowest among men with university education (49.8 percent), followed by those with only primary education (52.9 percent). Men in the Tec & Med and high school categories formed the middle group with 62.9 and 65.2 percent respectively. The highest share of smokers was among men with completed secondary education plus vocational training (78 percent) and those with primary education plus vocational training (70.9 percent). Prevalence in all groups except for the least educated declined across the 10-year period, with the strongest decreases among those with completed secondary (11.8 percentage points) and university education (9.1 percentage points).

Table 4.7 Smoking prevalence by education

Working-age individuals (males aged 15-59 / females aged 15-54)

Education	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Males:										
University	49.8	50.7	45	48.6	50	49.2	49.4	45.3	43.2	40.7
Tec & Med	62.9	66.4	64.9	66.7	63.2	63.9	65.6	63.5	61.1	57.7
Secondary+Voc	78	76.6	77.1	74.8	74.9	74.1	76	74.5	74.2	73.5
Primary+Voc	76.3	78	74.1	78.5	71.3	78.4	78.1	74.1	70.5	72.2
Secondary	65.2	66.2	63.4	58.1	60.8	60.6	56.4	56.2	52.3	53.4
Primary	52.9	55.7	54.6	54.7	51.6	57.9	58.7	59	56.9	53.5
Total	63.7	64.8	62.6	61.9	61.3	62.7	62.0	60.4	58.5	56.4
Females:										
University	15.3	13.9	15.4	15.9	14.7	17.7	15.8	13.3	12.2	13.2
Tec & Med	16.5	18	17.1	19.8	19.1	18.6	20.1	20.9	19.2	20.4

Secondary +Voc	24.4	27.8	25.5	28.1	26.8	31.5	31.9	27.8	29.4	26.1
Primary +Voc	25.5	26.8	22.9	23.1	28	24.3	28.8	33.2	33.8	29.5
Secondary	18.2	17.4	17.3	18.4	18.2	19.9	18.6	19	19.1	20
Primary	18.9	18	22	21.9	23.1	24.9	24.3	25.5	24.8	24.1
Total	18.7	18.8	18.9	20.2	19.9	21.3	21.2	20.6	20.1	19.7

Based on the representative samples for each year, using the survey weights provided by the RLMS
Education categories from highest to lowest educational attainment: University, Tec & Med (technical, medical, pedagogical and art colleges), Secondary +Voc (middle-level professional education for those with completed secondary education), Primary + voc (middle-level professional education for those with completed primary education), Secondary (completed secondary education corresponding to 11 years of schooling), Primary (completed primary education corresponding to 9 years of schooling)

Among women, in 2001 the share of smokers was lowest among those with completed secondary (18.2 percent) and primary education (18.9 percent)[36], followed by those with a university degree (15.3 percent) and 'Tec & Med' (16.5 percent). Prevalence was considerably higher in the two categories with vocational training, which are the only groups where the share of smokers exceeds 20 percent. Between 2001 and 2010 smoking decreased among those with university education, while it increased in the remaining categories (most notably among those with primary education only) resulting in a steepening of the educational gradient. The steeper declines among the highly educated among both genders are worth highlighting at this point as they might indicate smoking becoming a less socially acceptable behaviour in this group and thus signal their greater receptiveness to the currently implemented policy changes.

While the RLMS data show the typical educational gradient in smoking for both genders, data collected by the Global Adult Tobacco Survey (GATS) in 2009 seem to contradict this in the case of females as according to this survey Russian women with higher education have the highest prevalence. Table 4.8 below shows the data on current smoking as elicited by the GATS questionnaires. Since the GATS asks both about daily and less than daily smoking, we present the prevalence data separately for the two categories of smoking. While the GATS report groups the educational categories into 'primary', 'secondary' and 'high', we also present the prevalence for each of the original categories so as to better compare with the RLMS data.

[36] In 2001 the low prevalence among individuals with primary education interrupts the gradient for both genders. However, this will partly be an age effect reflecting (1) very young individuals who have not completed their education yet, and (2) older respondents who tend to have spent fewer years in formal education compared to younger respondents.

Table 4.8 Smoking prevalence by education according to GATS (2009) data

Individuals aged 15 and above

Education disaggregated	Daily smokers (%)	Less than daily smokers (%)	Education aggregated	Daily smokers (%)	Less than daily smokers (%)
Males:					
No education	22.2	23.5	Primary	43.0	7.4
Primary education	45.6	5.4			
Incomplete highschool	43.2	5.3	Secondary	59.4	4.8
Highschool	59.3	5.4			
Vocational or trade school	63.0	4.2			
Incomplete college	53.0	6.9	High	48.1	5.9
College	46.8	5.9			
Advanced degree	49.2	0.0			
Observations	3,418	327			
Females:					
No education	0.0	0.0	Primary	2.2	0.5
Primary education	2.3	0.5			
Incomplete highschool	7.5	3.2	Secondary	14.7	5.0
Highschool	14.1	5.3			
Vocational or trade school	16.7	5.2			
Incomplete college	28.1	8.5	High	20.1	6.6
College	18.5	6.0			
Advanced degree	5.7	19.5			
Observations	841	280			

Based on the 2009 GATS data, downloaded from
http://nccd.cdc.gov/gtssdata/Ancillary/Documentation.aspx?SUID=4&DOCT=1

The full sample contains 11,406 observations (5,189 females/ 6,217 males).

When we take a closer look at Tables 4.7 and 4.8, we can see that the discrepancy between the RLMS and the GATS data is likely to be driven by two things: (1) the different classification of higher education, and (2) differences in the wording of the smoking question.

(1) Classification of higher education: The GATS uses a different educational coding which appears to be a standard international classification system rather one that takes into account the specificities of the Russian educational system, as done in the RLMS. For example, Russia has a range of vocational schools ('Tehnikums') that provide so

called ‘non-university higher education’, which is not comparable to a university degree. In the RLMS these vocational schools form two separate categories, whereas they are likely to be grouped under higher education in the GATS data, thereby ‘inflating’ the share of respondents with higher education compared to the RLMS. In the RLMS, 20 percent of female respondents in the representative sample have higher education in 2009, compared to 32 percent in the GATS data. That is, respondents who would fall into one of the medium-level educational categories in the RLMS (which also have the highest smoking prevalence rates) would likely be classified as having ‘higher education’ in the GATS data. Furthermore, the category ‘incomplete college’ has also been grouped under ‘higher education’ in the report. While representing only 7 percent of respondents, this group has the highest prevalence of smoking with 36.6 percent.

(2) Smoking question: The GATS question on tobacco consumption asks individuals whether they presently smoke tobacco (i) every day, (ii) less than every day, or (iii) not at all. By contrast, the RLMS asks “Do you currently smoke”, which is more vague and I argue less likely to pick up less than daily smokers very well, given that these might not classify themselves as ‘smokers’. In the GATS report 26.6 of women with ‘higher education’ smoke. A look at the raw data reveals that 20 percent report to smoke every day, and 6.6 percent report to smoke less than every day.

The same discrepancy, if not as stark, applies to males: According to the GATS data 50.4 percent of men with higher education smoke, whereas the RLMS representative sample for 2009 shows 43.2 percent men to be smoking. A possible reason why the discrepancy is larger for women is that a greater share of female respondents in the GATS higher education category reports to smoke on a less than daily basis compared to men.

In sum, the discrepancy is likely to result both from the difference in educational classification and wording of the smoking question in the two surveys.

4.2.6 Bivariate associations net of compositional changes in the sample

The bivariate associations of smoking status with socioeconomic characteristics presented in the previous paragraphs do not only depend on the development of smoking rates, but also on changes in the composition of the sample across the 10 survey rounds. For example, if the share of people with university education in the sample increases over time, smoking prevalence in this group might seem to be decreasing even if the smoking rate remained stable. To get a sense of the ‘true’ changes, Table 4.9 below examines the changes in smoking prevalence net of changes in the composition of the age 15+ sample, i.e. holding constant the population share of subgroups such as gender, region, education or settlement size. Given the impact of differential mortality of smokers particularly among males, Table 4.10 repeats the same calculation for the working-age sample (men aged 15-59, women aged 15-54). The comparison between the 2001 and 2010 samples nicely illustrates the effects of the 2010 replenishment, which increased the sample size by nearly 100 percent compared to 2009 (from 5,630 to 10,000 individuals). Overall, the sample became younger (the share of respondents below 35 increased from 36.79 in 2001 to 38.83 in 2010 in the 15+ sample) and slightly more ‘male’. The share of the Moscow and St. Petersburg region declined and the sample became more rural. Most notably, the 2010 sample has a 6 percent higher share of respondents with university education.

In the sample with individuals aged 15 and above (Table 4.9) we can see that between 2001 and 2010 the smoking rate among men declined by 6.54 percentage points, from 60.24 in 2001 to 53.7 in 2010. However, the share of males in the smoking population (column F) only declined by 3.17 percentage points, which together with a slight increase in the overall share of men in the sample means that prevalence only declined by 0.3 percentage points net of compositional changes in the sample (column J). This scenario looks quite different when we look at the working-age sample only, where male prevalence declined by 9.9 percentage points. The reason for this difference between the 15+ and the working-age samples lies in the stronger increase in the share of men in the working age sample (1.12 percentage points compared to only 0.4 percentage points in the 15+ sample), which means that the prevalence decline is underestimated for working-age men. In 2010, the ‘raw’ decrease in prevalence is underestimated, with the effect being stronger in the 15+ sample.

Table 4.9 Changing composition of smokers 2001-2010, individuals aged 15 and above

	A	B	C	D	E	F	G	H	I	J
	Share of current smokers in 2001	Share of current smokers in 2010	Change 2001-2010 (B-A)	% of subgroup in smoking population 2001	% of subgroup in smoking population 2010	Change 2001-2010 (E-D)	% of subgroup in 2001	% of subgroup in 2010	Prevalence in 2010 with constant 2001 share	% change in smoking with constant 2001 pop share
Overall	34.95	32.49	-2.46							
Men	60.24	53.7	-6.54	78.47	75.3	-3.17	45.55	45.59	60.2	-0.3
Women	13.82	14.75	0.93	21.53	24.7	3.17	54.45	54.41	18.2	4.8
15-34 years	39.38	36.42	-2.96	41.39	49.95	8.56	36.79	38.83	46.0	8.1
Moscow & SPB	41.99	36.35	-5.64	14.29	11.38	-2.91	11.87	10.16	34.6	-6.8
City>500k	33.54	32.93	-0.61	20.51	21.92	1.41	21.3	21.65	37.2	4.8
Rural	31.32	29.71	-1.61	32.3	37.62	5.32	36.02	41.14	41.0	11.0
University	27.13	22.21	-4.92	12.31	14.96	2.65	15.97	22.02	34.1	8.4

Based on the representative samples for 2001and 2010, using the survey weights provided by the RLMS

Table 4.10 Changing composition of smokers 2001-2010, working-age sample (males aged15-59 / females aged 15-54)

	A	B	C	D	E	F	G	H	I	J
	Share of current smokers in 2001	Share of current smokers in 2010	Change 2001-2010 (B-A)	% of subgroup in smoking population 2001	% of subgroup in smoking population 2010	Change 2001-2010 (E-D)	% of subgroup in 2001	% of subgroup in 2010	Prevalence in 2010 with constant 2001 share	% change in smoking with constant 2001 pop share
Overall	41.5	38.68	-2.82							
Men	63.66	56.42	-7.24	77.88	75.33	-2.55	50.8	51.68	53.7	-9.9
Women	18.65	19.73	1.08	22.12	24.67	2.55	49.2	48.32	20.7	2.0
15-34 years	39.38	36.42	-2.96	45.16	54.83	9.67	47.66	51.53	36.6	-2.7
Moscow & SPB	49.4	43.32	-6.08	14.18	11.26	-2.92	11.89	10.04	35.2	-14.2
City>500k	39.86	39.23	-0.63	20.86	22.26	1.4	21.68	21.98	37.7	-2.2
Rural	37.96	35.41	-2.55	31.65	37.01	5.36	34.65	40.41	44.0	6.1
University	31.43	25.04	-6.39	12.61	14.92	2.31	16.61	23.08	34.2	2.8

Based on the representative samples for 2001and 2010, using the survey weights provided by the RLMS

For women the opposite holds true: since the share of women in both the 15+ and working-age samples slightly decreased, the compositional changes in the sample have stronger impacts when looking at prevalence among respondents below age 35. Given that the sample got younger, as seen by the share of those under 35 increasing from 36.79 to 38.83 percent in 2010 in the 15+ sample, it seems as if prevalence among this group increased by 8 percentage points when we keep the 2001 population share constant (column I), even though the 'raw' rate declined by 2.96 percentage points. However, when we look at the working-age sample, the declines are confirmed and only slightly below the raw measure. Similarly, although the raw rates show a decline in rural areas, smoking increased quite notably by 11 percentage points in the 15+ and 6.1 percentage points in the working-age sample. Also with regard to university education the seeming declines seem to be driven by compositional changes in the sample, with prevalence rates in effect increasing quite substantially. Moscow and St. Petersburg provide an interesting case. Here the declines in smoking in the working-age sample are more than twice as high when we take into account the compositional changes (14.2 versus 6.08 percentage points).

4.2.7 Summary of descriptive findings

In sum, from the bivariate descriptive analysis we can conclude that: (1) smoking patterns differ most strongly by gender, with prevalence among men being nearly four times higher than among women; (2) for men the defining developments from 2007 onwards are decreases in smoking among the working-age population which are even higher net of the compositional changes of the sample; (3) while male smoking rates are broadly similar except for education, there are pronounced differences among females, with the strongest gradients defined according to age and region; (4) the trends in smoking are more diverse among women, with the gradients in prevalence rates according to age, region, and settlement size becoming flatter, and the educational gradient becoming steeper.

4.3 SOCIOECONOMIC PROFILES OF SMOKERS

The previous section examined the bivariate associations of current smoking according to criteria such as age, education, region, and settlement type. In this section we will draw a more nuanced picture by examining how smokers differ in socioeconomic characteristics from their non-smoking counterparts. The socioeconomic profile in Table 4.11 below, based on two-group mean comparison tests of socioeconomic characteristics by current smoking status, shows that male smokers are on average 4 years older than non-smokers. They are less likely to have a university degree (12 percent compared to 22 percent for non-smokers), and are more likely to have completed vocational training. Smokers are more likely to work in a non-manual occupation (38 percent versus 21 percent for non-smokers), and are less likely to be in a managerial position (14 versus 21 percent for non-smokers). As concerns family status, male smokers are less likely to be single (26 versus 41 percent) and more likely to be married or divorced. Their real per capita income is 580 roubles (13 percent) lower than the average income of non-smokers. They live in a medium-sized rather than a large city (>500,000), and accordingly are less likely to live in Moscow & St. Petersburg or the Caucasus, and more likely to live in the Urals, and the two Siberian regions.

The profile of female smokers is relatively similar to that of men with regard to socioeconomic characteristics such as education, occupation and marital status, but differs with regard to settlement and geographic criteria. One commonality is the educational gradient, as seen in the lower likelihood of female smokers to have a university degree (16 percent compared to 23 percent for non-smokers) and higher likelihood to have primary education only. Correspondingly, female smokers are less likely to work in a managerial or professional occupation (34 versus 23 percent). They are also less likely to be single and are more likely to be married or divorced. In contrast to men, women who smoke are slightly younger than non-smoking women. In line with the regional diversity we have seen in the tabulations of the second section, smokers are more likely to reside in Moscow & St. Petersburg, as well as in the North & North Western and the East Siberian and Far Eastern regions, and less likely to live in the North Caucasian, Volga and Ural regions.

Table 4.11 Socioeconomic profile of male smokers

Working-age individuals (age 15-59)	**2001**		**2004**		**2007**		**2010**		**All years**	
Males	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**
Age:										
Age in years	32.76	36.63	33.26	37.04	33.8	38.01	34.96	37.86	33.79	37.49
	-3.88***		-3.79***		-4.21***		-2.90***		-3.69***	
Age 15-17	0.19	0.04	0.18	0.04	0.14	0.02	0.11	0.02	0.15	0.03
	0.16***		0.15***		0.12***		0.09***		0.12***	
Age 18-24	0.19	0.15	0.19	0.16	0.22	0.17	0.2	0.15	0.2	0.16
	0.03*		0.03		0.05***		0.04***		0.04***	
Age 25-34	0.16	0.23	0.18	0.23	0.19	0.23	0.21	0.26	0.19	0.24
	-0.07***		-0.05**		-0.04*		-0.05***		-0.05***	
Age 35-44	0.2	0.29	0.16	0.26	0.15	0.22	0.18	0.22	0.17	0.24
	-0.08***		-0.10***		-0.07***		-0.04**		-0.07***	
Age 45-59	0.26	0.29	0.29	0.31	0.3	0.36	0.3	0.35	0.29	0.34
	-0.04		-0.03		-0.06***		-0.05***		-0.04***	
Education:										
University education	0.21	0.12	0.2	0.11	0.21	0.12	0.25	0.13	0.22	0.12
	0.09***		0.08***		0.08***		0.12***		0.10***	

Working-age individuals (age 15-59)	**2001**		**2004**		**2007**		**2010**		**All years**	
Males	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**
Technical, medical, pedagocial, art college	0.14	0.13	0.12	0.15	0.13	0.15	0.16	0.17	0.14	0.15
	0.01		-0.03*		-0.02		-0.01		-0.01*	
Highschool + Vocational	0.12	0.23	0.12	0.22	0.11	0.21	0.12	0.24	0.12	0.23
	-0.12***		-0.10***		-0.10***		-0.12***		-0.11***	
Primary + Vocational	0.05	0.1	0.05	0.1	0.05	0.09	0.04	0.07	0.05	0.09
	-0.04***		-0.06***		-0.05***		-0.04***		-0.04***	
Highschool (11 years)	0.25	0.27	0.29	0.25	0.31	0.25	0.27	0.24	0.28	0.25
	-0.02		0.04*		0.06***		0.03*		0.02***	
Primary (8 years)	0.22	0.15	0.22	0.16	0.18	0.16	0.16	0.15	0.19	0.15
	0.07***		0.05***		0.02		0.01		0.03***	
Occupation:										
Managerial & prof-essional occupation	0.2	0.14	0.19	0.13	0.22	0.15	0.25	0.14	0.21	0.14
	0.06***		0.05***		0.07***		0.11***		0.07***	
Manual occupation	0.03	0.04	0.03	0.03	0.04	0.05	0.05	0.05	0.04	0.04
	-0.01		0		0		0		0	
Non-manual occupation	0.29	0.41	0.28	0.41	0.26	0.42	0.28	0.44	0.27	0.42
	-0.12***		-0.13***		-0.16***		-0.16***		-0.15***	
Unskilled occupation	0.05	0.09	0.05	0.09	0.05	0.1	0.06	0.1	0.06	0.1
	-0.04***		-0.04***		-0.05***		-0.04***		-0.04***	

Working-age individuals (age 15-59)	**2001**		**2004**		**2007**		**2010**		**All years**	
Males	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**
No occupation	0.44	0.32	0.45	0.33	0.42	0.28	0.36	0.27	0.42	0.3
	0.12***		0.12***		0.14***		0.09***		0.11***	
Marital status:										
Single	0.42	0.22	0.43	0.24	0.43	0.25	0.41	0.3	0.43	0.26
	0.21***		0.19***		0.18***		0.11***		0.17***	
Married	0.54	0.71	0.53	0.68	0.53	0.69	0.54	0.56	0.53	0.65
	-0.16***		-0.15***		-0.15***		-0.02		-0.12***	
Divorced	0.02	0.07	0.04	0.07	0.03	0.06	0.05	0.13	0.04	0.08
	-0.04***		-0.03**		-0.02**		-0.08***		-0.04***	
Widow	0.01	0.01	0	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	0		-0.01*		0		0		-0.00***	
Household characteristics:										
Household has children	0.64	0.56	0.59	0.52	0.53	0.48	0.53	0.49	0.56	0.51
	0.08***		0.06**		0.05**		0.04*		0.05***	
Household income real	9474.36	8182.65	13750.31	10752.46	15478.59	14099.42	19003.46	17002.18	15755.55	13311.7
	1291.71**		2997.85***		1379.17**		2001.28**		2443.85***	
Per capita income real	2633.59	2424.42	4489.42	3077.59	4440.78	4188.71	5442.59	5035.72	4487.44	3907.07
	209.18		1411.83*		252.06		406.87		580.37***	
Household alcohol expenditure real	176.31	192.46	168.14	215.09	173.83	208.89	173.9	215.03	163.67	203.63

Working-age individuals (age 15-59)	2001		2004		2007		2010		All years	
Males	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**
	-16.15		-46.95		-35.06*		-41.13**		-39.96***	
Settlement type:										
Urban	0.65	0.67	0.65	0.66	0.65	0.65	0.64	0.65	0.65	0.65
	-0.02		-0.01		0		-0.01		0	
Urban-type	0.08	0.05	0.09	0.05	0.07	0.05	0.06	0.06	0.08	0.05
	0.03**		0.04***		0.03**		0		0.03***	
Rural	0.27	0.28	0.26	0.29	0.28	0.3	0.3	0.29	0.27	0.3
	-0.01		-0.03		-0.02		0.01		-0.02***	
City>500,000 inhabitants	0.22	0.21	0.19	0.19	0.2	0.2	0.21	0.2	0.21	0.2
	0.02		0		0		0.01		0.01*	
City 50,000-500,000 inhabitants	0.27	0.32	0.3	0.32	0.26	0.29	0.23	0.28	0.26	0.29
	-0.04*		-0.02		-0.02		-0.04***		-0.03***	
Towns <50,000 inhabitants & rural	0.38	0.37	0.38	0.37	0.41	0.41	0.46	0.44	0.41	0.4
	0.01		0.01		0		0.03		0.01	
Region:										
Moscow & St. Petersburg	0.12	0.1	0.13	0.12	0.13	0.1	0.1	0.09	0.12	0.11
	0.01		0.01		0.02*		0.01		0.01**	
North & North Western	0.06	0.06	0.06	0.06	0.05	0.07	0.06	0.07	0.05	0.07

Working-age individuals (age 15-59)	**2001**		**2004**		**2007**		**2010**		**All years**	
Males	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**
	-0.01		-0.01		-0.02*		-0.01		-0.01***	
Central & Central Black Earth	0.17	0.16	0.16	0.15	0.17	0.18	0.2	0.19	0.18	0.17
	0.01		0.01		-0.01		0.01		0.01	
Volga-Vyatski & Volga Basin	0.16	0.17	0.15	0.17	0.16	0.17	0.15	0.16	0.15	0.17
	-0.01		-0.02		-0.02		-0.02		-0.01**	
North Caucasus	0.17	0.13	0.17	0.12	0.21	0.14	0.19	0.14	0.19	0.14
	0.04**		0.05***		0.07***		0.05***		0.05***	
Ural	0.14	0.15	0.15	0.15	0.13	0.14	0.14	0.15	0.14	0.15
	-0.01		-0.01		-0.01		-0.02		-0.01**	
West. Siberian	0.08	0.11	0.1	0.11	0.08	0.1	0.09	0.09	0.09	0.1
	-0.02		-0.01		-0.02		-0.01		-0.01***	
East. Siberian	0.1	0.11	0.08	0.11	0.08	0.1	0.09	0.1	0.08	0.1
	0		-0.03*		-0.02*		-0.01		-0.02***	
N	2,574		2,614		3,053		4,839		29,358	

Based on the representative samples for 2001, 2004, 2007 and 2010, with "all years" based on the pooled representative sample for 2001-2010, using the survey weights provided by the RLMS. The results are based on two-group mean comparison tests (t-test by current smoking status). The upper row for each variable gives the mean for current non-smokers and current smokers, and the lower row provides the difference in means with the stars indicating the statistical significance of difference in means according to the following confidence levels: * p<0.05, ** p<0.01, *** p<0.001

Table 4.12 Socioeconomic profile of female smokers

Working-age individuals (15-54)	**2001**		**2004**		**2007**		**2010**		**All years**	
Females	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**
Age:										
Age in years	34.85	33.59	35.15	33.9	35.17	34.42	35.23	34.53	35.1	34.24
	1.26*		1.25*		0.75		0.7		0.86***	
Age 15-17	0.09	0.04	0.09	0.03	0.08	0.01	0.06	0.01	0.08	0.02
	0.06***		0.07***		0.07***		0.05***		0.06***	
Age 18-24	0.18	0.2	0.18	0.21	0.19	0.2	0.19	0.19	0.18	0.2
	-0.01		-0.03		-0.01		-0.01		-0.01*	
Age 25-34	0.2	0.33	0.2	0.31	0.2	0.29	0.24	0.3	0.21	0.31
	-0.13***		-0.10***		-0.10***		-0.06***		-0.10***	
Age 35-44	0.25	0.23	0.23	0.26	0.22	0.3	0.23	0.3	0.23	0.28
	0.02		-0.03		-0.08***		-0.07***		-0.05***	
Age 45-59	0.28	0.21	0.3	0.2	0.31	0.2	0.28	0.2	0.3	0.2
	0.07***		0.10***		0.11***		0.09***		0.10***	
Education:										
University education	0.18	0.15	0.2	0.15	0.23	0.16	0.29	0.18	0.23	0.16
	0.04*		0.05**		0.07***		0.11***		0.07***	
Technical, medical, pedagocial, art college	0.26	0.22	0.26	0.25	0.25	0.24	0.24	0.25	0.25	0.24

Working-age individuals (15-54)	**2001**		**2004**		**2007**		**2010**		**All years**	
Females	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**
	0.04		0.01		0.02		0		0.02**	
Highschool + Vocational	0.13	0.18	0.12	0.18	0.11	0.19	0.11	0.15	0.12	0.18
	-0.05**		-0.06***		-0.08***		-0.05***		-0.06***	
Primary + Vocational	0.04	0.07	0.05	0.06	0.04	0.07	0.03	0.06	0.04	0.06
	-0.02*		-0.01		-0.02*		-0.03***		-0.02***	
Highschool (11 years)	0.26	0.25	0.24	0.22	0.25	0.21	0.22	0.22	0.24	0.22
	0.01		0.02		0.04		0		0.02**	
Primary (8 years)	0.12	0.13	0.12	0.13	0.11	0.13	0.1	0.13	0.11	0.14
	-0.01		-0.01		-0.02		-0.03**		-0.02***	
Occupation:										
Managerial & prof-essional occupation	0.32	0.24	0.33	0.24	0.36	0.28	0.39	0.27	0.34	0.25
	0.08***		0.09***		0.08***		0.12***		0.09***	
Manual occupation	0.15	0.22	0.15	0.24	0.17	0.25	0.19	0.26	0.17	0.24
	-0.06***		-0.09***		-0.08***		-0.07***		-0.07***	
Non-manual occupation	0.07	0.08	0.08	0.1	0.06	0.08	0.05	0.08	0.07	0.09
	-0.01		-0.03*		-0.02		-0.03***		-0.02***	
Unskilled occupation	0.07	0.08	0.07	0.08	0.07	0.09	0.06	0.08	0.06	0.08
	-0.01		-0.01		-0.02		-0.02**		-0.02***	
No occupation	0.39	0.38	0.37	0.35	0.35	0.3	0.32	0.31	0.35	0.33

Working-age individuals (15-54)	**2001**		**2004**		**2007**		**2010**		**All years**	
Females	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**
	0		0.03		0.04*		0.01		0.02***	
Marital status:										
Single	0.26	0.19	0.28	0.23	0.3	0.22	0.31	0.31	0.29	0.24
	0.08***		0.05*		0.08***		0		0.05***	
Married	0.61	0.57	0.58	0.56	0.56	0.6	0.51	0.39	0.56	0.53
	0.03		0.02		-0.03		0.12***		0.03***	
Divorced	0.08	0.19	0.09	0.14	0.09	0.14	0.13	0.23	0.1	0.17
	-0.10***		-0.06***		-0.04**		-0.10***		-0.07***	
Widow	0.04	0.05	0.05	0.06	0.05	0.05	0.05	0.06	0.05	0.05
	-0.01		-0.01		0		-0.01		-0.01*	
Household characteristics:										
Household has children	0.62	0.59	0.58	0.59	0.56	0.53	0.55	0.54	0.57	0.56
	0.03		-0.01		0.03		0		0.01	
Household income real	8251.08	7871.29	11032.46	11360.64	13966.61	14714.03	16964.07	16826.07	13468.81	13465.6
	379.79		-328.18		-747.43		138		3.2	
Per capita income real	2381.36	2517.88	3167.59	3364.26	4097.97	4441.29	4877.18	5461.13	3883.28	4153.56
	-136.52		-196.67		-343.32*		-583.95		-270.28**	
Household alcohol expenditure real	135.78	241.73	128.14	296.33	165.49	262.96	161.63	280.59	140.25	256.93
	-105.95***		-168.19***		-97.47***		-118.96***		-116.68***	

Working-age individuals (15-54)	2001		2004		2007		2010		All years	
Females	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**
Settlement type:										
Urban	0.67	0.81	0.67	0.8	0.64	0.8	0.65	0.77	0.65	0.79
	-0.14***		-0.14***		-0.16***		-0.12***		-0.14***	
Urban-type	0.07	0.04	0.07	0.04	0.06	0.03	0.07	0.04	0.07	0.03
	0.03**		0.03**		0.03**		0.02**		0.03***	
Rural	0.26	0.16	0.27	0.16	0.3	0.17	0.28	0.18	0.28	0.17
	0.10***		0.11***		0.12***		0.10***		0.11***	
City>500,000 inhabitants	0.22	0.19	0.18	0.2	0.21	0.24	0.2	0.25	0.2	0.22
	0.03		-0.03		-0.03		-0.04**		-0.02**	
City 50,000-500,000 inhabitants	0.31	0.34	0.33	0.33	0.27	0.32	0.26	0.29	0.29	0.32
	-0.03		0		-0.04*		-0.03*		-0.03***	
Towns <50,000 inhabitants & rural	0.38	0.21	0.38	0.21	0.42	0.24	0.45	0.29	0.41	0.24
	0.17***		0.17***		0.17***		0.16***		0.17***	
Region:										
Moscow & St. Petersburg	0.09	0.26	0.11	0.25	0.1	0.2	0.08	0.17	0.1	0.22
	-0.17***		-0.14***		-0.10***		-0.09***		-0.12***	
North & North Western	0.06	0.12	0.05	0.1	0.06	0.12	0.07	0.12	0.06	0.11

Working-age individuals (15-54)	2001		2004		2007		2010		All years	
Females	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**	**Smoker**
	-0.06***		-0.05***		-0.06***		-0.05***		-0.06***	
Central & Central Black Earth	0.17	0.2	0.16	0.16	0.17	0.16	0.19	0.17	0.17	0.16
	-0.03		-0.01		0.01		0.01		0.01	
Volga-Vyatski & Volga Basin	0.18	0.07	0.18	0.08	0.18	0.09	0.16	0.08	0.17	0.08
	0.10***		0.10***		0.08***		0.08***		0.09***	
North Caucasus	0.15	0.05	0.15	0.07	0.18	0.1	0.17	0.09	0.17	0.08
	0.10***		0.09***		0.08***		0.09***		0.09***	
Ural	0.15	0.11	0.16	0.13	0.15	0.14	0.15	0.15	0.15	0.13
	0.04*		0.03		0.01		0.01		0.02***	
West. Siberian	0.09	0.08	0.11	0.1	0.09	0.09	0.09	0.09	0.1	0.09
	0.02		0.01		0		0		0	
East. Siberian	0.1	0.11	0.09	0.12	0.08	0.11	0.08	0.13	0.09	0.12
	-0.01		-0.03*		-0.03*		-0.04***		-0.03***	
N	2,943		2,818		3,232		5,150		31,842	

Based on the representative samples for 2001, 2004, 2007 and 2010, with "all years" based on the pooled representative sample for 2001-2010, using the survey weights provided by the RLMS. The results are based on two-group mean comparison tests (t-test by current smoking status). The upper row for each variable gives the mean for current non-smokers and current smokers, and the lower row provides the difference in means with the stars indicating the statistical significance of difference in means according to the following confidence levels: * p<0.05, ** p<0.01, *** p<0.001

4.4 SMOKING INTENSITY

In the previous sections we have seen that while prevalence rates still differ strongly by gender, male and female smokers share similar characteristics with regard to socioeconomic criteria. However, since the health risks of smoking increase with higher consumption (a so-called 'dose-response' relationship) we also need to consider differences in consumption intensity in order to grasp the potential health consequences. Table 4.13 below compares the intensity of daily cigarette consumption between men and women across the same demographic and socioeconomic criteria as the socioeconomic profiles in the previous section (based on two-group mean comparison tests by gender). As we have seen in Table 4.1, men consume on average 6 cigarettes more than women per day (17 versus 11 cigarettes).

While in the youngest age group (15-17 years), consumption is relatively low among both males and females, from age 18 onwards differences start building up, peaking in the 45-54 age group with an average difference of 7.26 cigarettes per day. Average daily consumption has increased by 1-2 cigarettes between 2001 and 2010 across all age groups among both genders but the increases among females have been slightly more pronounced, resulting in a slight decrease in the gap between male and female smoking intensity. Overall, the biggest difference in consumption intensity is defined by gender and the differences across socioeconomic characteristics fall in the range of 2-3 cigarettes per day. While we observed an educational gradient in smoking status for both genders, among smokers consumption levels are broadly similar across educational groups. Among men, those working in non-manual occupations have the highest daily consumption, whereas among women those in the unskilled category smoke the most. In both genders, smokers who are divorced or widowed smoke more than single or married smokers. With regard to regional patterns, women in Moscow and St. Petersburg had the highest consumption in 2001, but by 2010 the Western Siberian and Central & Central Black Earth, and North & North-western regions had taken the lead. In 2010, male smokers in the two Siberian regions were the top consumers, a position previously occupied by the Central & Central Black Earth and Moscow and St. Petersburg regions.

Table 4.13 Differences in smoking intensity by gender and socioeconomic characteristics

Working-age individuals (males 15-59 / females 15-54)	**2001**		**2004**		**2007**		**2010**		**All years**	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Age group:										
Age 15-17	8	8.76	8.27	10.77	8	10.44	8.58	10.27	7.95	9.47
	-0.76		-2.5		-2.44		-1.69		-1.52**	
Age 18-24	8.7	13.41	10.54	13.61	10.16	13.67	9.72	14.52	9.74	13.72
	-4.71***		-3.07***		-3.51***		-4.80***		-3.98***	
Age 25-34	9.91	16.06	11.26	16.61	10.79	16.26	11.25	16.68	10.52	16.43
	-6.15***		-5.35***		-5.47***		-5.43***		-5.91***	
Age 35-44	10.57	16.94	14.17	17.64	11.83	18.14	12.08	18.01	12.15	17.51
	-6.37***		-3.47***		-6.31***		-5.93***		-5.36***	
Age 45-54	11.17	18.43	12.73	18.26	12.93	18.48	13.17	19.81	12.26	18.79
	-7.26***		-5.53***		-5.55***		-6.64***		-6.53***	
Age 55-59	11	17.16	15.52	18.88	12.77	19.5	12.64	18.51	12.6	18.5
	-6.16		-3.36*		-6.73***		-5.87***		-5.91***	
Education:										
University education	9.76	16.25	11.26	16.05	10.24	16.55	10.97	16.22	10.55	16.2
	-6.49***		-4.80***		-6.31***		-5.25***		-5.65***	

Working-age individuals (males 15-59 / females 15-54)	**2001**		**2004**		**2007**		**2010**		**All years**	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Technical, medical, pedagocial, art college	10.26	16.49	12.05	18.01	10.77	17.25	11.4	17.05	11	16.97
	-6.23***		-5.96***		-6.48***		-5.65***		-5.97***	
Highschool + Vocational	10.99	16.93	14.06	16.68	11.87	17.57	12.96	17.72	11.97	17.24
	-5.94***		-2.63***		-5.70***		-4.76***		-5.27***	
Primary + Vocational	11.47	17.47	10.91	16.8	11.09	17.37	12.2	18.04	11.4	17.74
	-5.99***		-5.89***		-6.28***		-5.84***		-6.34***	
Highschool (11 years)	8.95	15.61	12.22	16.62	12.5	16.64	10.97	17.9	11.07	16.71
	-6.66***		-4.40***		-4.14***		-6.93***		-5.64***	
Primary (8 years)	10.48	15.41	12.16	16.41	12.26	16.77	12.31	17.85	11.64	16.24
	-4.93***		-4.25***		-4.51***		-5.54***		-4.60***	
Occupation:										
Managerial & prof-essional occupation	9.57	16.22	11.33	16.85	10.53	16.92	10.38	16.45	10.3	16.51
	-6.65***		-5.52***		-6.39***		-6.07***		-6.21***	
Manual occupation	10.33	16.56	12.52	15.14	11.06	16.09	12.05	16.59	11.46	16.07
	-6.23***		-2.62*		-5.03***		-4.54***		-4.61***	
Non-manual occupation	10.55	17.2	12.26	17.93	12.43	18.35	12.6	18.43	11.58	18.04
	-6.66***		-5.67***		-5.93***		-5.83***		-6.46***	
Unskilled occupation	12.33	17.37	13.89	17.11	12.43	17.29	12.6	17.89	12.49	17.66

Working-age individuals (males 15-59 / females 15-54)	2001		2004		2007		2010		All years	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
	-5.04***		-3.21**		-4.86***		-5.30***		-5.17***	
No occupation	9.59	14.7	12.38	15.31	12.03	15.16	11.89	16.48	11.33	15.14
	-5.11***		-2.93***		-3.13***		-4.60***		-3.81***	
Marital status:										
Single	8.08	13.07	9.85	13.5	10.07	13.92	10.28	15.43	9.66	14.05
	-4.99***		-3.65***		-3.85***		-5.15***		-4.39***	
Married	10.1	17.23	12.54	17.71	11.79	17.97	11.5	18.07	11.37	17.7
	-7.12***		-5.17***		-6.18***		-6.58***		-6.33***	
Divorced	11.62	16.51	13.25	18.06	11.17	18.61	12.96	19.47	12.07	18.44
	-4.89***		-4.81***		-7.44***		-6.51***		-6.37***	
Widowed	10.26	16.55	14.81	19	13.4	19.06	13.23	19.75	12.89	18.87
	-6.29**		-4.19*		-5.66		-6.52***		-5.97***	
Household has kids	9.87	16.05	12.05	16.78	11.04	16.96	11.23	17.02	10.94	16.56
	-6.18***		-4.72***		-5.92***		-5.79***		-5.62***	
Settlement type:										
Urban	10.07	16.13	12.22	17.06	11.1	16.82	11.48	17.29	11.12	16.86
	-6.06***		-4.84***		-5.72***		-5.82***		-5.75***	
Urban-type	8.95	18.46	12.14	15.97	10.22	17.71	12.74	18.75	10.73	17.27
	-9.52**		-3.83*		-7.50***		-6.01***		-6.54***	
Rural	10.15	16.24	12.51	16.16	12.21	17.23	12.05	17.68	11.55	16.69

Working-age individuals (males 15-59 / females 15-54)	**2001**		**2004**		**2007**		**2010**		**All years**	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
	-6.09***		-3.65***		-5.03***		-5.62***		-5.14***	
City>500,000 inhabitants	10.53	16.53	12.86	17.44	11.56	16.84	11.65	17.46	11.59	16.95
	-6.00***		-4.59***		-5.28***		-5.81***		-5.36***	
City 50,000-500,000 inhabitants	9.37	15.44	11.31	16.75	10.99	16.84	11.08	17.36	10.57	16.74
	-6.07***		-5.45***		-5.85***		-6.28***		-6.17***	
Towns <50,000 inhabitants & rural	9.87	16.62	12.44	16.15	11.85	17.3	12.19	17.59	11.34	16.79
	-6.75***		-3.71***		-5.45***		-5.40***		-5.45***	
Region:										
Moscow & St. Petersburg	11.89	17.04	13.71	18.34	12.09	17.44	11.88	17.48	12.41	17.58
	-5.14***		-4.63***		-5.36***		-5.59***		-5.17***	
North & North Western	10.63	16.87	11.8	18.01	11.96	19.27	11.9	17.91	11.43	17.86
	-6.23***		-6.21***		-7.30***		-6.01***		-6.43***	
Central & Central Black Earth	8.59	17.11	11.59	17.58	11.63	17.45	12.12	17.63	10.9	17.58
	-8.52***		-5.99***		-5.82***		-5.51***		-6.68***	
Volga-Vyatski & Volga Basin	8.8	15.94	11	16.31	8.66	15.97	9.95	16.48	9.54	15.98

Working-age individuals (males 15-59 / females 15-54)	2001		2004		2007		2010		All years	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
	-7.13***		-5.31***		-7.31***		-6.53***		-6.44***	
North Caucasus	9.66	16.47	13.07	14.88	11	18.02	11.05	17.61	10.83	16.41
	-6.81***		-1.81		-7.02***		-6.56***		-5.58***	
Ural	8.48	15.41	10.21	15.63	11.13	15.92	11.44	17.15	10.26	16.24
	-6.93***		-5.43***		-4.78***		-5.71***		-5.98***	
West. Siberian	11	15.75	12.45	16.74	12.8	16.12	12.26	18.17	11.74	16.77
	-4.75***		-4.30***		-3.32**		-5.91***		-5.03***	
East. Siberian	9.53	15.91	12.62	17.4	11.45	17.14	11.65	18.21	11.15	16.94
	-6.37***		-4.78***		-5.69***		-6.56***		-5.79***	

Based on the representative samples for 2001, 2004, 2007 and 2010 as well as the pooled representative sample for 2001-2010
The results are based on two-group mean comparison tests (t-test by gender). The upper row for each variable gives the mean for females and males, and the lower row provides the difference in means with the stars indicating the statistical significance of difference in menas according to the following confidence levels:
* p<0.05, ** p<0.01, *** p<0.001

4.5 Smoking initiation, quitting and relapse

In the previous sections we have examined the associations of smoking status and consumption intensity with regard to socioeconomic and geographic criteria and, where possible, have outlined trends across the 10 survey years. As a precursor to our analysis of the dynamics of smoking in chapter 7, in this final section we take a first look at individual-level changes in smoking status across survey rounds. When individuals are observed in several rounds, there are three possible outcomes in terms of smoking status, which are shown in Table 4.14 below: (1) Individuals can be observed as 'always smoking' or 'always not smoking'; (2) they can start to smoke, i.e. they are observed as a non-smoker in earlier rounds and then switch to being a smoker; (3) they can attempt to quit, i.e. they are observed as a smoker in earlier rounds and then switch to being a non-smoker. Those attempting to quit can either quit successfully, which here is defined very narrowly as remaining a non-smoker for the remaining rounds an individual is observed after attempting to quit, or they can relapse. To put the changes in smoking status into perspective, the first row of Table 4.14 shows the overall prevalence rate across rounds, which is the total of the various individual-level smoking patterns over the ten years.

Table 4.14 Smoking initiation, quitting and relapse at a glance

		Pooled representative sample, 2001-2010, using survey weights		Longitudinal sample with gaps*	
		Males age 15-59	Females age 15-54	Males age 15-59	Females age 15-54
	Overall prevalence	61.18	18.48	64.07	17.74
(1)	% always smoking	45.78	12.55	45.55	9.80
(2)	% Starting to smoke 2001-2010	6.33	5.10	11.82	8.75
(3)	% attempting to quit at least once	10.44	6.52	20.26	10.96
	% Relapsing at least once	*50.17*	*43.87*	*57.75*	*50.47*
	% Quitting successfully	*31.59*	*27.63*	*30.59*	*38.36*

* The longitudinal sample with gaps includes temporary attritors, i.e. individuals who skipped one or several rounds

Since smoking is a habitual/addictive behaviour we would expect there to be persistence in smoking status, i.e. a high share of respondents with outcome (1). This is confirmed if we compare the first two rows of the table: While the overall prevalence among working-age men between 2001 and 2010 is 61.18 percent, 45.78 percent are always smoking, meaning that 75 percent of the overall prevalence figure is formed by respondents who are smoking in all rounds they are observed. Among females, the figure is slightly lower, with 12.55 percent of observations falling in the ‘always smoking’ category, which corresponds to 61 percent of the overall prevalence of 18.48 percent. Initiation rates between men and women are similar, with 5-6 percent of the representative sample starting to smoke between 2001 and 2010, and 8-11 percent respectively in the longitudinal sample. Quit attempts, by contrast, are approximately twice as high among men, but this has to be seen against the fact that their prevalence rate is about 3 times higher. Among male smokers, 10.44 percent made at least one quit attempt over the sample period, compared to 6.52 among female smokers. Half of those who tried to quit relapsed, with a slightly lower relapse rate among females. Furthermore, according to our narrow version of a successful quitter, about one third of those who attempt to quit remain non-smokers. The shares of relapses and successful quitters do not add up to 100 percent as the definitions are non-exclusive. For example, a respondent who is observed in all 10 years and who quits smoking in 2003, relapses in 2005, and then quits again in 2008 will form part of both the relapsing and successful quitting categories. Furthermore, individuals who quit in the last round they are observed are recorded as successful quitters, but cannot be observed as relapsing.

4.6 Conclusion

From this detailed review of descriptive smoking patterns we take some important lessons forward into the econometric analyses which follow in the third part of the thesis. Smoking patterns differ most strongly by gender and age. Among men, prevalence rates have been fluctuating for the first half of the 2000s according to most criteria, but we observed decreases starting around 2007/2008, with a relatively sharp decline in 2010. These decreases coincide with increases in the real prices of cigarettes, which started rising since 2008 due to higher taxation. Among women, the rises in smoking in the 35-44 and 54-65 age groups are likely the result of women from cohorts with higher initiation rates moving up into these age groups during the survey period, rather than women starting to smoke at this age. Among younger women (15-24) smoking decreased between 2001 and 2010, so that among the younger cohorts smoking seems to be on a downward trend for both genders. Among both men and women we observe a steep educational gradient in smoking rates (similar to Western European countries), with prevalence being highest among those with the lowest level of education and lowest among those with university education. This gradient appears to be steepening due to smoking rates among the most educated dropping at a faster rate. While the male sample does not show a strong regional patterning of smoking, female smoking rates differ considerably across regions, with smoking being much more prevalent among women living in Moscow and St. Petersburg, and still very rare in the Volga and North Caucasian regions. This may indicate that smoking in the latter regions is still restricted through cultural norms, as discussed in the previous chapter. Yet, female smoking rates appear to be on a downward trend in Moscow and St. Petersburg which if these regions are seen as the most progressive in terms of cultural change, could indicate that smoking is becoming less attractive.

Chapter 4 Appendices

4-A Smoking prevalence among respondents who change age categories between 2001 and 2010

Individuals aged 15 and above

Females	2002	2003	2004	2005	2006	2007	2008	2009	2010
agecatchg==0									
18-24	21.6	20.6	23.9	22	25.5	24.2	25.8	23.7	21.4
25-34	29.4	29.3	29.1	28	27.3	29	28.5	28.1	22.6
35-44	16.9	19.1	19.6	19.7	24.3	24.1	23.3	26.9	22.7
45-54	15.2	13.4	15.4	15.4	17.2	17.4	17.7	16.1	16.2
55-64	4.8	4.8	5.2	7.5	7.5	6.5	8.7	7.8	7.6
≥ 65	1	1.2	1.2	0.5	0.6	1	1.1	1	0.8
agecatchg>=1									
18-24	20.1	19.6	19.9	18.4	17.7	17.8	15.4	14.5	16.4
25-34	24.1	17.1	20.1	24.3	23.8	25.3	23.8	23.5	24.5
35-44	22.7	29.1	30.2	29.9	30.4	28.8	27.5	25.4	25.5
45-54	11.1	6.7	10.9	11.4	10.1	10	10.5	9.7	11.8
55-64	4.5	11.6	10.1	10.2	10.3	11.3	10.4	11.1	11.3
≥ 65	0	0.6	1.8	0.8	1.3	0.9	1.5	1.7	2.3

Based on the representative samples for each year, using the survey weights provided by the RLMS
agecatchg==1 designates individuals who move up into the next category during the time they are observed; agecatchg==0 designates individuals who stay in the same age category during the time they are observed
Note: There are only 10 (9) males (females) who move up into the next age category in the 15-17 group, therefore we restrict the comparison to ages 18 and above.

4-B Share of current and ex-smokers in ever-smokers by age group

Individuals aged 15 and above

Age group	2001		2004		2007		2010	
Males	Smoker	Ex-smoker	Smoker	Ex-smoker	Smoker	Ex-smoker	Smoker	Ex-smoker
0-17	55.7	44.3	67.1	32.9	75.2	24.8	75.1	24.9
18-24	82.1	17.9	87	13	86.9	13.1	86.9	13.1
25-34	87.6	12.4	87	13	87.1	12.9	83	17
35-44	84.8	15.2	86.7	13.3	84.1	15.9	80.6	19.4
45-54	83.5	16.5	80.4	19.6	81.9	18.1	78.4	21.6
55-64	67.7	32.3	71.3	28.7	74.9	25.1	70.5	29.5
65plus	44.9	55.1	50.1	49.9	47.9	52.1	46.7	53.3

Individuals aged 15 and above

Age group	2001		2004		2007		2010	
N	2,511		2,377		2,747		4,133	
Females								
0-17	42.4	57.6	40.5	59.5	38.3	61.7	47.9	52.1
18-24	57.5	42.5	60.6	39.4	66.4	33.6	64.4	35.6
25-34	67.7	32.3	67.9	32.1	69.1	30.9	65.6	34.4
35-44	69.3	30.7	70.6	29.4	76	24	68.9	31.1
45-54	72	28	71.6	28.4	69.4	30.6	67.9	32.1
55-64	67.4	32.6	67.9	32.1	66	34	68.8	31.2
65plus	52.7	47.3	58.4	41.6	46.6	53.4	37.2	62.8
N	907		916		1,069		1718	

Based on the representative samples for 2001, 2004, 2007 and 2010, using the survey weights provided by the RLMS

4-C Smoking prevalence by region

Individuals aged 15 and above

Region	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Males:										
Moscow & St. Petersburg	57.8	60.2	55.1	55.8	53	57.4	54.4	52.2	58.1	50.6
Northern & North Western	65	69.4	64	62.4	66.8	68	65.3	65.5	65.6	60.2
Central & Central Black Earth	57.9	57.4	59.3	55.5	54.8	56.2	57.4	55.1	52.5	51.8
Volga-Vyatski & Volga Basin	60.6	59.9	59.8	59.4	58.6	57.2	59.4	59.4	55.8	55.9
North Caucasian	54.8	59.6	52.2	51.3	53	53.5	49.3	47.8	44.2	48.4
Ural	63.8	64	64	61.3	60.2	62.5	61.4	58.6	58.6	56.6
Western Siberian	65.2	62.2	60.9	59.6	57.2	59.4	62.6	63.3	59.2	55.8
Eastern Siberian & Far Eastern	61.6	64.1	64.6	64	62.4	62.7	62.5	60.5	59.4	55.2
All regions	60.2	61.2	59.5	58	57.3	58.6	58.1	56.6	55.2	53.7
Females										
Moscow & St. Petersburg	30.5	29.6	28.9	28.2	27.6	28.3	26.7	25.4	24.6	25.3
Northern & North Western	23.7	25.2	21.1	24	22.5	26.6	26.7	25.7	25.4	24.3
Central & Central Black Earth	14.4	11.5	12.7	13.7	12.9	12.7	13.5	13.1	12.5	13.3

Volga-Vyatski & Volga Basin	6	6.3	6.7	6.6	7.6	6.9	8.5	9.2	8.9	8
North Caucasian	5.5	5.2	6.9	7.2	6.4	10.2	9.4	8.4	7.8	8.3
Ural	11	12.2	12	12.9	13.6	13.8	14.5	12.9	14.5	14.4
Western Siberian	11.9	12.1	13.8	14	14.8	15.5	15.5	17.7	15.6	16
Eastern Siberian & Far Eastern	15.1	16.1	17.1	18.6	17.4	18.6	18.1	19.4	20.2	19.4
All regions	13.8	13.8	13.9	14.6	14.2	15.2	15.2	15	14.8	14.8

Based on the representative samples for each year, using the survey weights provided by the RLMS

4-D SMOKING PREVALENCE BY SETTLEMENT SIZE

Individuals aged 15 and above

Settlement type	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Males:										
Moscow & St. Petersburg	*57.8*	*60.2*	*55.1*	*55.8*	*53*	*57.4*	*54.4*	*52.2*	*58.1*	*50.6*
City>500k	57.8	57.8	56.3	56.5	54.5	57.9	56.8	55	53.3	51.7
City 50-500k	63.5	62.6	62.1	60.1	59.6	59.9	59.8	59.1	59.5	58
Towns <50k & rural	59.7	63.2	60	57.7	57.7	58.2	57.8	55.8	54.1	52.4
All types	60.2	61.2	59.5	58	57.3	58.6	58.1	56.6	55.2	53.7
Females:										
Moscow & St. Petersburg	*30.5*	*29.6*	*28.9*	*28.2*	*27.6*	*28.3*	*26.7*	*25.4*	*24.6*	*25.3*
City>500k	19.3	20	19.8	20.7	19.7	20.4	20.2	20.2	18.5	19.8
City 50-500k	15.2	14.1	14.5	14.9	13.9	16.8	16.5	16.2	16.9	15.9
Towns <50k & rural	7.6	7.7	8.2	8.5	10.7	8.4	9.6	9	9.7	9.9
All types	13.8	13.8	13.9	14.6	14.2	15.2	15.2	15	14.8	14.8

Based on the representative samples for each year, using the survey weights provided by the RLMS
City>500k: City with more than 500,000 inhabitants
City 50-500k: Cities with 50,000 to 500,000 inhabitants
Towns <50k & rural: Towns with less than 50,000 inhabitants and rural settlements

4-E SMOKING PREVALENCE BY ADMINISTRATIVE SETTLEMENT TYPE

Working-age individuals (males 15-59/females 15-54)

Settlement type	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Males:										
Urban	64.4	63.7	62.4	62.4	61	62.6	62.4	61.6	60	56.7

Urban-type	53.2	62.1	51.3	45.8	49.1	50.3	52.2	40.5	41.1	56.6
Rural	64.4	68.2	66.3	64.7	65.5	65.5	63.6	63.1	60.4	55.7
All types	63.7	64.8	62.6	61.9	61.3	62.7	62.0	60.4	58.5	56.4
Females:										
Urban	21.6	21.8	21.7	23.4	22.9	24.6	24.2	23.3	22.7	22.2
Urban-type	10.8	10.1	10.3	11.3	13.3	12.5	10.9	6.6	6.6	13.7
Rural	12	12.1	13.1	13.2	13.2	13.4	13.2	13.5	13.2	13.9
All types	18.7	18.8	18.9	20.2	19.9	21.3	21.2	20.6	20.1	19.7

Based on the representative samples for each year, using the survey weights provided by the RLMS "urban-type" refers to so-called 'settlements of urban type' (Russian: посёлок городско́го ти́па. It usually designates localities which meet certain criteria in terms of urban infrastructure. In the Soviet era, urban-type settlements were typically the more 'artificial' types of towns created for industrial purposes.

4-F Smoking prevalence by administrative settlement type

Individuals aged 15 and above

Settlement type	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Males:										
Urban	60.8	60.2	59.2	58.1	56.7	58.5	58.4	57.4	56.4	53.8
Urban-type	51.2	59.4	50	44.6	48.8	48.2	51.6	41.9	41	53.4
Rural	61.2	64.2	62.8	61.2	60.9	61.1	58.6	58.6	56.5	53.6
All types	60.2	61.2	59.5	58	57.3	58.6	58.1	56.6	55.2	53.7
Females:										
Urban	16.6	16.6	16.5	17.1	16.6	17.9	17.4	17	16.9	16.8
Urban-type	8	7.5	8.1	8.7	10.5	9	9.4	5.8	5.6	11.1
Rural	7.7	7.7	8.7	9	8.8	9	8.9	9.1	9.2	9.9
All types	13.8	13.8	13.9	14.6	14.2	15.2	15.2	15	14.8	14.8

4-G Smoking prevalence by education

Individuals aged 15 and above

Education	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Males:										
University	46	47	41.7	43.9	45.6	45	44.8	41.6	40	39.1
Tec & Med	59.6	62.8	61	61.3	57.4	58.4	60.4	57.8	57.2	54.5
Secondary+Voc	76.4	75	75.2	73.4	72.7	72.9	73.9	72.3	72.6	72
Primary+Voc	70.9	72.2	69.1	68.3	64.6	69.1	71.2	67.1	64.2	64.7
Secondary	64.4	65.2	62.6	57.3	59.8	60	56.1	55.9	51.8	52.9
Primary	49.4	52	52.4	52	49.1	52.9	52.8	53	51.8	49.3

Total	60.2	61.2	59.5	58	57.3	58.6	58.1	56.6	55.2	53.7
Females:										
University	12.7	11.9	12.8	12.9	12	14	13	11.2	10.3	10.8
Tec & Med	13.1	14.4	13.4	15.2	14.3	14	14.8	15.4	14.3	15.2
Secondary+Voc	22.9	25.4	23.4	26.5	24.7	28.2	28.6	25.5	25.9	23.2
Primary+Voc	20.8	20.5	18.8	16.9	19.9	17.4	20.6	23.3	25.1	22.8
Secondary	16.3	15	15.1	16.1	15.8	16.8	15.7	16	16	16.6
Primary	7.4	7.3	9.2	8.5	9	9.7	10.1	10.8	11	11
Total	13.8	13.8	13.9	14.6	14.2	15.2	15.2	15	14.8	14.8

Based on the representative samples for each year, using the survey weights provided by the RLMS
Education categories from highest to lowest educational attainment: University, Tec & Med (technical, medical, pedagogical and art colleges), Secondary +Voc (middle-level professional education for those with completed secondary education), Primary + voc (middle-level professional education for those with completed primary education), Secondary (completed secondary education corresponding to 11 years of schooling), Primary (completed primary education corresponding to 9 years of schooling)

4-H SOCIOECONOMIC PROFILE OF MALE SMOKERS

Individuals aged 15 and above	2001		2004		2007		2010		All years	
Males	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker
Age:										
Age in years	44.28	40.84	43.32	40.93	43.61	41.58	43.65	41.62	43.91	41.38
	3.44***		2.39***		2.03***		2.02***		2.53***	
Age 15-17	0.13	0.03	0.13	0.03	0.11	0.02	0.08	0.01	0.11	0.02
	0.10***		0.10***		0.09***		0.07***		0.09***	
Age 18-24	0.13	0.13	0.14	0.14	0.16	0.15	0.15	0.13	0.15	0.14
	0		0		0.02		0.01		0.01*	
Age 25-34	0.11	0.2	0.13	0.2	0.14	0.2	0.16	0.23	0.14	0.21
	-0.09***		-0.07***		-0.06***		-0.07***		-0.07***	
Age 35-44	0.14	0.25	0.12	0.23	0.11	0.19	0.14	0.19	0.12	0.21
	-0.11***		-0.11***		-0.09***		-0.05***		-0.09***	
Age 45-54	0.14	0.21	0.15	0.2	0.16	0.23	0.15	0.22	0.15	0.22
	-0.08***		-0.05***		-0.07***		-0.07***		-0.07***	
Age 55-64	0.12	0.1	0.1	0.11	0.11	0.13	0.15	0.15	0.12	0.12
	0.02*		0		-0.02		0		0	
Age 65 plus	0.23	0.08	0.23	0.09	0.22	0.08	0.17	0.07	0.22	0.08

Individuals aged 15 and above	2001		2004		2007		2010		All years	
Males	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker
	0.15***		0.13***		0.14***		0.11***		0.13***	
Education:										
University education	0.2	0.11	0.2	0.11	0.21	0.12	0.25	0.14	0.22	0.12
	0.09***		0.09***		0.09***		0.11***		0.10***	
Technical, medical, pedagocial, art college	0.13	0.13	0.13	0.15	0.14	0.15	0.16	0.17	0.14	0.15
	0		-0.02		-0.01		0		0	
Secondary + Vocational	0.09	0.21	0.1	0.2	0.1	0.19	0.11	0.23	0.1	0.21
	-0.11***		-0.10***		-0.10***		-0.12***		-0.10***	
Primary + Vocational	0.07	0.1	0.07	0.11	0.06	0.1	0.05	0.08	0.06	0.1
	-0.04***		-0.04***		-0.04***		-0.03***		-0.03***	
Secondary (11 years)	0.2	0.24	0.23	0.23	0.26	0.24	0.23	0.22	0.22	0.24
	-0.05**		0		0.02		0		-0.01*	
Primary (8 years)	0.29	0.2	0.26	0.21	0.23	0.18	0.19	0.16	0.23	0.19
	0.10***		0.05***		0.04**		0.03**		0.05***	
Occupation:										
Managerial & prof-essional occupation	0.17	0.12	0.16	0.12	0.18	0.14	0.21	0.13	0.18	0.13
	0.04***		0.03**		0.04***		0.08***		0.05***	
Manual occupation	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.03	0.04
	-0.01*		0		-0.01		-0.01		-0.01**	

Individuals aged 15 and above	2001		2004		2007		2010		All years	
Males	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker
Non-manual occupation	0.22	0.37	0.22	0.37	0.21	0.38	0.23	0.39	0.21	0.38
	-0.15***		-0.15***		-0.17***		-0.17***		-0.16***	
Unskilled occupation	0.04	0.08	0.04	0.08	0.05	0.1	0.05	0.1	0.05	0.09
	-0.04***		-0.04***		-0.05***		-0.05***		-0.04***	
No occupation	0.56	0.39	0.56	0.4	0.52	0.34	0.46	0.33	0.53	0.37
	0.16***		0.16***		0.18***		0.13***		0.16***	
Marital status:										
Single	0.3	0.19	0.32	0.21	0.32	0.22	0.31	0.26	0.31	0.22
	0.11***		0.11***		0.10***		0.05***		0.09***	
Married	0.62	0.72	0.6	0.7	0.61	0.71	0.6	0.59	0.6	0.68
	-0.10***		-0.10***		-0.10***		0.01		-0.07***	
Divorced	0.03	0.07	0.03	0.06	0.03	0.06	0.05	0.12	0.04	0.08
	-0.04***		-0.03***		-0.02**		-0.08***		-0.04***	
Widow	0.06	0.02	0.05	0.03	0.04	0.02	0.04	0.02	0.05	0.02
	0.03***		0.02***		0.02***		0.02***		0.02***	
Household characteristics:										
Household has children	0.49	0.51	0.47	0.48	0.43	0.45	0.44	0.45	0.45	0.46
	-0.01		-0.01		-0.01		-0.01		-0.02**	
Household income real	8407.43	7826.98	12220.19	10405.16	14138.27	13590.49	18093.05	16578.61	14234.77	12797.41

Individuals aged 15 and above	2001		2004		2007		2010		All years	
Males	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker
	580.45		1815.03*		547.78		1514.44*		1437.36***	
Per capita income real	2559.73	2401.53	4119.4	3053.02	4319.92	4122	5537.47	5043.33	4332.82	3859.86
	158.2		1066.38		197.92		494.14*		472.95***	
Household alcohol expenditure real	149.73	186.35	146.22	198.91	168.29	201.51	162.49	206.81	149.17	193.68
	-36.62*		-52.70**		-33.22*		-44.31***		-44.52***	
Settlement type:										
Urban	0.66	0.66	0.66	0.65	0.65	0.65	0.66	0.65	0.66	0.65
	0		0.01		0		0.01		0.01	
Urban-type	0.07	0.05	0.08	0.05	0.07	0.05	0.06	0.06	0.07	0.05
	0.02*		0.03***		0.02*		0		0.02***	
Rural	0.27	0.29	0.26	0.3	0.28	0.3	0.28	0.29	0.27	0.3
	-0.02		-0.04*		-0.02		-0.01		-0.03***	
City>500,000 inhabitants	0.34	0.3	0.33	0.3	0.33	0.31	0.32	0.29	0.33	0.3
	0.04*		0.02		0.02		0.03**		0.03***	
City 50,000-500,000 inhabitants	0.28	0.32	0.29	0.31	0.27	0.28	0.24	0.28	0.26	0.29
	-0.04*		-0.02		-0.02		-0.04***		-0.03***	
Town <50,000 inhabitants & rural	0.38	0.38	0.38	0.38	0.4	0.41	0.45	0.44	0.4	0.41
	0		0		-0.01		0.01		0	

Individuals aged 15 and above	2001		2004		2007		2010		All years	
Males	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker
Region:										
Moscow & St. Petersburg	0.11	0.1	0.13	0.12	0.12	0.1	0.1	0.09	0.12	0.11
	0.01		0.01		0.02		0.01		0.01***	
North & North Western	0.05	0.06	0.05	0.06	0.05	0.07	0.05	0.07	0.05	0.07
	-0.01		-0.01		-0.02*		-0.02**		-0.02***	
Central & Central Black Earth	0.19	0.17	0.17	0.15	0.18	0.18	0.21	0.19	0.19	0.17
	0.02		0.02		0.01		0.02		0.02***	
Volga-Vyatski & Volga Basin	0.17	0.17	0.16	0.17	0.17	0.17	0.15	0.16	0.17	0.17
	0		-0.01		-0.01		-0.01		0	
North Caucasus	0.16	0.14	0.17	0.13	0.19	0.14	0.17	0.14	0.18	0.14
	0.03*		0.04**		0.05***		0.03**		0.04***	
Ural	0.13	0.15	0.13	0.15	0.12	0.14	0.13	0.15	0.13	0.15
	-0.02		-0.02		-0.02		-0.02		-0.02***	
West. Siberian	0.08	0.1	0.1	0.11	0.08	0.1	0.09	0.09	0.09	0.1
	-0.02		-0.01		-0.02		-0.01		-0.01***	
East. Siberian	0.1	0.11	0.08	0.11	0.08	0.1	0.09	0.1	0.09	0.1
	-0.01		-0.03*		-0.02		-0.01		-0.02***	

Individuals aged 15 and above	2001		2004		2007		2010		All years	
Males	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker
N	3,262		3,209		3,721		5,909		36,318	

Based on the representative samples for 2001, 2004, 2007 and 2010, with "all years" based on the pooled representative sample for 2001-2010, using the survey weights provided by the RLMS. The results are based on two-group mean comparison tests (t-test by current smoking status). The upper row for each variable gives the mean for current non-smokers and current smokers, and the lower row provides the difference in means with the stars indicating the statistical significance of difference in means according to the following confidence levels: * p<0.05, ** p<0.01, *** p<0.001

4-I SOCIOECONOMIC PROFILE OF FEMALE SMOKERS

Individuals aged 15 and above	2001		2004		2007		2010		All rounds	
Females	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker
Age:										
Age in years	48.03	35.76	48.76	36.11	49.15	37.11	48.65	37.68	48.87	36.86
	12.27***		12.65***		12.04***		10.97***		12.01***	
Age 15-17	0.06	0.03	0.06	0.02	0.05	0.01	0.04	0.01	0.05	0.02
	0.02*		0.03**		0.04***		0.02***		0.03***	
Age 18-24	0.11	0.18	0.1	0.19	0.11	0.18	0.11	0.17	0.11	0.18
	-0.07***		-0.08***		-0.07***		-0.06***		-0.07***	
Age 25-34	0.12	0.3	0.12	0.28	0.11	0.26	0.14	0.26	0.12	0.28
	-0.18***		-0.16***		-0.15***		-0.12***		-0.15***	
Age 35-44	0.16	0.22	0.14	0.24	0.13	0.27	0.14	0.26	0.14	0.25

Individuals aged 15 and above	2001		2004		2007		2010		All rounds	
Females	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker
	-0.06***		-0.11***		-0.14***		-0.12***		-0.12***	
Age 45-54	0.17	0.19	0.18	0.18	0.18	0.18	0.17	0.17	0.18	0.18
	-0.02		0		0		0		0	
Age 55-64	0.14	0.04	0.12	0.06	0.15	0.09	0.18	0.11	0.15	0.08
	0.10***		0.07***		0.06***		0.07***		0.07***	
Age 65 plus	0.25	0.03	0.28	0.02	0.27	0.02	0.23	0.02	0.26	0.02
	0.22***		0.26***		0.26***		0.21***		0.25***	
Education:										
University education	0.16	0.15	0.18	0.16	0.2	0.17	0.25	0.17	0.2	0.16
	0.01		0.02		0.03*		0.07***		0.04***	
Technical, medical, pedagocial, art college	0.23	0.22	0.23	0.25	0.24	0.24	0.26	0.26	0.24	0.24
	0.01		-0.01		0.01		0		0	
Secondary + Vocational	0.09	0.18	0.08	0.18	0.08	0.18	0.09	0.15	0.08	0.17
	-0.09***		-0.09***		-0.10***		-0.07***		-0.09***	
Primary + Vocational	0.04	0.07	0.05	0.06	0.04	0.06	0.04	0.07	0.04	0.07
	-0.03**		-0.01		-0.02*		-0.03***		-0.02***	
Secondary (11 years)	0.2	0.25	0.19	0.22	0.2	0.21	0.19	0.22	0.19	0.22
	-0.05**		-0.03		-0.01		-0.03*		-0.03***	
Primary (8 years)	0.27	0.13	0.25	0.13	0.22	0.13	0.18	0.13	0.23	0.13

Individuals aged 15 and above	2001		2004		2007		2010		All rounds	
Females	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker
	0.14***		0.12***		0.09***		0.05***		0.09***	
Occupation:										
Managerial & professional occupation	0.22	0.23	0.23	0.24	0.25	0.27	0.27	0.26	0.24	0.25
	-0.01		-0.01		-0.02		0.02		-0.01	
Manual occupation	0.1	0.2	0.1	0.22	0.11	0.23	0.13	0.24	0.11	0.23
	-0.10***		-0.12***		-0.12***		-0.11***		-0.11***	
Non-manual occupation	0.05	0.08	0.05	0.1	0.05	0.08	0.04	0.08	0.05	0.09
	-0.03**		-0.04***		-0.04***		-0.04***		-0.04***	
Unskilled occupation	0.05	0.08	0.05	0.08	0.06	0.08	0.05	0.08	0.05	0.08
	-0.03**		-0.03**		-0.03**		-0.03***		-0.03***	
No occupation	0.58	0.41	0.57	0.37	0.54	0.34	0.51	0.34	0.55	0.36
	0.17***		0.20***		0.21***		0.17***		0.19***	
Marital status:										
Single	0.17	0.18	0.18	0.21	0.19	0.2	0.2	0.28	0.19	0.22
	0		-0.03*		-0.01		-0.08***		-0.04***	
Married	0.53	0.56	0.51	0.54	0.49	0.58	0.46	0.38	0.49	0.51
	-0.03		-0.03		-0.08***		0.08***		-0.02***	
Divorced	0.08	0.19	0.09	0.16	0.09	0.15	0.12	0.24	0.1	0.18
	-0.11***		-0.07***		-0.06***		-0.12***		-0.09***	

Individuals aged 15 and above	**2001**		**2004**		**2007**		**2010**		**All rounds**	
Females	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker
Widow	0.22	0.08	0.22	0.09	0.23	0.07	0.22	0.1	0.22	0.08
	0.14***		0.14***		0.15***		0.12***		0.14***	
Household characteristics:										
Household has children	0.45	0.57	0.42	0.57	0.4	0.5	0.4	0.51	0.41	0.53
	-0.12***		-0.15***		-0.09***		-0.11***		-0.12***	
Household income real	6995.7	7683.5	9275.3	11251.1	12020.5	14598.3	15202.9	16494.1	11594.7	13517.8
	-687.7		-1975.8***		-2577.8***		-1291.2		-1923.1***	
Per capita income real	2287	2474.5	3011.8	3392.9	3977.7	4524.1	5002.7	5482.8	3816.4	4354.5
	-187.5		-381.1**		-546.4***		-480.1		-538.1***	
Household alcohol expenditure real	111.2	241.1	110.8	288.1	141.7	252	136.4	268.8	120.6	251.1
	-129.9***		-177.3***		-110.3***		-132.4***		-130.5***	
Settlement type:										
Urban	0.66	0.81	0.66	0.8	0.65	0.79	0.67	0.77	0.66	0.79
	-0.16***		-0.14***		-0.14***		-0.10***		-0.13***	
Urban-type	0.07	0.03	0.07	0.04	0.06	0.04	0.06	0.05	0.06	0.04
	0.03**		0.03**		0.02*		0.02*		0.03***	
Rural	0.28	0.15	0.27	0.16	0.29	0.17	0.27	0.18	0.28	0.17
	0.13***		0.11***		0.11***		0.09***		0.11***	
City>500,000 inhabitants	0.32	0.47	0.3	0.46	0.32	0.45	0.3	0.43	0.31	0.45

Individuals aged 15 and above	2001		2004		2007		2010		All rounds	
Females	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker
	-0.16***		-0.16***		-0.14***		-0.13***		-0.14***	
City 50,000-500,000 inhabitants	0.3	0.33	0.31	0.32	0.28	0.3	0.26	0.28	0.29	0.3
	-0.03		-0.01		-0.02		-0.02		-0.02**	
Town <50,000 inhabitants & rural	0.38	0.2	0.38	0.21	0.4	0.25	0.43	0.29	0.4	0.24
	0.18***		0.17***		0.15***		0.15***		0.16***	
Region:										
Moscow & St. Petersburg	0.1	0.28	0.12	0.27	0.11	0.22	0.09	0.18	0.11	0.24
	-0.18***		-0.15***		-0.11***		-0.09***		-0.13***	
North & North Western	0.06	0.11	0.05	0.09	0.06	0.11	0.06	0.12	0.06	0.11
	-0.06***		-0.04***		-0.06***		-0.06***		-0.05***	
Central & Central Black Earth	0.19	0.19	0.17	0.16	0.19	0.16	0.2	0.18	0.19	0.16
	0		0.01		0.03		0.02		0.02***	
Volga-Vyatski & Volga Basin	0.18	0.07	0.18	0.07	0.18	0.09	0.17	0.08	0.18	0.08
	0.11***		0.11***		0.09***		0.09***		0.09***	
North Caucasus	0.15	0.05	0.15	0.07	0.16	0.09	0.16	0.08	0.15	0.08
	0.09***		0.08***		0.07***		0.07***		0.08***	
Ural	0.14	0.11	0.14	0.12	0.14	0.13	0.15	0.14	0.14	0.12

Individuals aged 15 and above	**2001**		**2004**		**2007**		**2010**		**All rounds**	
Females	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker	Smoker
	0.04*		0.02		0.01		0.01		0.02***	
West. Siberian	0.09	0.08	0.11	0.1	0.09	0.09	0.09	0.09	0.09	0.1
	0.01		0.01		0		-0.01		0	
East. Siberian	0.09	0.11	0.09	0.11	0.08	0.1	0.09	0.12	0.08	0.11
	-0.01		-0.03*		-0.02		-0.04***		-0.03***	
N	4,516		4,391		5,152		8,143		50,327	

Based on the representative samples for 2001, 2004, 2007 and 2010, with "all years" based on the pooled representative sample for 2001-2010, using the survey weights provided by the RLMS. The results are based on two-group mean comparison tests (t-test by current smoking status). The upper row for each variable gives the mean for current non-smokers and current smokers, and the lower row provides the difference in means with the stars indicating the statistical significance of difference in means according to the following confidence levels: * p<0.05, ** p<0.01, *** p<0.001

4-J SMOKING INTENSITY

Individuals aged 15 and above	2001		2004		2007		2010		All rounds	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Age group:										
Age 15-17	8	8.76	8.27	10.77	8	10.44	8.58	10.27	7.95	9.47
	-0.76		-2.5		-2.44		-1.69		-1.52**	
Age 18-24	8.7	13.41	10.54	13.61	10.16	13.67	9.72	14.52	9.74	13.72
	-4.71***		-3.07***		-3.51***		-4.80***		-3.98***	
Age 25-34	9.91	16.06	11.26	16.61	10.79	16.26	11.25	16.68	10.52	16.43
	-6.15***		-5.35***		-5.47***		-5.43***		-5.91***	
Age 35-44	10.57	16.94	14.17	17.64	11.83	18.14	12.08	18.01	12.15	17.51
	-6.37***		-3.47***		-6.31***		-5.93***		-5.36***	
Age 45-54	11.17	18.43	12.73	18.26	12.93	18.48	13.17	19.81	12.26	18.79
	-7.26***		-5.53***		-5.55***		-6.64***		-6.53***	
Age 55-59	11	17.16	15.52	18.88	12.77	19.5	12.64	18.51	12.6	18.5
	-6.16		-3.36*		-6.73***		-5.87***		-5.91***	
Education:										
University education	9.76	16.25	11.26	16.05	10.24	16.55	10.97	16.22	10.55	16.2
	-6.49***		-4.80***		-6.31***		-5.25***		-5.65***	
Technical, medical, pedagocial, art college	10.26	16.49	12.05	18.01	10.77	17.25	11.4	17.05	11	16.97
	-6.23***		-5.96***		-6.48***		-5.65***		-5.97***	
Secondary + Vocational	10.99	16.93	14.06	16.68	11.87	17.57	12.96	17.72	11.97	17.24

Individuals aged 15 and above	2001		2004		2007		2010		All rounds	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
	-5.94***		-2.63***		-5.70***		-4.76***		-5.27***	
Primary + Vocational	11.47	17.47	10.91	16.8	11.09	17.37	12.2	18.04	11.4	17.74
	-5.99***		-5.89***		-6.28***		-5.84***		-6.34***	
Secondary (11 years)	8.95	15.61	12.22	16.62	12.5	16.64	10.97	17.9	11.07	16.71
	-6.66***		-4.40***		-4.14***		-6.93***		-5.64***	
Primary (8 years)	10.48	15.41	12.16	16.41	12.26	16.77	12.31	17.85	11.64	16.24
	-4.93***		-4.25***		-4.51***		-5.54***		-4.60***	
Occupation:										
Managerial & professional occupation	9.57	16.22	11.33	16.85	10.53	16.92	10.38	16.45	10.3	16.51
	-6.65***		-5.52***		-6.39***		-6.07***		-6.21***	
Manual occupation	10.33	16.56	12.52	15.14	11.06	16.09	12.05	16.59	11.46	16.07
	-6.23***		-2.62*		-5.03***		-4.54***		-4.61***	
Non-manual occupation	10.55	17.2	12.26	17.93	12.43	18.35	12.6	18.43	11.58	18.04
	-6.66***		-5.67***		-5.93***		-5.83***		-6.46***	
Unskilled occupation	12.33	17.37	13.89	17.11	12.43	17.29	12.6	17.89	12.49	17.66
	-5.04***		-3.21**		-4.86***		-5.30***		-5.17***	
No occupation	9.59	14.7	12.38	15.31	12.03	15.16	11.89	16.48	11.33	15.14
	-5.11***		-2.93***		-3.13***		-4.60***		-3.81***	
Marital status:										
Single	8.08	13.07	9.85	13.5	10.07	13.92	10.28	15.43	9.66	14.05

Individuals aged 15 and above	2001		2004		2007		2010		All rounds	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
	-4.99***		-3.65***		-3.85***		-5.15***		-4.39***	
Married	10.1	17.23	12.54	17.71	11.79	17.97	11.5	18.07	11.37	17.7
	-7.12***		-5.17***		-6.18***		-6.58***		-6.33***	
Divorced	11.62	16.51	13.25	18.06	11.17	18.61	12.96	19.47	12.07	18.44
	-4.89***		-4.81***		-7.44***		-6.51***		-6.37***	
Widowed	10.26	16.55	14.81	19	13.4	19.06	13.23	19.75	12.89	18.87
	-6.29**		-4.19*		-5.66		-6.52***		-5.97***	
Household has kids	9.87	16.05	12.05	16.78	11.04	16.96	11.23	17.02	10.94	16.56
	-6.18***		-4.72***		-5.92***		-5.79***		-5.62***	
Settlement type:										
Urban	10.07	16.13	12.22	17.06	11.1	16.82	11.48	17.29	11.12	16.86
	-6.06***		-4.84***		-5.72***		-5.82***		-5.75***	
Urban-type	8.95	18.46	12.14	15.97	10.22	17.71	12.74	18.75	10.73	17.27
	-9.52**		-3.83*		-7.50***		-6.01***		-6.54***	
Rural	10.15	16.24	12.51	16.16	12.21	17.23	12.05	17.68	11.55	16.69
	-6.09***		-3.65***		-5.03***		-5.62***		-5.14***	
City>500,000 inhabitants	10.53	16.53	12.86	17.44	11.56	16.84	11.65	17.46	11.59	16.95
	-6.00***		-4.59***		-5.28***		-5.81***		-5.36***	
City 50,000-500,000 inhabitants	9.37	15.44	11.31	16.75	10.99	16.84	11.08	17.36	10.57	16.74
	-6.07***		-5.45***		-5.85***		-6.28***		-6.17***	

Individuals aged 15 and above	2001		2004		2007		2010		All rounds	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Towns <50,000 inhabitants & rural	9.87	16.62	12.44	16.15	11.85	17.3	12.19	17.59	11.34	16.79
	-6.75***		-3.71***		-5.45***		-5.40***		-5.45***	
Region:										
Moscow & St. Petersburg	11.89	17.04	13.71	18.34	12.09	17.44	11.88	17.48	12.41	17.58
	-5.14***		-4.63***		-5.36***		-5.59***		-5.17***	
North & North Western	10.63	16.87	11.8	18.01	11.96	19.27	11.9	17.91	11.43	17.86
	-6.23***		-6.21***		-7.30***		-6.01***		-6.43***	
Central & Central Black Earth	8.59	17.11	11.59	17.58	11.63	17.45	12.12	17.63	10.9	17.58
	-8.52***		-5.99***		-5.82***		-5.51***		-6.68***	
Volga-Vyatski & Volga Basin	8.8	15.94	11	16.31	8.66	15.97	9.95	16.48	9.54	15.98
	-7.13***		-5.31***		-7.31***		-6.53***		-6.44***	
North Caucasus	9.66	16.47	13.07	14.88	11	18.02	11.05	17.61	10.83	16.41
	-6.81***		-1.81		-7.02***		-6.56***		-5.58***	
Ural	8.48	15.41	10.21	15.63	11.13	15.92	11.44	17.15	10.26	16.24
	-6.93***		-5.43***		-4.78***		-5.71***		-5.98***	
West. Siberian	11	15.75	12.45	16.74	12.8	16.12	12.26	18.17	11.74	16.77
	-4.75***		-4.30***		-3.32**		-5.91***		-5.03***	
East. Siberian	9.53	15.91	12.62	17.4	11.45	17.14	11.65	18.21	11.15	16.94

Individuals aged 15 and above	**2001**		**2004**		**2007**		**2010**		**All rounds**	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
	-6.37***		-4.78***		-5.69***		-6.56***		-5.79***	

Based on the representative samples for 2001, 2004, 2007 and 2010 as well as the pooled representative sample for 2001-2010
The results are based on two-group mean comparison tests (t-test by gender). The upper row for each variable gives the mean for females and males, and the lower row provides the difference in means with the stars indicating the statistical significance of difference in menas according to the following confidence levels:
* p<0.05, ** p<0.01, *** p<0.001

Part III

Modelling cigarette demand

In light of the currently implemented cigarette tax increases in Russia, a central interest of this thesis lies in the price responsiveness of cigarette demand. We therefore develop an empirical model of cigarette demand and estimate this on ten years of data (2001-2010) for the working-age sample of the RLMS. The sparse literature which does exist on cigarette demand in Russia has found price elasticities to be close to zero. If this is the case, it would seem to imply that the tax increases introduced and foreseen will have minimal impact on smoking in Russia. However, the previous studies have focused on short time spans and/or have methodological shortcomings that we seek to improve upon in this thesis.

Microeconometric analysis of cigarette demand faces both theoretical challenges, due to the addictive nature of cigarettes, and empirical challenges related to micro-level data, particularly the limited-dependent variable nature of cigarette consumption due to the high share of zero observations. To provide a conceptual framework for our econometric analysis, chapter 5 starts by outlining the three major theoretical frameworks for modelling cigarette consumption, distinguishing between static, myopic and rational addiction demand models. It then reviews the available empirical evidence for each of the three models, focusing on a selection of studies to highlight the key empirical challenges beyond the limited-dependent variable problem. Given the complexity of modelling challenges, empirical studies typically either focus on the role of addiction (as the major theoretical challenge) or try to address the limited-dependent variable problem, with only a handful of studies trying to do both at the same time. In our empirical analyses in chapters 6 and 7, we therefore take each challenge in turn. Chapter 6 starts by addressing the modelling challenges related to the dependent variable – a non-negative integer characterised by a large proportion of zero observations and a bunching of values in multiples of 5, with the latter reflective of and equivalent to measurement error in the dependent variable. To address the large proportions of zeroes we split observed cigarette consumption into participation and consumption decisions, and compare alternative ways to account for measurement error in the positive observations. The resulting two-part model is estimated using a static demand specification, treating the data as a pooled cross-section.

In chapter 7 we then turn to the role of habit formation which moves us from a static to a dynamic demand model. The two key challenges in dynamic models of cigarette demand relate to endogeneity problems caused by the inclusion of lags (and leads) of the dependent variable among the set of regressors: (1) correlation between the lags/leads of the dependent variable with the idiosyncratic regression error by construction of the model, requiring the use of an instrumental-variable strategy and (2) the potential correlation between the lags/leads and time-invariant, unobserved individual effects, requiring some form of unobserved effects panel model strategy to control for the heterogeneity observed and unobserved.

5 Microeconometric approaches to modelling cigarette demand

5.1 Introduction

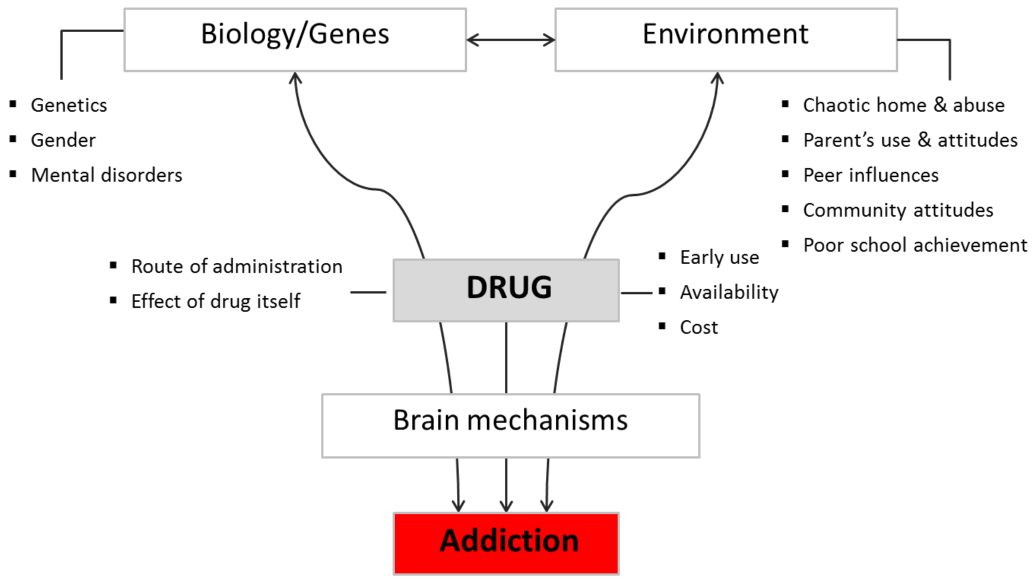
In the previous chapter we have seen that smoking among men has been declining since 2008 - a period which coincides with the beginning of real price rises following the first round of tax increases implemented by the Russian government. In light of the future tax increases due to be implemented over the coming years, it is important to understand how responsive to price increases cigarette consumption in Russia is. This is a complex task though, because the latest law simultaneously implements a number of tobacco control measures across the country making it difficult to disentangle the effects of price increases from the effects of, say, banning the sale of tobacco from small kiosks. In this analysis we focus on an earlier period (2001-2010) where tax increases were implemented independently of a larger set of tobacco control measures.

The WHO promotes tobacco taxes as the most effective policy tool available to governments for decreasing the number of smokers and recommends countries to set taxes so that they make up 70 percent of the final retail price of cigarettes. A substantial body of economic literature on the price responsiveness of cigarette demand supports the argument that cigarettes are indeed subject to the law of demand, meaning that consumption falls as price increases (IARC, 2011). Economic analysis of cigarette demand is, however, not as straightforward as the analysis of other consumption goods given the addictive nature of tobacco. In this chapter we review the three major economic approaches to modelling cigarette consumption so as to provide a conceptual framework for the econometric analyses following in chapters 6 and 7. We start by providing a short background on the evolution of economic models of addiction which can be divided into conventional (static), myopic (dynamic but short-sighted) and rational (dynamic and forward-looking) demand models. In the third section we present the corresponding econometric models for these three approaches and review the available empirical evidence for each of them. Given that in this thesis we draw on individual-level survey data, we focus on the literature using micro-data. Excellent overviews of the large literature based on cross-sectional and time-series aggregate data can be found in Laporte (2006) and the IARC Handbook of Cancer Prevention (2011, volume 14, chapter 4).

5.2 THEORETICAL FRAMEWORKS FOR MODELLING THE DEMAND FOR TOBACCO

Smoking is a complex behaviour that is influenced by a wide range of biological, environmental, and socio-cultural factors. In general, there is no one factor that determines whether an individual will become addicted or not. Rather, as shown in Figure 5.1 below, addiction is the result of a complex interplay of individual biological and environmental factors, as well as the specific features of the particular psychoactive substance (drug) and the brain mechanisms associated with it. For example, a person's gender will influence her clearance rate of nicotine (which determines the "rush' she gets and thus her susceptibility to addiction) as well as the peer influences and community attitudes she experiences which, by encouraging or discouraging tobacco consumption, might influence the initial decision to 'try'.

Figure 5.1 Factors influencing addiction



Source: Adapted from The science of addiction, (NIDA, 2010)

The array of factors associated with addiction has led to a vast literature examining addiction from a number of different theoretical frameworks and with different methodologies. This literature can be viewed as falling into two broad types of analysis: (1) Analyses at a molecular level, which look at the forces that act from inside the individual at the time of drug consumption (e.g. neurophysiological effects of nicotine on the brain), which is the predominant approach in the sciences; (2) Analyses at a molar level which examine aggregates of behaviour over a more extended period of time rather than particular consumption episodes and thus focus on the forces outside of the individual, e.g. price and availability of the drug, family and social relationships, or cultural and societal practices (Vuchinich and Heather, 2003).[37] Economic studies of smoking fall squarely into the set of molar approaches.

The economic literature on smoking can itself be divided into three major streams of literature: (1) Economic theories of smoking (i.e. models seeking to explain tobacco consumption patterns in individuals), (2) welfare economic approaches concentrating on whether smoking is a net cost or benefit for society and thus focusing on potential policies to improve welfare, and (3) empirical microeconomic studies which examine the influences of various factors on smoking behaviour (e.g. risk perception, price increases or smoking bans), as well as the consequences of smoking for individuals, such as health and labour market outcomes (Kenkel and Sindelar, 2011). In the two subsequent chapters of this thesis we model the demand for cigarettes in Russia with a particular focus on the impact of price changes and thus contribute to the empirical microeconomic literature on smoking.

For many years economists either ignored the nature of addiction and treated the consumption of addictive substances in the same way as other consumption goods, or they ignored addictive goods altogether asserting that addiction was an irrational behaviour and therefore not subject to the basic laws of economics, meaning that increases in price and other changes in costs associated with the consumption of addictive goods would not have any predictable impact on their use (Chaloupka and Warner, 2000). That is, those economists who did look at tobacco consumption did so within the standard rational choice framework without any modification to the underlying utility function and

[37] The two types of analyses also reflect the opposing views of addiction as a disease versus addiction as a chosen (albeit difficult to reverse) behaviour, which remains the dividing line between natural and social science approaches.

subject to similar constraints as other goods. They used conventional, static demand models which examined the impact of factors such as price on tobacco demand within a single time period only, assuming tastes (and therefore parameters) to be stable during the sample period. This early research tended to focus on the supply-side of the tobacco market, motivated, for example, by the tobacco industry's interest in the degree of price elasticity for its products or policy makers' interest in the causes and welfare implications of market concentration (Chaloupka and Warner 2000). This changed, however, with the emergence of a body of medical research which established the harmful health effects of smoking in the 1950s and 1960s and drew attention to the public health damage caused by smoking. In turn, this development shifted the research agenda towards demand-side market failures and the overall objective of garnering economic tools to bring about decreases in smoking (ibid.).

The 1950s mark an important turning point for our understanding of tobacco consumption and nicotine dependence in two respects. First, although tobacco has been consumed for pleasure since at least the end of the 16th century, it was not until the mid-20th century that compelling evidence of the harmful health effects of smoking was recognised by the scientific community and the general public. While medical evidence relating smoking to a number of diseases had been accumulating since the end of the 18th century, it was only with the publication of five epidemiological case-control studies linking smoking to the development of lung cancer in the 1950s that proof of causality was finally accepted. This was marked by two widely publicised reports from the Royal College of Physicians of London in 1962 and the Advisory Committee to the US Surgeon General in 1964 acknowledging that smoking was a major cause of lung cancer (Doll, 1998). Since then a substantial body of literature linking smoking to a wide range of illnesses has developed, constituting the largest and most robust literature linking any behaviour to disease within humans (Chaloupka and Warner, 2000). Second, in addition to new evidence on the harmful consequences of smoking, research of the brain reward pathways in the 1950s revolutionised understanding of the neurobiological and cognitive mechanisms underlying reward and addictive processes (Dani and Balfour, 2011). These developments stimulated interest among economists in explicitly modelling the effects of addiction in their demand analyses. This task required them to "dynamize" their models so as to incorporate the specific temporal features of addiction (Laporte, 2006).

5.2.1 From static to dynamic demand models

In neoclassical economic theory of consumer behaviour individuals choose consumption bundles to maximise utility subject to a budget constraint and individual preferences. The optimal level of cigarette consumption is where the expected marginal benefits (e.g. pleasure derived from smoking an additional cigarette) equal the expected marginal costs (both monetary and non-pecuniary costs). Demand analysis then examines the impact of changes in price or income on consumption in terms of comparative statics, that is, it compares two static equilibria without concerning itself with the move from one equilibrium to another and without the equilibria being observed in the real world. This involves questions of the "what if" type such as: "Assuming income to be held constant, which market basket would be chosen if the price vector were *z*?" (Houthakker and Taylor, 1970). However, particularly where goods are addictive, it seems likely that consumption in one period affects the marginal utilities of consumption in the next period. If this is the case, the invariance assumptions imposed by the static demand model are violated.

Dynamic models of addiction explicitly model the effect of past consumption on current choices and consist of two additional components compared to the static model - one component that links consumption over time (implemented through so called 'state adjustment models' which represent habit formation), and one component that specifies how habits affect preferences (Jones, 1999). State adjustment models reflect the fact that for an addictive good, consumption in the current period depends on previous consumption decisions.[38] This interdependence between past and current consumption is built into dynamic models of addiction by extending the demand function to include an addictive 'stock', which increases proportionally with consumption and depreciates at a constant rate when consumption is reduced.[39] In the case of smoking this stock can be thought of as relating to the state of your nervous system and how it is impacted by prior consumption (Rachlin, 1997). In this context, a good is considered addictive or habit-forming if there is a positive causal relation between past and current consumption.

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[38] Addictive goods in this sense refer to habitual goods more generally and include both positive and negative habits/addictions. This differs from the definition employed in other disciplines as well as the official definition of the WHO and APA.

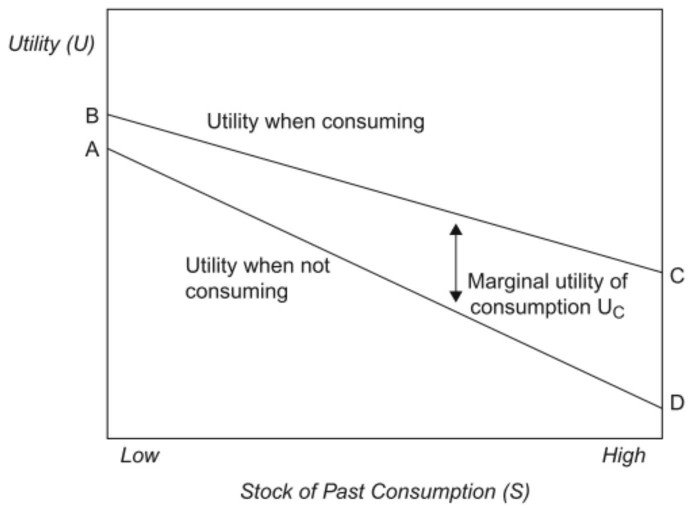
[39] The most widely used form of state adjustment builds on the work by Houthakker and Taylor (1970) who first introduced the idea of an accumulated 'stock' of past consumption in their work on consumer demand in the US. The stock variable can represent a physical stock of goods (e.g. for durable goods such as clothing) or a psychological stock of habits (e.g. for food, cigarettes).

The second component of these addiction models specifies how the addictive stock affects the utility function. Specifically, it identifies how three fundamental characteristics of nicotine - tolerance, reinforcement and withdrawal - influence preferences. *Tolerance* is understood as the process through which the gradual adaptation of the brain to the effects of nicotine leads to higher levels of the substance being necessary to produce the same level of satisfaction. Translated into economic terminology, tolerance means that a higher stock of past consumption of the addictive good decreases the utility of current consumption, i.e. the marginal utility of addictive stock is negative. Present consumption of nicotine thus reduces the utility of future consumption, not only of the addictive good but also of all other possible activities (non-addictive consumption). In figure 2 below, this effect is illustrated by the negative slope of the lines B-C (utility when consuming) and A-D (utility when not consuming) respectively. The negative slope of A-D (utility conditional on currently not consuming the addictive good) depicts the harmfulness of addiction, e.g. decreases in utility due to the adverse health consequences of past addictive consumption.

Reinforcement describes the learned response to the consumption of addictive goods and the rewards associated with it. In the case of cigarettes, the pleasure derived from smoking (both physiological and psychological effects) acts as a positive reinforcer, leading the individual to repeat the behaviour and thus build up addictive stock[40]. In the utility function this means that the marginal utility of current consumption raises with the stock of past consumption - the higher the addictive stock, the greater the immediate gain in utility from current consumption. The effect of reinforcement is shown by the divergence of the two lines B-C and A-D as we move from a low to a high stock of past consumption. The difference in immediate utility is much larger between C and D, than between A and B. Tolerance and reinforcement thus exhibit opposing effects on utility: although utility decreases as addictive stock increases, the immediate gain in utility from current consumption of the addictive substance increases as stock increases (Cawley and Ruhm, 2011). That is, the chain smoker (with a high level of addictive stock) gets a greater immediate boost from smoking than the occasional smoker.

[40] Reinforcement in the context of economic theories of addiction overlaps, but is not identical with reinforcement as a psychological construct In economics it merely designates the increases in immediate utility (current utility) from the consumption of the addictive substance as the addictive stock increases (Rachlin 1997).

Figure 5.2 Graphical representation of the characteristics of addiction



Source: Cawley & Ruhm 2011, p. 113

Augmenting and relating to these opposing effects are the *negative* physical and psychological effects of withdrawal. While in the beginning individuals will smoke for the pleasure derived, at later stages (i.e. at higher addictive stock) they will keep up consumption to avoid these negative effects. In economic terms, the negative impacts of *withdrawal* (the steeply sloping A-D line in figure 2) imply a positive marginal utility of current consumption at every stock of past consumption. As smoking avoids the utility-diminishing effects of withdrawal, consuming cigarettes always yields higher utility than abstaining, which is illustrated in the graph by the line B-C (utility conditional on consuming) lying above the line A-D (utility conditional on currently not consuming) for every level of addictive stock. In this way, withdrawal increases the efficiency of current consumption. Both tolerance and withdrawal show the negative effects of harmful addictions: While it is always (i.e. at any level of addictive stock) better to smoke a cigarette than not to smoke (so as to avoid withdrawal), smoking decreases utility in the long run (due to tolerance), though this is counter-balanced by the effects of reinforcement.

While there is a general consensus on addictive stock as the mechanism for habit formation (meaning that there is a positive relation between past and current consumption due to tolerance and withdrawal), economic models of addiction differ in their assumptions about the effects of addictive stock on future utility, that is, how the characteristics of nicotine addiction are thought to impinge on the assessment of marginal costs and benefits and thus on optimal choice over time.

Early dynamic models such as Pollak, 1970 relied on a myopic (naïve) view of behaviour in which individuals were ignorant of the impact of their current consumption choices on future tastes and therefore unable to see the dependence of optimal future consumption on their decisions in the current period. In these models a positive coefficient of past consumption (representing the addictive stock) is interpreted as evidence of addiction.[41] These myopic models posed a challenge to the prevailing economic wisdom of rational utility maximising individuals who make their choices cognisant of the inter-temporal relationship between current and future utility.

Subsequently, the proponents of the so-called ‘rational addiction models’ challenged the notion that the consumption of addictive substances conflicts with forward-looking utility maximisation (Becker and Murphy, 1988). Becker and Murphy use the term ‘rational’ to refer to farsighted behaviour, meaning that individuals correctly anticipate the future consequences of their current consumption and factor those consequences into their consumption decisions (Cawley, 2008). The central tool for reconciling addiction with forward-looking rational choice is the property of reinforcement, which is called ‘adjacent complementarity’ in the model. Adjacent complementarity means that due to reinforcement the quantities of the addictive good consumed in adjacent time periods are complements, i.e. past, current and future consumption are positively related in the utility function. In deciding how much of the addictive commodity to consume individuals weigh the current utility effects (the satisfaction derived from smoking) against the anticipated impact of today’s consumption on future utility, taking into account both utility-diminishing effects (through tolerance and health damage) and utility-enhancing effects (the increased future utility from consumption through adjacent complementarity), discounted by their individual rate of time preference. That is, rather than making independent consumption decisions each period, individuals map out an optimal lifetime consumption path based on their beliefs of the relative effects of tolerance and reinforcement, the expected value of exogenous variables such as the price of cigarettes,

[41] While myopic models attribute the dynamic effects in consumption to the addictiveness of nicotine and the resulting short-sighted behaviour rather than to mere habit formation, they are similar in their statistical structure to models of habit persistence which have been applied more widely in consumer demand analysis.

as well as unobservable individual characteristics such as attitudes to health consequences and the rate of time preference. The model assumes individuals to have perfect information about the future and preferences to be stable, meaning that their future behaviour is consistent with their current desires regarding this behaviour, and there will be no future 'regret' (Gruber and Köszegi, 2001).

Yet, while adjacent complementarity leads to future gains in utility through present consumption, this does not automatically override the future disutility caused by tolerance. For someone to rationally follow an addictive consumption path, the positive effects of reinforcement must exceed the negative effects of tolerance. The balance of reinforcement and tolerance and thus the potential for addiction depends on (1) the rate of time preference (the degree to which future utility is discounted), (2) the rate of dissipation of the addictive stock (which determines the degree of adjacent complementarity), and (3) the extrinsic price of the addictive commodity (i.e. price including money, time to obtain the commodity etc) (Rachlin, 1997). In its econometric realisation the Becker-Murphy model includes both future consumption and future prices, *in addition* to past consumption, to represent the addictive stock. For rational addiction to hold, current consumption has to be positively related to past and future consumption, as well as past and future prices (Jones and Contoyannis, 2002).

In both myopic and rational models the impact of price increases are expected to be higher in the long-run than in the short-run due to the lags in the adjustment of the addictive stock. However, while both models predict that a price increase in the past will reduce current consumption; rational models additionally predict a reduction in current consumption for anticipated *future* price increases, and the reduction is larger if this price increase is expected to persist, due to adjacent complementarity. In this case it becomes optimal to consume less and reduce the level of addictive stock in order to mitigate future utility losses.

Myopic models and the Becker-Murphy model characterise two extreme views of individual behaviour. In the former, the individual is naïve and while he realizes the dependence of his current choices on past consumption, he cannot project this into the future period so that his addiction is the result of the unexpected consequences of consumption. The rational individual in the Becker-Murphy model by contrast is able to correctly anticipate all the future utility effects and implements a consistent maximising plan, thus choosing rationally to become an addict. In the middle of this spectrum we find rational models of addiction which, while assuming forward-looking behaviour, relax some of the assumptions underlying the Becker-Murphy model, such as the assumption of perfect foresight or time-consistent preferences. While theoretically more appealing than the perfect optimizer of the Becker-Murphy model, the imperfectly rational models of addiction (Schelling, 1978) have not been applied in the empirical literature so far – partly because they are empirically equivalent to the Becker-Murphy model, as is for example the case with time-consistent and time-inconsistent preferences. In our review of the literature in the following section we therefore focus on the three major modelling approaches that have found application, that is, on static, myopic and (perfectly) rational addiction models.

5.3 EMPIRICAL APPROACHES TO MODELLING CIGARETTE DEMAND

While up to the 1990s the majority of empirical studies on the price elasticity of cigarette demand were based on aggregate-level sales data, that is, time-series or pooled time-series cross-sectional data (e.g. state-level sales data in the US), in the past two decades research based on individual or household-level data has dominated, promoted by the increasing availability of large-scale representative survey data and advances in computing power (IARC, 2011). From an empirical perspective, micro-level data come with a number of advantages compared to aggregate-level data for estimating the effects of prices on cigarette consumption. Individual-level data allow for a richer specification of the empirical model and thus a more nuanced analysis than aggregate data (IARC, 2011). While aggregate-level studies generally confirmed that cigarette consumption is subject to the downward-sloping demand curve and that price increases reduce consumption, they cannot identify the source of these variations, that is, whether the reduction is due to fewer smokers in the population (prevalence decreased) or due to smokers reducing their consumption, or a combination of both. Survey data typically ask respondents about current smoking status, initiation and cessation, as well as consumption levels, so that it is possible to analyse the effect of price separately for each of the decision processes underlying observed consumption patterns. Furthermore, surveys provide rich information on demographic and socioeconomic characteristics of respondents which, in addition to controlling for observable individual heterogeneity, allow a further differentiation of price elasticities with respect to various subgroups of the population. With longitudinal survey data one can additionally account for (fixed) unobservable individual factors, such as individual rates of time preference or risk attitudes, through panel data estimation techniques.

Notwithstanding the advantages over aggregate sales data, survey data do come with their own empirical challenges. First, as noted in chapter 2, self-reported consumption data are subject to reporting biases, which can seriously distort the estimates. Second, survey data sets typically lack macro-level variables that characterise the environmental influences on individual consumption decisions, for example the extent of tobacco control policies such as advertising bans or restrictions on smoking in public places, as well as data on socio-cultural influences such as the social acceptability of smoking or peer effects. If these factors are not controlled for in the empirical specification, elasticity estimates will be biased away from zero (i.e. they will be over-estimated). With observations on multiple time periods, i.e. pooled cross-sectional or longitudinal data, one solution to avoid the resulting omitted variable bias is to include location-specific dummy variables that capture any time-invariant, unobserved environmental factors particular to the location the individual resides in. However, to avoid collinearity issues this approach requires sufficient within-location variation in the price variable over time and runs into problems if there is reason to believe that omitted variables such as anti-smoking sentiment have changed over the time period under consideration. As an alternative strategy, one can attempt to capture features of the smoking environment and include them among the covariates, e.g. tobacco control variables such as the presence of worksite smoking bans or advertising bans, or variables that try to proxy anti-smoking sentiment in the population, such as attitudes towards tobacco control policies, although such a proxy might be endogenous in the demand model, particularly if based on the same survey that the consumption data are derived from.

A key issue that pertains to both micro- and macro-level studies is the cigarette price measure employed. Scanner-based data collected at retail or household-level provide the most accurate price measures, but might not provide good geographic coverage/representativeness and are challenging to implement in low- and middle-income countries. Observational collection methods gather prices from shops but might also be problematic in terms of representativeness, both through limited geographic coverage and non-random sampling strategies. These data can then be aggregated to create regional price measures, for example, the regional prices provided by Rosstat and used in this thesis are calculated from the Household Budget Surveys that Rosstat conducts. Finally, surveys often collect self-reported prices or household expenditure data on tobacco from which prices could be derived. In addition to reporting bias and (often substantial) missing data, this raises serious endogeneity problems. For example, heavier smokers might be more likely to smoke economy brands, which would overstate the effect of price on consumption if we estimated their demand on self-reported price measures. Furthermore, household-level expenditures are typically reported by one individual of the household who might not be knowledgeable about all items purchased, particularly with respect to cigarettes which are often bought separately in small shops rather than being part of the household shopping. A second problem that relates equally to micro and macro data are tax avoidance strategies and smuggling, resulting in understated price effects. This issue has been particularly relevant in the US where differences in tax levels between states create incentives for cross-border shopping. While cross-border shopping opportunities can be accounted for to some extent in the analysis, capturing illicit trade is more problematic, especially since these data are typically only available at the state level. To the extent that smuggling is location-specific and constant over time it could be addressed through location dummies.

While the theoretical developments described in the second section have moved aggregate-level analyses from static to dynamic models based on the rational addiction framework, the majority of empirical work using individual-level data has been carried out with cross-sectional survey data, which preclude the estimation of dynamic models since this would require multiple observations of cigarette consumption on the same individual. Therefore, rather than testing between myopic and forward-looking addiction models, this literature has focused on the various empirical challenges outlined above. Given the possibility to distinguish between smoking participation and consumption decisions in micro data, the predominant empirical model that has been employed is the two-part model proposed by (Cragg, 1971) which models consumption as two sequential decisions on whether to consume and how much to consume and estimates elasticities separately for smoking participation (typically via a probit or logit model) and smoking intensity (typically via OLS). Alternative estimation strategies that have been adopted are sample selection models which correct the consumption equation for self-selection into smoking, or censoring/latent demand approaches such as Tobit models, which address the high frequency of zeros in cigarette consumption data. Jones (1989) proposed a class of models called double-hurdle models, which nest the original two-part model, sample selection and censoring models and which will be explored in more detail in chapter 6.

In the empirical analyses of the two subsequent chapters of the thesis we address both the theoretical challenges due to the addictive nature of cigarettes and the empirical challenges related to micro-level data. In our review of the empirical evidence in the following section we therefore distinguish between static, myopic and rational addiction demand models, and within the static models classify studies according to the empirical challenges they try to address. We do not go into detail concerning the estimation strategies adopted in each of the studies as this will we be covered in chapter 6. Since a review of the complete literature is beyond the scope of this chapter we focus on select papers. For details regarding data, sample size, empirical approach and elasticity estimates of the studies reviewed in this chapter see to appendices 5-A to 5-C for the static, myopic and rational addiction demand models respectively. An excellent and detailed review of the available empirical evidence on the effects of prices and taxes on cigarette consumption can be found in volume 14 of the IARC Handbook on Cancer Research (chapters 4 and 5 for studies using aggregate and individual-level data respectively).

In reviewing the evidence it is important to differentiate the conclusions with regard to price responsiveness that can be drawn from studies based on cross-sectional versus longitudinal data. The concept of price elasticity is a unit-free measure that indicates by what percentage the quantity demanded changes in response to a 1 percent change in the price. In a cross-sectional setting individuals are surveyed at a single point in time. With pooled cross-sectional data several years might be spanned but the data is still treated as a collection of single observations on different individuals surveyed in different years. This is in contrast to studies using longitudinal data which collect repeated observations on the same individual. With cross-sectional data we can estimate a demand curve that tells us how the quantity demanded varies with price and distinguish price responsiveness with regard to important demographic and socioeconomic criteria such as age, gender and income. Pooled cross-sectional data allow us to make this estimation for multiple points in time. This does not, however, tell us how individuals respond to price *changes* since this requires data on individual-level changes in consumption which we can only observe in longitudinal settings. That is, with cross-sectional data we can estimate a population-level demand curve, whereas with longitudinal data we can estimate individual-level demand curves and consumption dynamics.

5.3.1 Static demand model

In a static demand model based on cross-sectional survey data, current consumption C_i (typically average daily consumption) can be expressed as a function of the real price of cigarettes P_i, the real price of related goods PR_i (e.g. alcohol), a vector of individual and household characteristics X_i (e.g. age, education, occupation, household income and size), as well as a vector capturing environmental and location-specific factors L_i (e.g. settlement type or tobacco control features such as smoking bans), where *i* denotes the individual.

$$C_i = \alpha + \beta_1 P_i + \beta_2 PR_i + \beta_3 X_i + \beta_4 L_i + \varepsilon_i \quad (1)$$

The price of alcohol can be expected to be negatively related to cigarette demand in so far as alcohol and cigarettes are complements, i.e. tend to be consumed together, so that a price increase for alcohol would lead to a drop in cigarette consumption via reduced alcohol consumption. That is, if prices of complementary goods are omitted from the model the responsiveness of demand to cigarette prices will be overstated. Income is expected to be positively related to consumption if cigarettes are a normal good, i.e. as income raises individuals consume more of it. However, since rising income could at the same time increase the demand for health, the effects of income on smoking are not clear, *a priori* (Grossman, 1972).

The price elasticity of demand is calculated as the percentage change in quantity demanded over the percentage change in price. Elasticities of less than 1 in absolute value indicate that demand is inelastic (i.e. the percentage change in quantity demanded is less than the percentage change in price), and elasticities greater than 1 describe elastic or highly responsive demand.

Models accounting for cross-border shopping

The first analysis based on individual-level data was conducted by Lewit and Coate (1982) using a sample of 19,266 respondents aged 20-74 from the 1976 wave of the National Health Interview Survey in the US. To assess whether cross-border shopping leads to biased estimates of price elasticity they estimated their two-part model on both the full sample and on a restricted sample which eliminated those respondents who resided in areas where the average price of cigarettes was higher than the price in localities within 20 miles from that area (based on the idea that for those individuals there are substantial incentives to travel to a neighbouring area with cheaper prices to buy their cigarettes so that their area prices would overstate the prices they actually faced). Their results highlight the importance of accounting for cross-border shopping, with the elasticities in the full sample being half the size of the elasticities in the restricted sample. Lewit and Coate (1982) also estimated price elasticities by gender and age groups and found that price elasticities were higher among men and decreased with age. An alternative (simpler) strategy is to construct cigarette prices as a weighted average of mean prices in the area of residence and the border price, with border price being the lowest price observed within a certain radius of the area of residence – this approach is adopted for example in Chaloupka (1991) and Ohsfeldt (1994).

Models Accounting for other tobacco control policies and anti-smoking sentiment

Wasserman et al. (1991) focused on the development of price responsiveness over time and were the first to examine the effect of excise taxes and restrictions on smoking in public places, while at the same time controlling for cross-border shopping using the same approach taken in Lewit and Coate (1982). In their study they pooled seven waves of the National Health Interview Survey between 1970 and 1985. To capture the strength of smoking restrictions they calculated a regulation index that was based on state-level laws regarding restrictions on smoking in public transportation, public facilities (e.g. indoor recreational or cultural facilities, health care facilities, schools), retail stores, restaurants, as well as public and private worksites. The index took a higher value for states where smoking was restricted in a large number of places and/or in places where people spend a lot of time, e.g. the indicator took the value one if smoking was restricted in private worksites. The authors found that smoking restrictions reduced the intensity of consumption, but did not have statistically significant impact on smoking participation. Cigarette prices by contrast had a greater impact on smoking prevalence than on smoking intensity (-0.17 compared to -0.09 in 1985). Furthermore, they found price elasticities to be increasing over time.

A similar approach to Wasserman et al. is taken by Tauras (2004) who examines the impact of price and other tobacco control policies on some-day smoking[42] among adults using three years of the National Health Interview Surveys (1992-1994). He adopts a three

[42] Meaning smoking on a less than daily basis, e.g. social smokers who only smoke on certain occasions.

part model which, conditional on being a current smoker, distinguishes between daily and some-day smokers in the second part of the model, and then estimates conditional demand for some-day smokers in the third part. The clean-air laws indicator is based on ten dichotomous indicators for the presence of restrictions in various indoor facilities. To create the index each indicator is given a value from 0 to 3 depending on the strength of the restriction as well as assigned a weight to emphasise places where individuals spend much of their time. He finds that price increases affect all three parts of the model: in addition to reducing prevalence and smoking intensity, higher prices increase the likelihood that smokers will smoke less than daily. Clean-air laws by contrast do not have any statistically significant effect on consumption frequency.

Since taxes (and therefore prices) are the outcome of political processes at the state-level, they will reflect attitudes towards smoking in the population and thus are likely to be endogenous in the demand equation. Tauras (2006) and Sloan and Trogdon (2004) address this endogeneity problem by accounting for unobservable state-level influences through year and state fixed effects in addition to observable factors such as tobacco control policies. Both studies find a statistically significant, albeit rather low, effects of cigarette prices on consumption (elasticities between -0.1 to -0.4). In line with earlier studies they find smoke-free air laws to decrease average consumption but to have little effect on prevalence. An interesting study by Stehr (2007) focuses on gender differences in price responsiveness based on 15 waves of the Behavioural Risk Factor Surveillance system (1985-2000). The author argues that previous studies of price responsiveness suffer from omitted variable bias resulting from a negative correlation between gender differences in smoking prevalence and cigarette taxes. Using gender-specific state fixed effects he shows that in contrast to the findings from previous studies, women are twice as responsive to price as men.

Models accounting for compensating behaviours

If the ultimate goal for cigarette taxes is to improve population health, reduced daily consumption of cigarettes might be an imperfect measure since it does not take into account any compensating behaviours that have negative effects on health, for example smoking cigarettes with higher nicotine and tar content or smoking each cigarette more intensively. If smokers compensate for reduced cigarette consumption in this way, tax increases might lead to deteriorating health outcomes among remaining smokers.

Three studies that were able to draw on individual-level nicotine, tar and partly cotinine values confirm this hypothesis. Evans and Farrelly use the 1979 and 1987 supplements to the National Health Interview Survey (NHIS) in the US which, in addition to consumption levels, asks individuals about the cigarette brand they smoke. Based on this information and the reported daily consumption level the authors calculate average daily nicotine and tar intake for each respondent. They find that smokers in high-tax states consume longer cigarettes and with higher tar and nicotine content (Evans and Farrelly, 1998). A similar approach is taken by Farrelly et al. (2004) who have the advantage of being able to draw on longitudinal data from a telephone survey (1983-1993) that was part of the Community Intervention Trial for Smoking Cessation (COMMIT). Nicotine and tar levels are calculated based on respondents' indication of which brand or type of cigarettes they preferred (light, ultralight, regular, unfiltered). Their results confirm the earlier work of Evans and Farrelly and show that smokers compensate for a reduction in the number of cigarettes by increasing the tar and nicotine consumed per cigarette (Farrelly et al., 2004). A third study by Adda and Cornaglia (2006) could additionally draw on data on cotinine concentration collected through the National Health and Nutrition Examination Survey in the US. Their analysis shows that in addition to adjusting the numbers smoked and switching to cigarettes with higher tar and nicotine yield, smokers also extract more nicotine per intake (Adda and Cornaglia, 2006). Taken together, these results suggest that while the effects of prices on smoking cessation will have a positive impact on population health, reductions in consumption in response to price increases are unlikely to yield any tangible health benefits.

MODELS ACCOUNTING FOR OTHER HEALTH BEHAVIOURS

Cigarette smoking is related to a number of other health behaviours, with studies typically finding that smoking increases with alcohol consumption and decreases with physical exercise and obesity. To the extent that smoking and alcohol are positively correlated, not accounting for alcohol consumption will underestimate price elasticities. Hu et al. (1995) were the first to estimate the demand for cigarettes taking into account a range of other health behaviours drawing on pooled cross-sectional surveys from the California BRFSS (1985-1991). They find that controlling for other behavioural risk factors (alcohol consumption, physical exercise and obesity) significantly reduces the price elasticity of participation (-0.54 versus -0.33), but has only minimal effects on consumption elasticity (-0.22 versus -0.20) (Hu et al., 1995). Given the strong complementarities between tobacco and alcohol consumption a number of studies estimate the demand for the two products jointly rather than controlling for alcohol in the cigarette demand equation, for example Aristei and Pieroni (2010) and Yu and Abler (2010).

However, while smoking might be causally related to other behaviours, the relationship could also be linked via unobservable individual factors such as a propensity for anxiety, a low rate of time preference and/or low rate of risk aversion. If this is the case, the estimates will suffer from omitted variable bias even after controlling for other observable health behaviours. This would then necessitate an instrumental variable strategy or individual-level panel data that allow controlling for unobservable individual heterogeneity.

MODELS ACCOUNTING FOR PEER EFFECTS

In addition to being related to other health behaviours, smoking is also impacted by the behaviour of other persons, that is, there are interpersonal complementarities in consumption. Cutler and Glaeser (2010) classify the sources of social interactions in smoking into three broad categories: (1) Direct social interactions, including social approval and stigma, (2) formation of beliefs through social learning, and (3) market-mediated spill-overs (e.g. through supply structures). An example for the first category is interaction in the workplace. For example, I might smoke more cigarettes when working together with a smoking colleague and stepping out together for frequent smoking breaks than I would when working together with a non-smoking colleague. Also, if that smoking colleague stops smoking this might have positive spill-over effects on my consumption. As concerns social learning, I might revise my beliefs about the consequences of smoking if friends or family members quit smoking for health reasons.[43] Cutler and Glaeser (2010) consider the third category (market spill-overs) to be less relevant in the case of smoking.

Peer groups can be defined at various levels of aggregation, from parents and spouses, through friends and people with similar socioeconomic characteristics, to people living in the same area and thus being affected to similar extent by policies such as workplace smoking bans. Aristei and Pieroni (2009) use a sample of 47,777 ever-smokers from the 2000 Italian Survey on Health Status and Use of Health Services to model the decisions of how much to smoke and whether to quit. Peer effects are measured at two levels: (1)

[43] The social learning effects are also supported by the finding that individuals are more likely to revise their beliefs if risk information is personalized and in response to health shocks (Sloan et al., 2003).

the number of smokers in the household and (2) the smoking rate in the reference group (i.e. people with similar demographic characteristics), and, while the model is static in nature, the strength of addiction is proxied through a continuous variable for the duration of smoking. The results indicate that the impact of addiction is higher for men and the habit thus likely to be more persistent among male smokers. Female participation rates and consumption levels by contrast are more susceptible to peer group influences (Aristei and Pieroni, 2009). The price elasticity of participation (here measured in terms of quitting) is four times higher among women than among men (-0.65 vs. -0.13), suggesting that a higher level of addiction reduces the impact of price in men's decision to quit.

Cutler and Glaeser (2010) take a similar approach to Aristei and Pieroni, but at the household-level they look at the effect of social interactions by examining the influence of one spouse's smoking decision on the smoking propensity of the other spouse. They address the endogeneity of spousal smoking by using the presence of a worksite smoking ban at one of the spouses' workplaces as an instrument. As a second measure of peer influence they include the smoking rates of people with similar demographic characteristics. Their results suggest that spousal smoking has a much stronger impact on smoking participation decisions than cigarette taxes (0.4 versus -0.005 in the instrumental variable estimates). That is, the probability of smoking decreases by 40 percent if a spouse quits smoking (Cutler and Glaeser, 2010).

EVIDENCE FROM LOW- AND MIDDLE-INCOME COUNTRIES

While the majority of studies on the price responsiveness of cigarette demand have been conducted in high-income countries (predominantly the US), the empirical literature on low- and middle income countries is rather sparse, owing mostly to lack of good quality survey data in these countries. The reported price elasticities are generally in line with the results from high-income settings and confirm that cigarette demand is responsive to price, albeit rather inelastic.[44] However, the four published studies for Russia report very low elasticities, which for men were close to zero (Herzfeld et al., 2013; Lance et al., 2004; Ogloblin and Brock, 2011, 2003). These studies will be discussed in detail in section 4.

[44] Price elasticities for studies from selected countries can be found in table 5-A in the appendix.

5.3.2 NAÏVE (MYOPIC) DEMAND MODELS

As described in the second section, the early models of addiction explained addictive consumption patterns (defined in economic terms as an increase in past consumption of a good leading to an increase in current consumption) as a result of short-sighted preferences. The intertemporal dependence in consumption is built into the model by means of the addictive stock that is thought to reflect both the physiological and psychological effects of addictive substances, which in the empirical specification is most often implemented through one or several lags in consumption ($\gamma_1 C_{it-1}$). A positive coefficient on $\gamma_1 C_{it-1}$ is then interpreted as evidence of addiction. In dynamic models, the price coefficient β_1 captures the short run impact of price on consumption. The long-run price effect additionally depends on how long it takes for consumption to adjust to the price change and is calculated as the ratio of the price coefficient $\beta_1$over 1 minus the coefficient on lagged consumption γ_1, i.e. $\beta_1/1-\gamma_1$. The model predicts that short-run elasticities will be shorter than long-run elasticities due to the lags in the adjustment of the addictive stock.

$$C_{it} = \alpha + \gamma_1 C_{it-1} + \beta_1 P_{it} + \beta_2 PR_{it} + \beta_3 X_{it} + \beta_4 L_{it} + \varepsilon_{it} \qquad (2)$$

Mullahy (1985) was the first to estimate a myopic addiction model using individual-level data from the 1979 wave of the US Health Interview Survey. He adopted a two-part model to estimate cigarette demand separately by gender, and used instrumental variable methods to account for unobservable individual heterogeneity likely to be correlated with the stock of past consumption. Mullahy finds strong support for addiction, as shown by positive and significant coefficients on the addictive stock (measured as cumulative past consumption) in both the participation and consumption equations, with an overall price elasticity of -0.47. Contrary to the results from the literature using static models he shows that men are more price responsive than women (-0.56 versus -0.39). Finally, using an interaction between the addictive stock and price, Mullahy concludes that more-addicted smokers (defined as those with a larger addictive stock) are less responsive to price than their less-addicted counterparts.

In a careful analysis, Gilleskie and Strumpf (2005) examine the influence of previous smoking behaviour on the persistence of cigarette consumption among youths, drawing on data from the National Educational Longitudinal Study (NELS) in the US which surveyed approximately 24,500 eighth graders in 1988 and conducted two follow-up surveys in 1990 and 1992 (Gilleskie and Strumpf, 2005). In addition to student characteristics, the study also collects information on the student's background, upbringing, early family environment, as well as parental and early school characteristics, allowing the authors to control for a rich set of observable characteristics at individual, family, school and state level. While assuming that individuals are forward-looking, Gilleskie and Strumpf argue that current consumption decisions depend on the optimal *expected* values rather than the *ex-post* values implied by including leads of prices and/or consumption as typically done in empirical specifications of the rational addiction model. Since prices are typically not known with perfect foresight, expectations are formed based on current prices and future optimal consumption is a function of these expectations and future unobserved preferences. As a result, their empirical specification resembles a myopic specification which models the dependence of current smoking behaviour on past consumption and accounts for the endogeneity of lagged smoking through permanent individual unobservables. Starting from a simple static model with few covariates the authors first build into their models a richer set of covariates, before subsequently seeking to account for: (1) state-level unobservable heterogeneity; (2) lagged smoking behaviour; (3) the endogeneity of past smoking. Their results show that while accounting for a richer set of observable exogenous characteristics improves and slightly reduces estimates of the price elasticities, accounting for unobservable effects at the state level and past smoking behaviour fundamentally changes the results, with the price effects becoming insignificant. Yet, once they account for the correlation between individual unobservable heterogeneity and past smoking behaviour, prices again have a significant and negative effect on both participation and consumption, with long-run elasticities exceeding short-run elasticities.

5.3.3 The Becker-Murphy rational addiction model

As in myopic models of addiction, the Becker-Murphy rational addiction model captures the addictive nature of smoking through the positive relationship between past and current consumption. In addition, future consumption and future prices are included to test the rational (forward-looking) aspect. Thus, a positive coefficient on C_{it-1} is interpreted as evidence for the addictiveness of smoking, while rational behaviour requires a positive coefficient on C_{it+1} and P_{it+1} .

$$C_{it} = \alpha + \gamma_1 C_{it-1} + \gamma_2 C_{it+1} + \beta_1 P_{it} + \beta_2 P_{it+1} + \beta_3 PR + \beta_4 X_{it} + \beta_5 L_{it} + \varepsilon_t \quad (3)$$

Individuals discount the value of future events and therefore the coefficient on lead consumption is expected to be smaller than the coefficient on past consumption, with the difference between the two representing the discount rate (Laporte, 2006). As in myopic models, the long-run price elasticity takes into account the adjustment process through the addictive stock, which now consists of the impact of past consumption and future (expected) consumption, and is calculated as $(\beta_1 + \beta_2)/(1 - \gamma_1 - \gamma_2)$.

Chaloupka (1991) was the first to estimate the Becker-Murphy rational addiction model based on individual-level cross-sectional data from the Second National Health Examination and Nutrition Survey (NHANES) in the US, conducted from 1976 to 1980. To estimate a rational addiction model at least three observations on consumption per individual are required (past, current, future). However, being cross-sectional, the survey only collected one year of data per individual, in which daily cigarette consumption in the current and past period is reported, as well as the maximum daily quantity the individual smoked at any point in time. In order to derive consumption for three consecutive periods, Chaloupka treats reported current consumption as future consumption, reported past consumption as current consumption, and uses reported maximum consumption to approximate consumption in t-1 and with this the addictive stock, setting the value to zero for those who began smoking less than two years before the interview. In contrast to Mullahy (1985), he also takes into account the depreciation of addictive stock according to

$$A_t = \sum_{i=0}^{t-1} C_i D_i = t\overline{CD} \quad (4)$$

where *t* is the duration of smoking, *C* maximum reported consumption, and *D* the rate of depreciation. For non-smokers the addictive stock is set to zero. To address the endogeneity of past and future smoking in the current demand equation he adopts two-stage least squares models using four lags, four leads and current prices and taxes as instruments, and reports results for four models with different rates of depreciation of the addictive stock (60, 80 and 100 percent, as well as rate assumed), estimated on the full sample, the sample of ever-smokers, and the sample of current smokers only. His results generally confirmed that smoking is an addictive but also forward-looking behaviour, with positive coefficients obtained for both past and future consumption.[45] Consistent with the results from myopic models of addiction he finds that men are more responsive to price than women, highlighting the importance of accounting for dynamics in estimating cigarette demand. Models estimated on sub-samples by age and education showed cigarette consumption among younger and less educated individuals is affected strongly by past but only weakly by future consumption, suggesting that these groups behave more myopically (Chaloupka, 1991).

Labeaga (1999) and Jones and Labeaga (2003) estimated a rational addiction model based on household-level panel data from the Spanish Permanent Survey of Consumption. While the main focus of their papers was on measurement errors, the censoring nature of cigarette consumption data and unobservable heterogeneity, Labeaga (1999) also reports detailed price elasticities, which confirm the results of Chaloupka (consumption among younger and less educated individuals is less responsive to price, long-run elasticities are larger than short-run elasticities). While confirming that addiction is a product of forward-looking behaviour, Jones and Labeaga (1993) caution that the rational addiction specification is sensitive to unobservable heterogeneity and censoring in the dependent variable (Jones and Labeaga, 2003).

5.4 Empirical literature on smoking in Russia

To our knowledge there are currently four published papers on the price responsiveness of smoking in Russia, all of which use the RLMS data:[46]

1. Ogloblin and Brock (2003) estimate a static model of smoking participation using two rounds of the RLMS (1996 and 1998).

2. Lance et al. (2004) adopt a static two-part model focusing on male smoking participation and cigarette consumption in Russia and China, using three rounds of the RLMS (1996, 1998 and 2000).

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[45] The validity of these instruments seems questionable however in this context, since by construction they are associated with the dependent variable as well as the endogenous variable.

[46] For details regarding sample size, estimation methods see Table 5-D in the appendix.

3. Ogloblin and Brock (2011) estimate a static model of cigarette demand for females using two rounds of the RLMS (2000 and 2009).

4. A recent study by Herzfeld et al. (2013) estimated the dynamics of food, alcohol and cigarette consumption using 10 rounds of the RLMS spanning the period 1995 to 2005.

In their first paper, Ogloblin and Brock (2003) examine the determinants of smoking participation separately by gender. They find that while male smoking participation is unresponsive to price (-0.085), the decision to smoke among females is more sensitive to price (-0.628). Similarly, income was found to have a very small negative effect on participation among men (-0.007), whereas female participation increased with income (0.047). For both men and women, the probability of smoking increased with age and then started to decrease around middle age for men, and in the late 20s for women. As with the bivariate associations between smoking prevalence and education outlined in the previous chapter, Ogloblin and Brock find education to be an important correlate of smoking participation, which is particularly pronounced among men.

Given that Ogloblin and Brock (2003) only use two rounds of the RLMS, they do not exploit the panel nature of the data and so their results might be unreliable to the extent that endogeneity and/or serial correlation are important factors in cigarette demand functions. Indeed, Lance et al. (2004) show that more restrictive specifications allowing for unobservable effects at the regional and community level yield consistently lower estimates of price elasticity for both participation and consumption. In their analysis, the coefficients for most elasticity estimates are more than halved in the most restrictive specification compared to the ‘heterogeneity free’, pooled cross-section specification. They find overall price elasticities of smoking in the range of 0 to -0.15, which is much smaller than elasticities reported for other countries, typically falling between -0.3 and -0.5 (Chaloupka and Warner, 2000). However, their analysis is restricted to men (albeit a younger sample, compared to the analysis of Ogloblin and Brock, including men aged 14 and above) and in view of the gender specific determinants of smoking, we would expect different estimates for a female sample. Indeed, in their second paper on female cigarette demand drawing on RLMS data from 2000 and 2009, Ogloblin and Brock (2011) find higher price elasticities for female cigarette consumption. In that analysis they use the years 2000 and 2009 to estimate a static cigarette demand model for females, both separately for 2000 and 2009, and using a pooled sample. In the separate models, the price elasticity of consumption is -0.454 and -0.541 for the years 2000 and 2009 respectively, with very low but significant income elasticities (0.080 and 0.037). Using the 2009 elasticity estimate they calculate that a 50 percent increase in the price of cigarettes would reduce the average daily quantity consumed by 27 percent, and conclude that tax increases are an effective means for reducing consumption among women in Russia. In addition, they estimate the model on the pooled sample and include a dummy variable for the year 2009, which leads them to conclude that keeping everything else constant, "the average number of cigarettes smoked in 2009 would increase 45.2 percent compared with 2000 (Ogloblin and Brock, 2011, p. 45). Apart from price and income, their results again confirm that education has a strong and negative effect on cigarette consumption, with women having university education smoking 68.8 (83) percent less per day compared to those with high school education only in 2000 (2009). While this represents an important addition to the previous two studies, the results need to be interpreted cautiously, not least because of the choice of years. That is, as outlined in chapter 2, in 2001 the Moscow and St. Petersburg samples were replaced due to high attrition in the sample and the previous observations excluded from the representative cross-sectional sample, meaning that part of the effect observed by Ogloblin and Brock could be driven by compositional changes in the Moscow and St. Petersburg sample after 2001. While we are not using the year 2000 in the thesis so cannot evaluate this effect, our analysis of the effect of compositional changes in the sample on the bivariate associations of smoking prevalence in the previous chapter suggest replenishments of the sample do have non-negligible effects, which are stronger when including respondents above working age.

While differing with regard to estimation methods and sample specification, all of the above three studies work within static specifications, which is restrictive given the likely intertemporal effects in consumption due to habit formation/addiction. A recent study by Herzfeld et al. (2013) provides insight into the dynamics of food, alcohol and cigarette consumption in Russia. Drawing on ten rounds of data, from 1994-2005, the authors estimate a demand model in which they test for habit formation by including the one period lagged value of the dependent variable among the set of regressors.[47] In addition to individual and household level demographic and socioeconomic controls, they also include a set of regional-level indicators such as gross-regional product (GRP), GRP

[47] While the authors do not refer to addiction models in their paper, the habit formation approach is equivalent to empirical applications of myopic addiction models.

growth, and unemployment rate, derived from the Russian Statistical Yearbook, published by the State Statistics Agency Rosstat. The model is estimated on the subsample of individuals who smoke in at least one round and using an estimator that adjusts for sample selection bias.[48] In contrast to the previous dynamic models of cigarette consumption in the myopic and rational addiction literature, the results from Herzfeld et al. show that female smokers are more responsive to price than male smokers, confirming the previous, static models of cigarette demand referred to above. Furthermore, in order to test whether those who formed their demand preferences under the central command economy exhibit different demand behaviour compared to the younger generations, they also estimate their demand model on subsamples defined according to whether individuals were below or above the age of 50 in the first survey year (1994). They find that the older cohorts display both a higher level of habit persistence (coefficient on lagged consumption of 0.82 for the older cohort compared to 0.42 for the younger cohort) and are more sensitive to price (-0.22 compared to -0.13). However, these results also need to be interpreted with a degree of caution since these models are pooled by gender so that the cohort differences might partly reflect gender differences, especially in light of the different cohort patterns for females that we catalogued in chapters 3 and 4.

5.5 Conclusion

Our review of the empirical literature on the price responsiveness of cigarette consumption has highlighted a number of empirical challenges in estimating cigarette demand based on individual-level survey data. Some of these challenges are less acute in longitudinal data which allow for more sophisticated attempts to control for both observable and unobservable individual heterogeneity. Notwithstanding the numerous modelling choices that influence estimates of price elasticity in static models, there is a strong indication that the results from dynamic specifications (whether myopic or rational) undermine conclusions (e.g. price responsiveness by gender) based only on static models, which highlights the importance of accounting for addiction. In summary, the main conclusions from the empirical literature surveyed here are:

[48] A more detailed discussion of the empirical approach in this study will follow in the context of our dynamic demand model in chapter 7.

- Price elasticities will be underestimated if there are possibilities for individuals to systematically purchase cigarettes at a lower price than in their area of residency (e.g. in the neighbouring state with lower taxes in the US), i.e. if the actual price they paid is lower than assumed in the analysis.

- Price elasticities will be overestimated if one fails to control for other tobacco control policies and environmental influences such as anti-smoking sentiment which will also exert a negative influence on demand. This can be achieved through the inclusion of proxy variables capturing such effects, or via location fixed effects in a repeated cross-sectional or longitudinal setting.

- Since smoking correlates strongly with other health behaviours such as alcohol consumption, price elasticities will be underestimated if these behaviours are omitted from the demand model. However, since these behaviours might also be linked through unobservable factors like time preferences or risk aversion, accounting for individual unobservable heterogeneity through panel methods is crucial.

- While the literature based on individual-level survey data adopting a dynamic demand model is rather sparse, the few published studies do indicate that accounting for addiction crucially affects the results and reverses some of the conclusions from the static literature, e.g. that men are less responsive to price than women.

CHAPTER 5 APPENDICES

5-A SELECT EVIDENCE FROM STATIC MODELS OF CIGARETTE DEMAND

Publication (author, year, country)	Methods (time period, study design, sample size)	Total price elasticity of demand	Price elasticity of participation	Price elasticity of intensity
Empirical challenge: Cross-border shopping				
Lewit and Coate (1982) USA	Cross-sectional Health Interview Survey 1976; Analysis sample N=19,266 (age 20-74). Restricted sample n=11,052 excluded respondents in high price localities to account for cross-border shopping.	Overall: -0.221 Restricted sample: -0.416 By age: elasticity decreasing with age By gender: more elastic for men	Overall: -0.135 Restricted sample: -0.264 By age: elasticity decreasing with age By gender: more elastic for men	Overall: -0.037 Restricted sample: -0.103 By gender: more elastic for men
Empirical challenge: Other tobacco control policies and anti-smoking sentiment				
Wassermann et al. (1991) USA	Repeated cross-sectional NHIS (1970-1985); Analysis sample N=84301 (7 survey years, age 17/20-74 depending on year of survey). Collapsed data on state-level tobacco regulation into a regulation index to control for other tobacco control policies. Also account for cross-border shopping with the same approach as Lewit and Coate (1982).	Two-part model By survey year 1970: +0.072 1974: -0.013 1976: -0.057 1979: -0.124 1980: -0.147 1983: -0.217 1985: -0.263	Two-part model By survey year 1970: +0.059 1974: +0.002 1976: -0.028 1979: -0.074 1980: -0.098 1983: -0.139 1985: -0.171	Two-part model By survey year 1970: +0.013 1974: -0.015 1976: -0.029 1979: -0.050 1980: -0.057 1983: -0.078 1985: -0.092

Publication (author, year, country)	Methods (time period, study design, sample size)	Total price elasticity of demand	Price elasticity of participation	Price elasticity of intensity
Sloan and Trogdon (2004) USA	Cross-sectional (13 pooled surveys) Behavioural Risk Factor Surveillance System (BRFSS) (1990-2002); Analysis sample N=1,761,686 (≥ age 18). Indicators for various tobacco control policies: advertising restrictions, licensure requirements, clean-air regulations. State and year fixed effects to control for unobserved factors such as anti-smoking sentiment. Also accounts for cross-border shopping with minimum and maximum prices in neighbouring states.		By age: 18-20: -0.26 21-24: -0.11 25-44: -0.10 45-64: -0.10 ≥ 65: -0.25	
Tauras (2004) USA	National Health Interview Surveys (1992, 1993, 1994) Age 18-64 Three part model where second part estimates probability of some-day smoking (less than daily smoking only). Includes a set of dummy variables for restrictions on smoking in various places (worksites, restaurants etc.).		Average current smoking price elasticity: -0.265 Average price elasticity of some-day smoking participation conditional on current smoking: +0.860	Average some-day smoking conditional demand elasticity: 0.375
Tauras (2006) USA	Cross-sectional (pooled surveys) Tobacco Use Supplements to the Current Population Survey (CPS) (1992-1999) Analysis sample N=545,603 (≥ age 18) Includes 5 dummy variables for restrictions on smoking in various places (worksites, restaurants etc.). State and		Overall: -0.120 to -0.129	Overall: -0.071 to -0.073

Publication (author, year, country)	Methods (time period, study design, sample size)	Total price elasticity of demand	Price elasticity of participation	Price elasticity of intensity
Tauras (2006) ctd	time fixed effects included. Alternatively two clean air laws indices measuring scope and strength or policies are included instead of the highly correlated dummy indicators. More restrictive smoke-free air laws decrease average consumption among adults but have little effect on prevalence.			
Stehr (2007) USA	Cross-sectional (pooled surveys) from Behavioural Risk Factor Surveillance System (BRFSS) (1985-2000); Analysis samples N=1,339,459 (≥ age 18) Men n= 571,631 Women n=767,872 Two-part model adjusted for gender-specific state fixed effects, capturing e.g. gender-specific norms in smoking. When gender-specific state-fixed effects are included women are twice responsive as men to prices.	Overall: 0.36 Males: -0.26 Income quartiles: 1st: -0.36 2nd : -0.11 3rd : -0.21 4th: -0.23 Females: -0.51 Income quartiles: 1st: -0.59 2nd : -0.30 3rd : -0.47 4th: -0.53	Overall: 0.25 Males: -0.16 Income quartiles: 1st: -0.23 2nd : -0.07 3rd : -0.09 4th: -0.15 Females: -0.40 Income quartiles: 1st: -0.43 2nd : -0.25 3rd : -0.30 4th: -0.43	Overall: 0.10 Males: -0.09 Income quartiles: 1st: -0.13 2nd : -0.03 3rd : -0.013 4th: -0.07 Females: -0.12 Income quartiles: 1st: -0.16 2nd : -0.05 3rd : -0.16 4th: -0.10
DeCicca and McLeod (2008) USA	Cross-sectional (5 surveys) from Behavioural Risk Factor Surveillance System (BRFSS) (2000-2005); Analysis samples N=543,384 (age45-64) N= 435,973 (age 45-59).		By age (smoking daily): 45-64: -0.21 to -0.22 45-59: -0.29 to -0.31 Smoking some days: 45-64: -0.21 to -0.22 45-59: -0.24 to -0.28	

Publication (author, year, country)	Methods (time period, study design, sample size)	Total price elasticity of demand	Price elasticity of participation	Price elasticity of intensity
DeCicca and McLeod ctd	Two-way fixed effects models to account for unobservable state-level effects such as anti-smoking sentiment. Dummy variables for state-level ban of smoking in worksites and restaurants.		By health status: Healthy: -0.54 Unhealthy: -0.11	
Empirical challenge: Compensating behaviours				
Evans and Farrelly (1998) USA	Cross-sectional (pooled) NHIS supplements: 1979 smoking, 1987 cancer control; Analysis sample 1979 N=24092 1987 N=22043 (≥ age 18) Calculate average daily nicotine and tar intake to control for compensating effects of tax increases.	Pooled model 1979-1987 Tax overall: -0.214; Price overall: -0.156 Fixed-effect model 1979-1987 Tax overall:+0.160 Price overall: +0.344		
Farrelly et al. (2004) USA	Longitudinal analysis from Community Intervention Trial for Smoking Cessation (COMMIT) study (1988 and 1993) Analysis sample n=9,087 (age 25-64) Also includes clean air laws index.			Price elasticity by age: 25-34: -0.235 35-44: -0.115 45-64: -0.110 Tar elasticities: +0.041 to +0.364 Nicotine elasticities: +0.035 to +0.306
Adda and Cornaglia (2006) USA	Cross-sectional National Health and Nutrition Examination Survey (NHANES III 1988-1994 and NHANES 1999-2000) Analysis sample: 20,050 (≥ age 17). survey collected data on nicotine, tar and carbon monoxide			Overall: 0.11 Elasticity n° of cigarettes: -0.15 Elasticity cotinine: -0.03

Publication (author, year, country)	Methods (time period, study design, sample size)	Total price elasticity of demand	Price elasticity of participation	Price elasticity of intensity
	concentration and collected saliva samples to measure cotinine concentration.			
Empirical challenge: Health status and other health behaviours				
Hu et al. (1995) USA	Cross-sectional (pooled surveys) California BRFSS (1985-1991); Analysis sample N=13,531 (≥ age 18) Controls for other behavioural risk factors including drinking, exercise, and obesity.	Controlling for other health behaviours: -0.46	Overall -0.54; Controlling for other health behaviours: -0.33	Overall -0.22; Controlling for other health behaviours: -0.20
Mao et al. (2003)	National Smoking Consumption Survey (1998) Analysis sample: N=24, 641 (≥ age 20) Men: n=12,854 Women: n=11,786. Controls for perception of risk, knowledge and 'propaganda' of tobacco control.	Overall: -0.513 Men: -0.45 Women: -0.69 Income < poverty line: -1.906 Low income: -0.774 High income: -0.507		
Empirical challenge: peer effects				
Chung et al. (2007) South Korea	Telephone interview survey Analysis sample: 3,000 males (≥ age 20) Peer effects measured in terms of parental and friend's smoking. Also controls for health status and BMI.	Overall: -0.66	Overall: -0.2	Overall: -0.64
Aristei and Pieroni (2009) Italy	Cross-sectional 2000 Italian survey on health status and use of health services (HSHS); Analysis sample N=47,777 ever		Overall: -0.24 Men: -0.13	

Publication (author, year, country)	Methods (time period, study design, sample size)	Total price elasticity of demand	Price elasticity of participation	Price elasticity of intensity
Aristei and Pieroni (2009) ctd	smokers (current and former) Men: n=31,912, Women n=15,865 Box-Cox double hurdle model of how much to smoke and whether to quit. Peer effects (measured as the number of other smokers in the household) is treated as an endogenous variable. While static, the model includes a measure of the duration of smoking as a proxy for addiction.		Women: -0.65	
Evidence from low and middle-income countries:				
China				
Lance et al. (2004)	Pooled cross-sections from China Health & Nutrition Survey (1989-1993 waves) Analysis sample: N=8,557 men (≥ age 13). Three versions of two-part model: pooled cross-sections, with province-level fixed-effects, with community-level fixed effects.		Pooled: -0.019 Province-level fixed effects: -0.045 Community-level fixed effects: -0.034	Pooled: -0.063 Province-level fixed effects: -0.056 Community-level fixed effects: +0.027
Mao et al. (2007)	National Smoking Prevalence Survey (2002) Nationally representative sample Analysis sample: N=16,056 (≥ age 16).	Overall: -0.154 Poor: -0.589 Low income: -0.234 Middle: -0.018 High income: +0.257	Overall: -0.064 Poor: -0.478 Low income: -0.199 Middle: +0.093 High income: +0.340	Overall: -0.090 Poor: -0.111 Low income: -0.035 Middle: -0.111 High income: -0.083

Publication (author, year, country)	Methods (time period, study design, sample size)	Total price elasticity of demand	Price elasticity of participation	Price elasticity of intensity
India				
John (2008)	Cross-sectional survey (1999-2000) N=120,309 households Household with zero tobacco consumption excluded. Self-reported tobacco prices (bidis, cigarettes, leaf tobacco) Own and cross-price elasticities			Rural own elasticities accounting for substitution /complementary patterns: Bidis: -0.91 Cigarettes: -0.41 Leaf tobacco: -0.87 Urban own elasticities: Bidis: -0.91 Cigarettes: -0.41 Leaf tobacco: -0.87
Indonesia				
Adioetomo et al. (2005)	1999 National Socio-Economic Survey collected by Central Bureau of Statistics	Overall: -0.61 Lowest income third: -0.67 Middle income third: -0.33 High income third : -0.31		
Mexico				
Jimenez-Ruiz et al. (2008)	Cross-sectional (7 surveys) National Household and Expenditure Survey (1994-2005), nationally representative Analysis sample: N=109,089 (≥ age 16) Unit of analysis: household.	Overall: -0.52	Overall: -0.06	Overall: -0.45

Publication (author, year, country)	Methods (time period, study design, sample size)	Total price elasticity of demand	Price elasticity of participation	Price elasticity of intensity
Russia				
Ogloblin and Brock (2003)	Russia Longitudinal Monitoring Survey, two waves (1996 and 1998-1999) Analysis sample 14,472 (≥ age 18) Men: N=6,015 Women: N=8,457		Overall Men: -0.085 Women: -0.628 Year 1996: Men: -0.046 Women: -0.430 Year 1998: Men: -0.120 Women: -0.919	
Lance et al. (2004)	Russia Longitudinal Monitoring Survey, three waves (1996 and 1998/1999, 2000) Analysis sample 10,638 men (≥ age 13) Three versions of two-part model: pooled cross-sections, with province-level fixed-effects, with community-level fixed effects.		Pooled: -0.106 Province-level fixed effects: -0.101 Community-level fixed effects: -0.050	Pooled: -0.026 Province-level fixed effects: -0.026 Community-level fixed effects: -0.000
Turkey				
Bilgic et al. (2009)	Cross-sectional national household expenditure survey (2003) Analysis sample: N=22,208 households HH with teenagers: 7,844 HH without teenagers: 14,364 Unit of analysis: household		Family with teenagers: -0.264 Family without teenagers: -0.221	Family with teenagers: +0.075 Family without teenagers: +0.058

Publication (author, year, country)	Methods (time period, study design, sample size)	Total price elasticity of demand	Price elasticity of participation	Price elasticity of intensity
Bilgic et al. (2009) ctd	Controls for health insurance status and expenditure, alcohol intake, number of smokers in family.			
Ukraine				
Krasovsky et al. (2002)	Cross-sectional survey conducted in all regions of Ukraine; Analysis sample: N=2,700.		Overall: -0.47 High income: -1.1 Low income: -0.27	By age and income group High income: 14-17: -0.52 18-28: -0.24 28+: -0.15 Middle income 14-17: -0.7 18-28: -0.42 28+: -0.33 Low income: 14-17: -0.65 18-28: -0.37 28+: -0.28

5-B SELECT EVIDENCE FROM MYOPIC MODELS OF CIGARETTE DEMAND

Publication (author, year, country)	Methods (time period, study design, sample size)	Total price elasticity of demand	Price elasticity of participation	Price elasticity of intensity
Mullahy (1985) USA	National Health Interview Survey 1979 Analysis sample: N=13,794 (≥ age 17). Two-part model: (1) probit, (2) OLS with instrumental variables method.	Overall: -0.47 Men: -0.56 Women: -0.39		
Taal et al. (2004) Estonia	Monthly household data from the Household Income and Expenditure Study (1992-1999), monthly surveys of 700-800 households Dependent variable: Average monthly cigarette consumption per adult Independent variables: Average real income per household member, real tobacco product price index, quarterly dummies, time trend, lagged consumption (in previous months).	Overall: -0.32		
Gilleskie and Strumpf (2005) USA	Three waves of the National Educational Longitudinal Study (1988, 1992, 1990) Analysis sample: 10233 youths (30,699 person-years). While they assume individuals to be forward-looking, the empirical specification resembles a myopic model since the expectations process is not estimated.	:	Model 1 sparse covariates: -0.87 Model 2 parental & school: -0.78 Model 3 state fixed effects: insig. Model 4 lagged smoking: insig.	**Smoke 1-5** Model 1 sparse covariates: +0.43 Model 2 parental & school: +0.72 Model 3 state fixed effects: +1.12 Model 4 lagged smoking: insig Preferred model short-run & long-run: insig. **Smoke 6-10**

Publication (author, year, country)	Methods (time period, study design, sample size)	Total price elasticity of demand	Price elasticity of participation	Price elasticity of intensity
Gilleskie and Strumpf (2005) ctd	Two equation model (logit + multinomial logit) allowing for correlation between past smoking and permanent individual unobservables.		Preferred model addressing endogenous smoking: Short-run: -0.41 Long-run: -0.46	Model 1 sparse covariates: -1.05 Model 2 parental & school: -0.91 Model 3 state fixed effects: insig. Model 4 lagged smoking: insig. Preferred model short-run: -1.42 Preferred model long-run: -1.56 **Smoke 11+** Model 1 sparse covariates: insig. Model 2 parental & school: insig. Model 3 state fixed effects: insig. Model 4 lagged smoking: insig. Preferred model short-run: -1.84 Preferred model long-run: -1.96

5-C SELECT EVIDENCE FROM RATIONAL ADDICTION MODELS OF CIGARETTE DEMAND

Publication (author, year, country)	Methods (time period, study design, sample size)	Total price elasticity of demand	Price elasticity of participation	Price elasticity of intensity
Chaloupka (1990) USA	Cross-sectional National Health Examination and Nutrition Survey (NHANES). Analysis sample: N=14,005 (age 17-73). Two-stage least squares model of cigarette demand using four lags and leads of prices and taxes and assuming varying rates of depreciation of the addictive stock.	Long-run price elasticity Overall: -0.274 to -0.359 Ever smokers: -0.348 to -0.482 Current smokers: -0.296 to -0.890 *By education* <highschool: -0.587 to -0.618 ≥ highschool: +0.135 to +0.268 *By age* Age 17-24: -0.103 to +0.050 Age 25-64: -0.315 to -0.454 Age 65-73: -0.029 to +0.166		
Labeaga (1999) Spain	Panel data from Spanish Permanent Survey of Consumption. Unbalanced panel of approximately 2,000 household between 1977 and 1983. Analysis sample: 34,413 (household-years).		Model treating total expenditure as endogenous: Short-run price elasticities: Overall: -0.27 Ever-smoker: -0.17 Long-run price elasticities: Overall: -0.36 Ever-smoker: -0.23	Model treating total expenditure as endogenous: Short-run price elasticities: By education: no studies: -0.30 <highschool: -0.28 university: -0.21

Publication (author, year, country)	Methods (time period, study design, sample size)	Total price elasticity of demand	Price elasticity of participation	Price elasticity of intensity
Labeaga (1999) ctd	Estimates different double-hurdle specifications of the rational addiction models taking into account problems of measurement errors, censoring and unobservable heterogeneity.			By age: < 25: -0.26 ≥ 60: -0.34 By income decile: Poorest: -0.50 Richest: -0.17 Long-run price elasticities: By education: no studies: -0.40 <highschool: -0.37 university: -0.28 By age: < 25: -0.34 ≥ 60: -0.50 By income decile: Poorest: -0.67 Richest: -0.23
Jones and Labeaga (2003) Spain	Panel data from Spanish Permanent Survey of Consumption (quarterly data from 1986 to 1994). Balanced panel of 6,100 households Analysis sample: 24,858 (household-years). Estimate different double-hurdle specifications of the rational addiction models taking into account problems of measurement errors, censoring and unobservable heterogeneity.	Do not report price elasticities for all models estimated but state that “Only the model estimated in levels gives a sizeable (in magnitude) long-run value of the price elasticity (- 0.221). However, once heterogeneity is controlled for, the estimated price elasticities are very small.”		

5-D EMPIRICAL LITERATURE ON SMOKING IN RUSSIA

Publication (author, year,)	Methods (time period, sample size, empirical approach)	Price elasticity of participation	Price elasticity of intensity
Ogloblin and Brock (2003)	RLMS phase II, two rounds (1996 and 1998-1999) Analysis sample 14,472 (≥ age 18) Men: N=6,015 Women: N=8,457 Probit models of cigarette participation, estimated separately by gender	Overall Men: -0.085 Women: -0.628 Year 1996: Men: -0.046 Women: -0.430 Year 1998: Men: -0.120 Women: -0.919	
Lance et al. (2004)	RLMS phase II, three rounds (1996 and 1998/1999, 2000) Analysis sample 10,638 men (≥ age 13) Three versions of two-part model: pooled cross-sections, with province-level fixed-effects, with community-level fixed effects.	Pooled: -0.106 Province-level fixed effects: -0.101 Community-level fixed effects: -0.050	Pooled: -0.026 Province-level fixed effects: -0.026 Community-level fixed effects: -0.000
Ogloblin and Brock (2011)	RLMS phase II, two rounds (2000 and 2009) Analysis sample (women age 18-64) Pooled N=8,679; Year 2000 N=3701; Year 2009 N=4978 Tobit models of cigarette demand, estimated separately for each year and on the pooled sample		-0.454 (2000) -0.541 (2009)
Herzfeld et al. (2013)	RLMS phase II, 10 rounds (1994-2005) Longitudinal sample of the RLMS		Pooled subsample of smokers: -0.16

Publication (author, year,)	Methods (time period, sample size, empirical approach)	Price elasticity of participation	Price elasticity of intensity
Herzfeld et al. (2013) ctd	Full sample: 13,883 observations /2194 individuals (age 18) Subsample 'old cohort': individuals > age 50 in 1994, N=5,544 /742 Subsample 'young cohort': individuals ≤ age 50 in 1994 N=8339/1452 Subsample'smokers': smoking in at least one round and minimum of three consecutive observations N=3153/671 observations/individuals Male smokers N= 2517/527 observations/ individuals Female smokers N= 636/144 observations/ individuals Estimation methods: 1) Kernel-weighted GMM on subsample of smokers (pooled and by gender) adjusting for sample selection 2) System GMM on the full sample with13,883 observations (results not reported but similar to those estimated on subsample with sample selection correction		Old cohort: -0.22 Young cohort: -0.13 Males: -0.12 Females: -0.17

6 A static model of cigarette demand in Russia

6.1 Introduction

In the previous chapter we looked at the theoretical and empirical challenges of modelling cigarette demand based on individual-level data (microdata). Our review of the empirical literature has highlighted the need to control for both observable and unobservable factors at the regional/community level (e.g. other tobacco control policies, anti-smoking sentiment, peer effects) as well as at the individual level (e.g. other health behaviours, time preferences, risk attitudes). As importantly, the discussion of the results from dynamic models suggests the importance of accounting for addiction (persistence) when estimating cigarette demand. However, before we proceed to building these elements into our model of cigarette demand, our empirical strategy needs to take into account additional empirical challenges stemming from the nature of the dependent variable, average daily cigarette consumption. These challenges are not specific to cigarettes but are frequently encountered with microdata, for example, consumption and expenditure data on food and durables, health care utilisation (e.g. doctor visits, hospital stays etc) and labour market outcomes such as wages. First, survey data on consumption and expenditure are by construction non-negative (bounded at zero) and often display a high proportion of zero observations, for individuals not engaging in that particular consumption behaviour. Second, data on the consumption of (rather than expenditure on) goods such as cigarettes or alcohol are reported as discrete numbers (1, 2, 3….) and therefore the dependent variable is restricted to the range of non-negative integers. The combination of the latter so-called, limited support of the dependent variable, and the former, mass point at zero, creates problems for standard regression models, such as OLS, based – as they are – on the normal distribution. Such estimation methods are geared towards quantitative variables that are, at least in theory, linear continuums. Related to this is a third complication for the analysis, that individuals tend to report their cigarette consumption in convenient fractions and multiples of cigarette packs, leading to a so-called 'heaping' of observed consumption values in multiples of 5. In contrast to the first two problems, this restriction of observed values does not arise from the way the data are collected, but rather from the cognitive patterns which shape respondents' answers and incline them to report rounded estimates of consumption (a form of reporting error and thus measurement error in the dependent variable). While addressing these challenges separately would be relatively straight-forward, e.g. the discrete-value and strictly positive nature of cigarette consumption could be addressed by applying count data models (e.g. poisson, negative binomial etc), no single model will adequately address the issues simultaneously. We must therefore make an informed judgement as to the relative importance of these various issues based on our understanding of the raw data and its collection.

The remainder of the chapter proceeds as follows: In the second section we discuss our econometric approach with regard to the three challenges outlined above, taking in turn, (i) approaches for addressing the non-negativity of the dependent variable and cluster of observations at zero, and (ii) methods to account for the discrete nature of and measurement error in the dependent variable. Based on the econometric approach which emerges, in the third section, we describe our empirical model, taking into account the various challenges specific to cigarette consumption that we discussed in the previous chapter. Section 4 presents the results of the empirical estimations, and is followed by an extended discussion in section 5.

6.2 Econometric methods and empirical strategy

6.2.1 Econometric methods

Nonnegative data and the zero-problem

Our dependent variable, the average daily amount of cigarettes consumed, is a nonnegative integer (count) with zero as the lower bound. As can be seen from Figure 6.1 (males) and Figure 6.2 (females) below, its distribution is non-normal with a mass point at zero (particularly for females), a long tail at the high end of the distribution, and 'heaping' of observations in multiples of five. The cluster of observations at zero requires our attention for two reasons: (1) From an empirical perspective the concentration of observations at a particular value of the dependent variable poses a problem for regression models that are based on a single distribution, such as the normal distribution in the linear regression model, or the Poisson distribution in the Poisson regression model.

Figure 6.1 Frequency distribution of daily cigarette consumption (males)

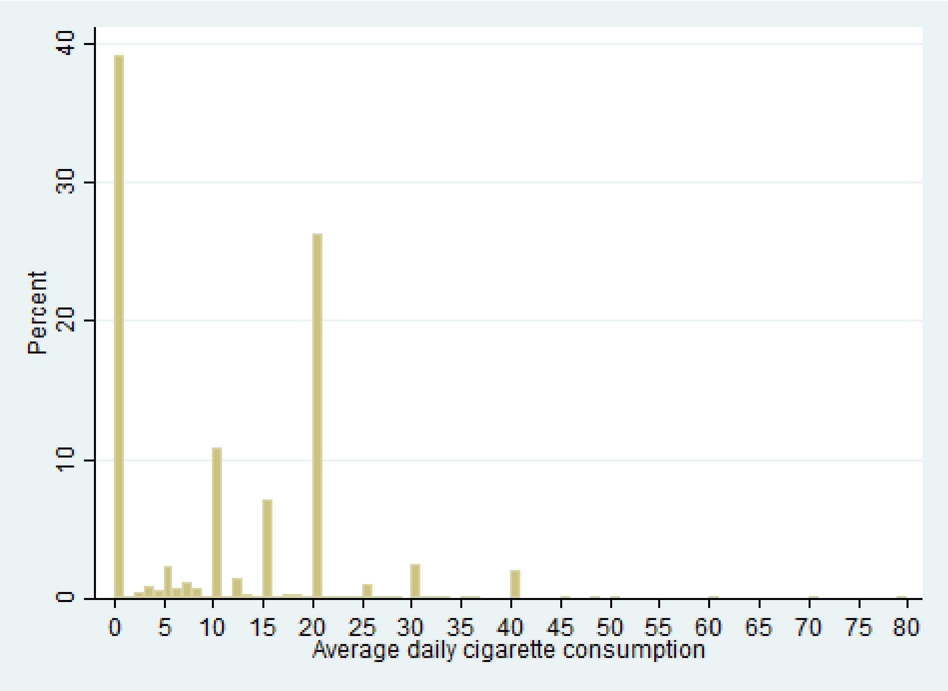
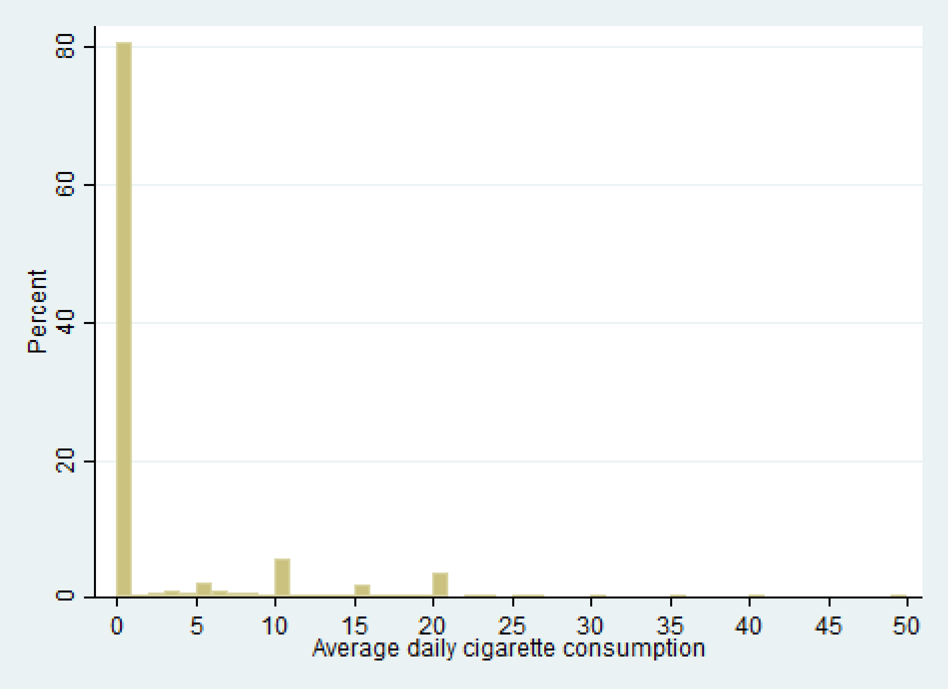


Figure 6.2 Frequency distribution of daily cigarette consumption (females)



(2) From a theoretical perspective the zeroes are a separate quantity of interest, especially given their large representation in our data. Therefore, in addition to estimating the conditional mean of cigarette consumption $E(y|x)$, we are also interested in the probability that y is zero $\Pr(y = 0|x)$ or positive $\Pr(y > 0|x)$, as well as in the expected cigarette consumption conditional on y being positive $\Pr(y|y > 0x)$. The main limitation of standard regression models is their inability to recover these quantities of interest from the conditional mean.

In order for a model to adequately represent our dependent variable, it needs to be able to predict both the large proportion of zeroes in the data, and the (non-negative) consumption values. The linear regression model (LRM) is inappropriate for a number of reasons in the case of cigarette consumption. First, it ignores the fact that the dependent variable is restricted to positive values and therefore allows for the possibility of the model producing empirical predictions outside of the plausible range. Second, it imposes constant marginal effects, which is unrealistic when the dependent variable is bounded from below (Winkelmann and Boes, 2006; Wooldridge, 2010). Addressing these two problems by log-transforming the dependent variable is not admissible since the log of zero is not defined. Moreover, the LRM cannot predict the probability of a particular outcome since it is based on a purely continuous density function which implies that the probability of the dependent variable taking on any particular value converges on zero (Pudney, 1989; Winkelmann, 2010). This is clearly inappropriate in our case, where the proportion of zeroes in the dependent variable is close to 40 percent for males, and approaches 80 percent for females. While count data models such as the Poisson regression model are better suited for dealing with the limited support of the dependent variable and do allow for inferences to be drawn on the probability of a particular outcome, the fraction of zeroes is often too high empirically to be compatible with the Poisson distribution (Winkelmann, 2010).[49] This applies in our case too.

An empirically coherent model that accommodates the zero observations and allows us to draw inferences on the quantities of interest should consist of a binary part with $0 \leq$

[49] While approaches to dealing with the high frequency of zero observations have been developed for both continuous dependent variables (belonging to the class of limited dependent variable models) and count dependent variables (under the heading of the 'excess' zeroes problem), we focus our discussion on approaches to the former since the underlying conceptual principle is the same in both cases. A thorough discussion of count models with excess zeroes is given in Winkelmann (2010) and Cameron and Trivedi (2013).

$P(y > 0|x) \leq 1$, and a positive part estimating $\mathrm{E}(y > 0|x) > 0$. A classical solution for creating such a model with both discrete and continuous features was proposed by James Tobin in 1958 which, inspired by his name, is referred to as the 'Tobit' model. The Tobit model uses a fictional censoring process to convert the purely continuous linear regression model into a discrete-continuous model (Pudney, 1989). Thus, we assume that the observed dependent variable y is generated by an underlying latent variable y^*, which can be seen to capture latent demand or, in our case, utility derived from smoking, according to the following rule:

$$y = \begin{cases} 0 & if\ y^* \leq 0 \\ y^* & if\ y^* > 0 \end{cases} \tag{1}$$

If latent demand/utility (y^*) is negative, y is replaced with 0 (censored compared to y^*), otherwise y is observed directly.[50] The structural equation of the Tobit model is given by:

$$y^* = x'\beta + u \tag{2}$$

Where u is unobservable and assumed to be conditionally normally distributed

$$u|x \sim Normal(0,\ \sigma^2) \tag{3}$$

Observed consumption y is generated by:

$$y = \max(0, y^*) \tag{4}$$

The expectation of y consists of two parts:

$$Pr(y > 0|\ x) = \phi(x'\beta/\sigma) \tag{5}$$

$$E(y|y > 0, x) = x'\beta + \sigma\lambda(x'\beta/\sigma) \tag{6}$$

Where $x'\beta + \sigma\lambda(x'\beta/\sigma)$ is the truncated normal distribution with truncation point 0, that yields the expected value for the positive observations. The λ in (6) is a rescaling

[50] It is important to note that this is only a *fictional* censoring process that is used as a conceptual device to create the mixture distribution. That is, unlike in most censored data cases, we do not have a data observability problem here. In order to avoid confusion, Wooldridge (2002) suggests referring to models such as the Tobit model as corner solution models, rather than censored normal regression as is frequently done in the literature (Wooldridge, 2002). While corner solution models and models for censored data (belonging to a class of sample selection models) have similar statistical structures they differ in their interpretation. In the former the discrete outcome (the zero) is the outcome of an economic choice, whereas in the latter they reflect a data deficiency (Winkelmann and Boes, 2006).

factor to ensure that the truncated density function integrates to 1. The unconditional expectation for y is then given by:

$$\mathrm{E}(\mathrm{y}|\,\mathrm{x}) = Pr(y > 0|\,x) \cdot E(y|y > 0, x) = \Phi(x'\beta/\sigma)[\sigma\lambda(x'\beta/\sigma)] \quad (7)$$

The Tobit model thus accounts for the zeroes by adjusting the conditional mean of y for the probability of the dependent variable taking on a positive value and is a combination of a probit and a linear regression model. The setup described in (5) to (7) allows us to distinguish between quantities of interest such as the probability of y taking on a zero value, $\mathrm{Pr}(\mathrm{y} = 0|\mathrm{x})$, or positive value, $\mathrm{Pr}(\mathrm{y} > 0|\mathrm{x})$, as well as the conditional expectation for positive observations of $\mathrm{Pr}(\mathrm{y}|\mathrm{y} > 0, \mathrm{x})$. However, as is evident from equations (5) and (6), the zero and positive observations depend on the same basic parameters β and σ, meaning that the partial effects of an explanatory variable have to have the same sign for $\mathrm{Pr}(y > 0|\,x)$ and $E(y|y > 0, x)$. For example, it is *not* possible that a variable such as age could reduce the probability of smoking (e.g. because respondents quit smoking as they grow older) and at the same time increase the conditional expectation of cigarette consumption (e.g. because older smokers might be more addicted than younger smokers). Furthermore, the relative effects of any two continuous variables are identical at the extensive and intensive margins. That is, if price has twice the effect of income on the probability of a positive outcome, then it also has to have twice the effect on the conditional expectation for those who are smoking (Wooldridge, 2010).

The restrictive statistical structure of the Tobit model relates to its theoretical interpretation as a corner solution model. In economic theory a corner solution assumes that zero consumption is driven by economic factors only, i.e. everyone is a potential consumer of the good and the only reason individuals report zero consumption is because the good in question is too expensive for them or they have a shortfall of income. However, in the case of goods such as tobacco, this assumption seems too restrictive since many non-smokers will not smoke even if they were given cigarettes for free and their non-consumption is related to social, health, psychological and ethical factors rather than due to economic considerations (Pudney, 1989). In this sense, a zero outcome can arise from two different decision processes: (1) a *participation* decision in which a zero outcome reflects individuals who are genuine non-smokers; and (2) a *consumption* or *amount* decision in which a zero outcome represents a corner solution, as in the Tobit model described above.[51] In the Tobit structure, only zero outcomes of the latter type are admissible.

In view of its restrictiveness, a number of extensions to the Tobit model, which build on a two-equation structure to allow for separate mechanisms to determine the participation and consumption decisions, have been proposed in the limited dependent variable literature. Of particular interest in our case are a class of models referred to as 'double-hurdle models' which were developed by Jones (1989a) in the context of tobacco consumption, extending the original double-hurdle model proposed by Cragg (1971). The double-hurdle approach generalises the original Tobit model in two respects: (1) it allows for separate mechanisms through a two-part structure; and (2) it accommodates the two types of zero observations that might occur in both stages (Cragg, 1971; Jones, 1989a).

Similarly to other two-equation models for limited dependent variables, the double-hurdle model (DHM) separates observed consumption into a participation choice and a subsequent consumption decision. To allow for both genuine (i.e. non-participation in the first stage) zeroes and corner solution zeroes (participating but choosing not to consume in this time period), the DHM views the participation and consumption decisions as two hurdles which the individual has to pass before being observed with a positive level of consumption. The first hurdle equates to the participation decision which separates potential smokers from genuine non-smokers. Individuals who pass the first hurdle might then still be observed with zero consumption if they fail the second hurdle in the consumption decision, thereby allowing for corner solutions in the second part of the DHM. The two decision stages are defined in terms of latent variables which are linked to observed consumption via the hurdle rules.

To set up the statistical model we assume the following about the relationship between observed consumption and the participation and consumption decisions:

Observed consumption: $$y = \mathrm{d}\, y^{**} \tag{8}$$

Participation equation: $$d^* = \alpha' \mathrm{Z} + \nu \qquad d = 1 \text{ if } d^* > 0 \tag{9}$$

[51] From the point of view of consumer choice theory, the qualitative distinction between genuine non-smokers and potential smokers suggests that there are two different preference regimes, and thus utility functions, underlying zero consumption. Cigarettes are unlikely to enter non-smokers' utility functions, whereas they will feature for both potential and current smokers.

$d = 0$ otherwise

Consumption equation: $y^{**} = \max(0, y^{*})$ (10)

$y^{*} = \beta' X + \mathrm{u}$

where Z and X are the covariates influencing participation and consumption with parameters α and β respectively, and ν and u are additive disturbance terms randomly distributed with a bivariate normal distribution. The two latent variables d^{*} and y^{*} can be seen as the propensity for participation and consumption respectively.[52] If $d^{*} \leq 0$ and thus $d = 0$, the first hurdle is not crossed and the individual does not participate, leading to the first source of zeroes in observed consumption y. If $d^{*} > 0$, $d = 1$, the first hurdle is passed and the individual is a potential smoker. A potential smoker can then still be observed with zero consumption if the second hurdle is not crossed, $y^{*} < 0$, which yields the classical (Tobit style) corner solution and second source of zero observations in y. Thus, a positive consumption value is conditional on having passed both hurdles. The double-hurdle model assumes that neither source of zeroes is separately identifiable in the data and that the data are drawn from a general population.

The precise specification of the DHM depends on assumptions with regard to two key issues, which give rise to four possible specifications of the DHM: (1) the interpretation regarding the generation of zero observations in the data i.e. whether there are one or two alternative processes resulting in zero consumption observations, and (2) the correlation of the error terms in the participation and consumption equations, i.e. whether the two choices are related via unobservable factors (Madden, 2008). The full DHM, as proposed by Jones (1989a), is the most general model which assumes two sources of zero consumption and allows for correlation between the two error terms. If we divide the sample into those with zero cigarette consumption and those with positive consumption, the log likelihood for the full DHM is given by:

$$L0 = \Pi_0 [1 - p(d = 1) p(y^{*} > 0 | d = 1)] \, \Pi_+ \, p(d = 1) p(y^{*} > 0 | d = 1) \, g(y | y^{*} > 0, d = 1) \quad (11)$$

[52] Although d^{*} and y^{*} are latent, the hurdle rules imply a Bernoulli distribution for d^{*} and a zero-inflated distribution for y^{*}.

$$= \Pi_0[1 - p(v > -\alpha'Z)p(u > \beta'X|v > -\alpha'Z)]$$

$$\Pi_+ \, p(v > \alpha'Z)p(u > \beta'X|v > -\alpha'Z) \; g(y|u > \beta'X, v > -\alpha'Z)$$

This is a complex expression involving the density and distribution functions of the truncated bivariate normal distribution and maximisation of the log likelihood, which is not available via standard econometric packages. One simplifying assumption is to impose independence between the error terms, u and v, and thus reduce the DHM to the original model proposed by Cragg (1971), which in Jones' terminology is an independent DHM:

$$L1 = \Pi_0[1 - p(d = 1)p(y^* > 0|d = 1)] \; \Pi_+ \, p(d = 1)p(y^* > 0|d = 1) \; g(y|y^* > 0, d = 1) \quad (12)$$

$$= \Pi_0[1 - p(v > -\alpha'Z)p(u > \beta'X|v > -\alpha'Z)]$$

$$\Pi_+ \, p(v > \alpha'Z)p(u > \beta'X|v > -\alpha'Z) \; g(y|u > \beta'X)$$

This means that the probability of a zero outcome in the second stage is now independent of having passed the first hurdle (that is, we removed $v > -\alpha'Z$ from the third part of Π_+). While this simplifies estimation compared to the full DHM, the two parts can still not be estimated separately, e.g. by a probit model for participation and a truncated normal regression model on the positive observations for consumption, since zeroes are still permissible in the second stage. Therefore, a second way of restricting the DHM is via assuming what is called *first-hurdle dominance,* which removes the possibility of corner solutions in the consumption equation. This means that the participation equation unambiguously separates smokers and non-smokers and the only type of zero in the data reflects non-participants. With dependence between the error terms, the dominant DHM reduces to a selection model (or in DHM terminology: a dependent DHM with first-hurdle dominance):

$$L2 = \Pi_0[1 - p(d = 1)] \; \Pi_+ \, p(d = 1)g(y|d = 1\,) \quad (13)$$

$$= \mathit{\Pi}_0[1 - p(v > -\alpha'Z)] \; \mathit{\Pi}_+ \, p(v > \alpha'Z)g(y|v > -\alpha'Z)$$

where we are now no longer conditioning on $y^* > 0$ (the corner solution zero). This model could be implemented via Heckman's sample selection model (Heckman, 1979), for which estimation routines are readily available in software packages such as STATA.

Finally, the most restrictive specification of the DHM, and at the same time most commonly implemented model in the empirical literature, arises when we impose both independence between the error terms and first hurdle dominance, in which case we arrive at a two-part model consisting of a probit/logit model for participation estimated on the whole sample, and a truncated normal regression model for consumption, estimated on the positive observations only.

$$L3 = \Pi_0[1 - p(d = 1)]\, \Pi_+\, p(d = 1)g(y) \tag{14}$$

$$= \Pi_0[1 - p(v > -\alpha' Z)]\, \Pi_+\, p(v > \alpha' Z)g(y)$$

So how are we to choose among the four specifications? The issue of dominance is an empirical question depending on the specific question at hand and on understanding of the underlying data generating process, for which one can refer to the survey questions and observed data (Jones, 1989b). For example, in many household surveys, including the RLMS, the consumption question is only asked of individuals who say they are currently smoking and is phrased in terms of typical consumption levels rather than exact consumption over a certain period. If the reported consumption data for smokers do not include any zeroes, as is the case in our data, it might be natural to assume that the zero observations are reflective of genuine non-smokers and thus exclude the possibility of corner solutions, through assuming first hurdle dominance. However, this assumption would overlook that individuals might be potential smokers at a corner solution and still report that they do not smoke currently, i.e. the smoking status question does not necessarily distinguish between genuine non-smokers and smokers that are currently not smoking. While this is a theoretical possibility, we believe this to be of minor importance in our case, especially in view of the very low prices and high affordability of cigarettes for the time period under consideration. In what follows, we therefore opt for first-hurdle dominance. The second question then is whether to assume dependence or independence between the error terms. From a theoretical perspective, allowing for the unobservables in both parts of the model to be correlated seems appealing since they refer to the same individual and are thus likely to be correlated. However, the empirical validity of this approach rests crucially on the existence of a valid exclusion restriction to identify the participation decision. This is a notoriously tricky problem in selection models using individual level survey data. While we explore both the dependent and independent DHM with first hurdle dominance, our interpretation of statistical criteria result in us falling back on the more restrictive independent version as our preferred model.

COUNT DATA AND MEASUREMENT ERROR

As we have seen above, our dependent variable is not only restricted to non-negative values, but is also reported in integers (1, 2,…, 80), which further limits its support compared to continuous limited dependent variables such as, for example, consumption expenditure. Count data measure how often an event occurred within a given time period and contain elements of both quantitative and qualitative data. They are quantitative in that their values have a precise numeric meaning (i.e. the number of cigarettes smoked per day), but at the same time, the discrete measurement scale of count data violates the standard assumption that a quantitative dependent variable has support over the entire real line, and renders standard regression approaches based on the linear regression model less suitable. In addition to problems created by the non-negativity of the data described in the previous section (predictions outside the permissible range and the unrealistic assumption of constant marginal effects), the LRM will also be prone to inefficiency stemming from the heteroskedasiticity inherent in count data, with the variance increasing in the mean (Cameron and Trivedi, 2013). The most widely used starting point for empirical work with count data is the Poisson regression model which is based on the Poisson distribution. The model specifies that the conditional mean is Poisson distributed with parameter λ (the mean number of counts) and has an exponential mean function.

$$\mathrm{E}(\mathrm{y}|\,\mathrm{x}) = \lambda = \exp(x'\beta) \tag{15}$$

It is estimated using maximum-likelihood estimation (MLE) and requires correct specification of both the conditional mean and the variance function for valid statistical inference. The Poisson regression model is similarly robust to distributional misspecification as OLS in the LRM. That is, as long as the conditional mean $\mathrm{E}(\mathrm{y}|\,\mathrm{x})$ is correctly specified, the Poisson MLE estimates are consistent even if y is not Poisson distributed. However, for valid statistical inference the standard errors and t-statistics need to be corrected, in a manner similar to the adjustment for heteroskedastic standard errors in the LRM. In addition to robustness, the Poisson model can also deal with endogenous regressors, is available for panel data and can be generalised in a similar manner as continuous dependent variables to account for a large fraction of zeroes in the data (via so called zero-inflated models), as well as modified to exclude zeroes (leading to zero-truncated Poisson models). Winkelmann (2010) suggests that the advantages of the Poisson model extend its applicability well beyond the domain of count data. He argues that it can be used for any constant elasticity mean function, such as for non-negative and positively skewed dependent variables (including continuous variables), and is preferable to the more common log-transformation of the dependent variable (Winkelmann, 2010).

Thus, if we were dealing with a count characterised by a large fraction of zeroes the Poisson estimator would commend itself for the consumption equation in our two-part model. However, as we saw in Figure 6.1 and Figure 6.2, observations do not only cluster at zero, but also bunch (or ‘heap’) at certain ‘rounded’ values (Pudney, 1989). Heaping is a common problem in self-reported consumption data in household surveys meaning that rather than reporting exact counts, individuals round off their answers to different levels of precision. Figure 6.3 and Figure 6.4 below, which plot the distribution of cigarette counts excluding the zeroes, show that consumption heaps around multiples of five, with the most important heaping point occurring at 20 (10) cigarettes per day for males (females), corresponding to one packet (half a packet) of cigarettes. The heaping problem is somewhat more pronounced in male cigarette consumption: as can be gleaned from Table 6.1 and Table 6.2, 60 percent of male cigarette consumption is reported as 10 and 20 cigarettes per day, with 84 per cent of observations falling on heaped counts in general, compared to about 47 per cent of females reporting half or one packet per day, and 70 per cent reporting their consumption as a multiple of 5.

Figure 6.3 Frequency distribution of positive daily cigarette consumption (males)

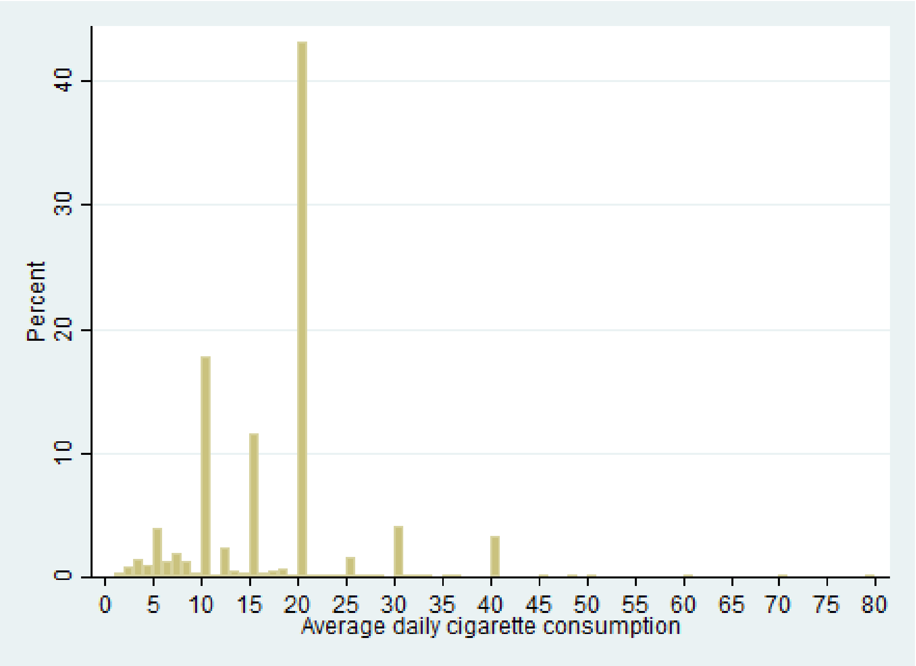


Figure 6.4 Frequency distribution of positive daily cigarette consumption (females)

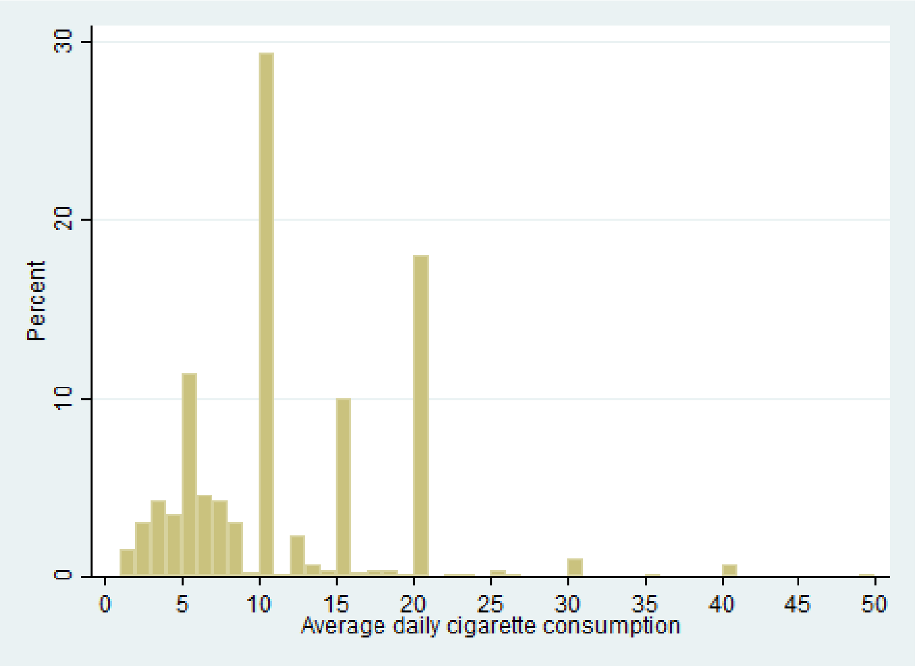


Table 6.1 Frequency distribution of daily cigarette consumption (males)

Daily cigarette consumption	Freq.	Percent	Cum.
1-4 cigarettes	650	3.61	3.61
5 cigarettes	689	3.82	7.43
6-9 cigarettes	871	4.83	12.26
10 cigarettes	3,165	17.56	29.81
11-14 cigarettes	604	3.35	33.16
15 cigarettes	2,060	11.43	44.59
16-19 cigarettes	278	1.54	46.13
20 cigarettes	7,656	42.46	88.6
21-24 cigarettes	28	0.16	88.75
25 cigarettes	296	1.64	90.39
26-29 cigarettes	12	0.07	90.46
30 cigarettes	734	4.07	94.53
35 cigarettes	35	0.19	94.75
40 cigarettes	595	3.3	98.06
40plus cigarettes	66	0.37	98.42
missing	284	1.58	100
Total	18,029	100	

Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59), using the survey weights provided by the RLMS.

Table 6.2 Frequency distribution of daily cigarette consumption (females)

Daily cigarette consumption	Freq.	Percent	Cum.
1-4 cigarettes	757	12.15	12.15
5 cigarettes	696	11.17	23.32
6-9 cigarettes	739	11.86	35.18
10 cigarettes	1,796	28.82	64
11-14 cigarettes	214	3.43	67.44
15 cigarettes	612	9.82	77.26
16-19 cigarettes	67	1.08	78.33
20 cigarettes	1,101	17.67	96
21-24 cigarettes	3	0.05	96.05
25 cigarettes	21	0.34	96.39
26-29 cigarettes	1	0.02	96.41
30 cigarettes	61	0.98	97.38
35 cigarettes	5	0.08	97.46

Daily cigarette consumption	Freq.	Percent	Cum.
40 cigarettes	43	0.69	98.15
40plus cigarettes	1	0.02	98.17
missing	114	1.83	100
Total	6,231	100	

Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (females 15-54), using the survey weights provided by the RLMS.

The stronger heaping present in male cigarette counts could be related to their higher average daily consumption since people are more likely to use rounding strategies if they remember less well, and recall inaccuracy tends to increase as the count increases (Bar and Lillard, 2012; Wang et al., 2012). As is evident from Table 6.1 and Table 6.2, heaping is substantial and reporting consumption as a multiple of 5 constitutes the rule rather than the exception. To the extent that heaping arises from misreporting of cigarette consumption, it is of concern for the analysis since it violates the assumptions of standard count data distributions and thus may bias estimation and inference. While in the classic linear regression model measurement error in the dependent variable simply causes less statistical precision and downward-biased estimates, in non-linear contexts, especially if, as in our case, the dependent variable only takes on a limited set of values, measurement error can lead to biased and inconsistent estimators (Cameron and Trivedi, 2013; Hausman, 2001). As imprecise counts of true consumption, heaped counts reduce within-subject variability over time, which is particularly important if we want to study systematic changes in consumption, and leads to attenuation bias in the estimators. Since heaping increases with consumption, attenuation bias is potentially more severe in the male sample of the RLMS.

In order to assess whether the heaped cigarette counts leave us with a mismeasured dependent variable or whether they are a real feature of the data, it is crucial to understand the process that generates the data, that is, the behavioural processes underlying cigarette consumption and its reporting, as well as the form of the survey question, response categories and potential processing of the raw data (Bar and Lillard, 2012). Pudney (2008) suggested that consumption data from large-scale household surveys should be seen as being generated by two underlying behavioural processes: (1) a process by which people decide how much to consume, and (2) another process by which people decide how to answer survey questions regarding their consumption (Pudney, 2008). If in the case of cigarette consumption, the heaps resulted from (1), they would reflect true consumption and thus be a real feature of the data, whereas if they arose only later in the reporting process (2) they would introduce measurement error. On the one hand, the fact that cigarettes are not sold individually but in packet sizes of 20 could mean that the heaps at fractions and multiples of a packet reflect true behaviour, for example, if individuals regulate their consumption according to packet size (such as not smoking more than one packet per day). Farrell et al. (2011) exploited the variation in packet sizes between 10 and 20 cigarettes in England and found support for this self-rationing hypothesis (Farrell et al., 2011). However, studies comparing heaped self-reported data with either biochemical markers of cigarette consumption or records based on electronic diaries find consumption to have a smooth distribution, suggesting that the heaps are predominantly a reporting phenomenon (Wang et al., 2012).

Since smoking is a repetitious and habitual behaviour, it is unlikely that smokers know *exactly* how many cigarettes they smoke per day. Evidence suggests that in forming an estimate of their daily consumption, individuals use information about their general smoking habits, typically oriented by packet sizes, e.g. one packet, half a packet, one quarter of a packet etc. (CDC Centers for Disease Control, 1992; Shiffman, 2009). The reported cigarette count then depends on the particular rounding strategy the individual uses, e.g. rounding to the nearest 5, 10 or 20. Wang et al. (2012) developed a statistical model that describes the process leading to distortions in cigarette counts in longitudinal measurements of cigarette consumption as a two-stage process of misremembering and rounding. Allowing for random, individual-specific effects in both stages and multiple heaping rules (e.g. round to nearest 5, 10 or 20) they show that both misremembering and rounding strategies contribute substantially to the distorted counts (Wang et al., 2012). Furthermore, in the RLMS, the question on cigarette consumption is phrased in terms of *usual* amounts of daily consumption. This already seems to presuppose that respondents need to resort to some form of rounding (measurement error) to ‘approximate’ their consumption, so that some degree of heaping is already implied through the design of the survey. In conclusion, the heaped cigarette counts will arise both by design of the survey question and through individuals’ reporting strategies, introducing (potentially substantial) measurement error in the dependent variable, that needs to be addressed in the analysis.

Since our interest lies in whether systematic changes in cigarette consumption occur in response to price changes, reduced variation in the dependent variable due to measurement error is a serious problem. One solution to correct for the measurement error would be to use a separate statistical model to predict true, unobserved cigarette consumption, allowing for various heaping strategies similar to the Wang et al. study referred to above, and use these estimates as the dependent variable in the subsequent demand model. While this approach will provide more accurate cigarette counts, it also leads to a much more complex model. A simpler approach, employed for example by Harris and Zhao (2007) and Christelis and Sanz-de-Galdeano (2011), is to create a categorical indicator of cigarette consumption which groups the observed counts in multiples of five by coarsening the data around the observed heaping points. For example, counts 8, 9, 10, 11 and 12 cigarettes per day would be recoded into one category representing the heaping point at 10 cigarettes. This version of the categorical consumption indicator can be seen as dealing with measurement error by classifying respondents into levels of consumption intensity, based on the assumption that the misremembering introduces error distributed around the originally reported value. Given that we are interested in larger, long-term changes in consumption patterns rather than fluctuations of 1-2 cigarettes, using a categorical indicator that picks up larger consumption adjustments seems an acceptable strategy to deal with measurement error in our case. Since people tend to base the number they report on their smoking habits, they would likely report a different category of 5 if they alter their consumption (for example, people will be aware if they switch from 1 to ½ packet and will report this accordingly).

In addition to addressing measurement error, utilising this categorical variable approach also allows us to explore the effects of price at different levels of consumption intensity (represented by the categories), compared to only mean effects in the standard linear and count regression models, which can provide useful information for policy makers. However, the ordered choice models, which this kind of categorical data imply, come at the cost of being considerably more difficult to interpret. For example, while in linear models, the parameter coefficients correspond to the marginal effects, this is not the case in non-linear models such as the ordered probit model, where the marginal effects of an independent variable depend on the values of all the other independent variables in the model. Furthermore, the ordered probit approach is also inefficient compared to linear or count regression, since it uses less data than is available (by recoding the observed counts into categories). The traditional application of ordered choice models is for categorical dependent variables which have an inherent ordering but no direct quantitative meaning (e.g. a preference measured on a 5-point likert-scale or self-assessed health status). That is, for classical ordered responses, the value assigned to an outcome can be arbitrary so long as it preserves the order, meaning that the sequence 1, 2, 3 carries the same information as 15, 25, 33 or -4, 5, 91 (Winkelmann and Boes, 2006).

The statistical model is constructed in a manner similar to binary choice models that treat the data as generated by an underlying continuous, but latent variable y^*, which on crossing a particular threshold μ results in an increase of one in the observed outcome, i.e. moves an individual into the next outcome category. Assume that:

$$y^* = x'\beta + u \qquad u|x\ Normal(0,1) \tag{16}$$

where $\mu_1 < \mu_2 < \mu_j$ are the thresholds to be estimated and y is linked to y^* via

$$y = \begin{cases} 0\ if\ y^* \leq 0, \\ 1\ if\ 0 < y^* \leq \alpha_1 \\ J\ if\ y^* > \alpha_J \end{cases} \tag{17}$$

In the standard ordered probit model μ_j (*j=1, ..., J-1*) represent the unknown boundary parameters or thresholds to be estimated, which divide the underlying continuous, but unobserved probit index y^* into their respective categories. However, because in our case we self-define the thresholds, the latent index has a precise and quantifiable meaning, namely observed but mismeasured cigarette consumption levels (Christelis and Sanz-de-Galdeano, 2011). As Wooldridge (2010) notes, the ordered probit model can be modified to apply to a quantitative outcome that is grouped into interval regression on interval or grouped data. Since y^* has a quantitative meaning we would use OLS to estimate β if y^* was observed. However, we only know whether y falls into a certain category of cigarette consumption as defined by our threshold values. Therefore, we can replace the unknown parameters μ_j with our threshold values (so that they do not need to be estimated in the model) which then also allows us to identify the variance and therefore relieves the need to normalise to 1 as assumed in equation (16). In Stata, this type of ordered probit estimation is available under the name of interval regression.

To sum up, in this section we have discussed the three challenges for the estimation strategy related to the nature of the dependent variable (non-negative integer, large fraction of zero observations and measurement error due to heaping of observations in multiples of 5). While the full DHM provides a theoretically appealing approach to address the zero problem, i.e. reflecting zeroes in both the participation and consumption decisions and allowing for correlated unobservables in both parts, we believe that the assumption of dominance is an acceptable simplification given the nature of our data (i.e. the way the questions are formulated) and the high affordability of cigarettes in Russia (i.e. if you are a smoker you are unlikely to make an economic choice not to smoke). The choice is therefore between a two-part model where the unobservables are uncorrelated and a selection model. Although the latter model is conceptually appealing, estimation of such a model is complicated by the absence of compelling exclusion restrictions in our dataset. The core model adopted in this chapter is therefore a two-part model, consisting of a probit model for the participation equation, and a variety of linear and non-linear estimators for the consumption equation, with the two parts estimated independently.

As concerns the choice of estimator for the second part, we pursue two different strategies in order to account for both the strictly positive nature of y and the presence of measurement error.[53] First, a linear approach in which we compare the following estimators: (1) OLS on the untransformed dependent variable (i.e. ignoring all of the problems outlined above); (2) OLS on the log-transformed dependent variable (taking into account the strictly positive nature of y but ignoring measurement error), (3) a generalised linear model with Gaussian distribution and log link on the untransformed dependent variable (addressing the non-negativity of y but modelling the log-transformed mean of y rather than the mean of log-transformed y); (4) OLS on the midpoints (i.e. the observed heaping points, as one approach to accounting for measurement error but not explicitly the non-negativity of y), and (5) interval regression (as an alternative approach to accounting for measurement error but not explicitly the non-negativity of y), which as outlined above is conceptually the same as applying an ordered probit model with known thresholds (defined through the lower and upper limit dependent variables). So (4) and (5) represent opposite ways of addressing the heaping problem: With (4) we assume that everyone in the sample consumes only in multiples of 5 and thus impose the closest heaping point on each respondent who reports a non-heaped value, whereas in interval regression we assume to know the interval limits into which consumption falls (corresponding to the lower and upper thresholds to create the categorical cigarette

[53] Table 6-A in the appendix summarises our different modelling strategies for the two-part model including the interpretation of coefficients and marginal effects.

consumption indicator), but not the exact value. This can be seen as a conservative approach in that it is based on the standard assumptions underlying the LRM.

Moving beyond these five variants, we also explore a second non-linear approach. Specifically, we adopt an ordered probit model in which we examine the effects of price on consumers with different consumption intensity. This approach differs conceptually from the interval regression approach (5), outlined above, in that it does not assume an underlying quantitative meaning for y^*, so that instead we treat consumption in terms of ordered categories of smoking intensity. As explained above, in the standard ordered probit the thresholds values are unknown, with the first threshold fixed at zero and the variance normalised to one. Before turning to the detail of the empirical model specifications, we briefly recap the details of the sample we are using.

6.2.2 The RLMS working-age sample

The analyses in this chapter are based on the representative cross-sectional sample of the RLMS. To recap, from the second chapter, the complete non-representative dataset for the period 2001 to 2010 contains 140,691 observations of which 102,224 (73 percent) fall on respondents in the representative sampling frame and 38,467 (27 percent) on respondents in the follow-up sample. To obtain the correct representative sample for 2001-2010, we exclude all individuals in the follow up sample, as well as individuals who left the representative sample in round 10 but returned to the survey after round 10, which leaves a representative sample of 101,526 observations. Furthermore, we restrict our analytical sample to the working-age population, which in Russia implies men aged 15-59 and women aged 15-54. There are two major reasons for this: (1) As we have seen, the prevalence rates for individuals above working-age is very low for both males and females. While this will partly reflect the differential mortality of smokers among men, the low rates among women reflect the strong cohort patterns in female smoking that we have examined in chapter 3. The patterns of smoking across the life-course, with individuals starting in their teenage and adolescence years and quitting in middle age, also make the working-age population of particular interest from a policy-making perspective; (2) Many of the socioeconomic characteristics, as well as the central variables of interest such as price and income, are likely to have differential effects for pension age respondents. We are therefore working with a total sample of 61,277 observations (29,400 males and 31,877 females) in the pooled representative sample for 2001-2010.

6.3 EMPIRICAL MODEL

We now turn to building the empirical model, a static demand model, drawing on the descriptive evidence from chapters 3 and 4 as well as our review of the empirical literature on cigarette demand in chapter 5. To recap from the previous chapter, in a static demand model based on cross-sectional survey data, current consumption C_i (typically average daily consumption) can be expressed as a function of the real price of cigarettes P_i, the real price of related goods PR_i (e.g. alcohol), a vector of individual and household characteristics X_i (e.g. age, education, occupation, household income and size), as well as a vector capturing environmental and location-specific factors L_i (e.g. settlement type), where i denotes the individual.

$$C_i = \alpha + \beta_1 P_i + \beta_2 PR_i + \beta_3 X_i + \beta_4 L_i + \varepsilon_i \tag{18}$$

That is, in addition to economic factors such as prices and wealth, demand is influenced by individual preferences which are generally unobserved but which we try to capture through a set of factors at the individual, household and community/regional level that we expect to influence smoking behaviour.

As in standard demand models, our key variables of interest are the price per packet of cigarettes as well as income, i.e. we are interested in responses at the extensive and intensive margins of cigarette consumption at different levels of price and income. In the second chapter we discussed the drawbacks of the RLMS data on cigarette prices reported at the household and community-levels, which has led us to merge into the dataset the regional cigarette prices for both domestic and foreign cigarette brands provided by the State statistical agency Rosstat. While the Rosstat prices provide a more consistent measure of the price level, exhibiting a clearly discernible time trend that ties in with the tax increases observed over the time period under consideration, their major drawback is to reduce the variability of prices within the cross-section. As explained in chapter 2, Rosstat provides cigarette prices for each of the 83 subjects of the Russian Federation. The RLMS is conducted in 38 of the 83 subjects (corresponding to the number of primary sampling units). Thus, while the RLMS community prices are collected for each of the 166 sites (secondary sampling units), the Rosstat prices are measured at a higher level of aggregation. Our comparison of the Rosstat and RLMS prices in chapter 2 showed that two-thirds of the discrepancies occur at the low end, particularly for rural settlements, suggesting that the former are biased downward and should be interpreted as lower bound estimates of the impact of price on demand. In our basic empirical specification, we use the average of the Rosstat prices for domestic and foreign cigarette brands, adjusted for inflation using the deflator variable provided with the RLMS dataset.

The relationship between quantity consumed and price can be expected to be non-linear, that is, it is likely that the response in consumption for each additional rouble will change along the distribution of prices, rather than being constant as would be implied by a linear relationship. To reflect this non-linearity we log-transform the price variable, so that our price variable is the average of the (logged) prices for domestic and foreign cigarette brands, in real terms. However, given the centrality of price, we also explore the effects of four other price measures (Rosstat domestic, Rosstat foreign, RLMS domestic, RLMS foreign).

In addition to price, demand will also depend on the budget constraint the individual faces. If cigarettes are a normal good, as suggested in the empirical literature, higher income will increase demand, all other things being equal. However, income might well be expected to have opposite effects in the two parts of the model, for example, respondents with higher income might be more health-conscious (i.e. have a greater demand for health), while conditional on being a smoker, higher income might increase the quantity demanded, meaning that income would enter with a negative sign in the participation equation, and a positive sign in the consumption equation. The RLMS provides data on household income, which is constructed using information on a variety of sources of income such as work wages (formal and informal), self-employment, pensions, agriculture etc., and available both in nominal and in real terms (adjusted to 1992 roubles). To adjust the disposable income at the individual level for size and composition of the household we weighted the real household income using OECD equivalence scale. [54] Similar to price, we expect the relationship between income and smoking participation/consumption to be non-linear, therefore we log-transform the equivalised income variable.

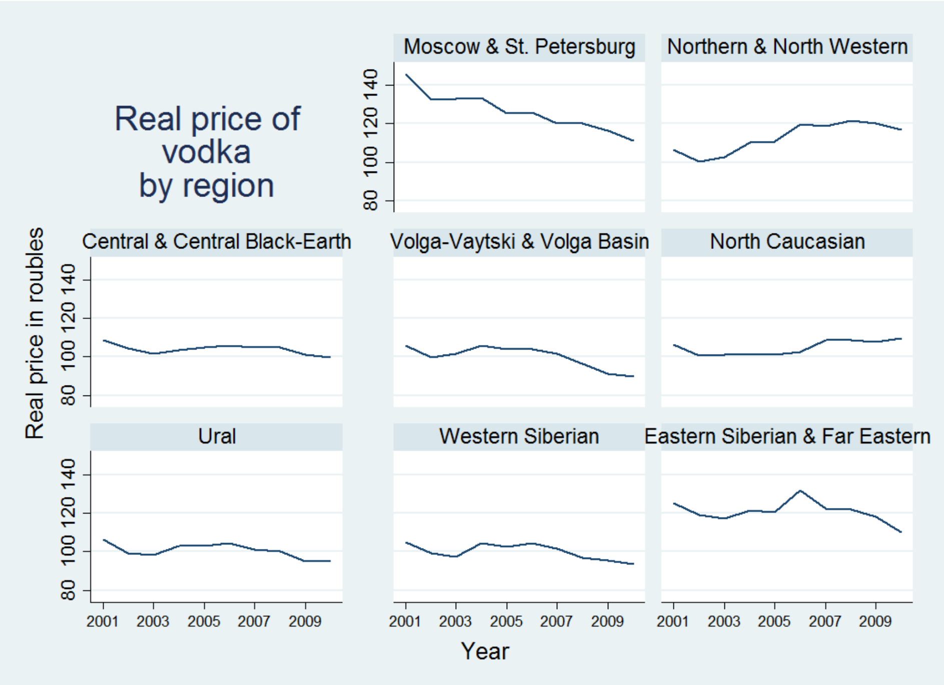
[54] The weights per household member according to the OECD scale are: 1.0 for the first adult, 0.7 for the second and each subsequent person aged 14 and over, 0.5 to each child aged under 14.

Given the expected complementarities between cigarette and alcohol consumption, a prime candidate for the price of related goods is the price of alcohol. The complementary relationship between alcohol and cigarettes has also been found in Russia, with 85.9 (41.1) percent of male (female) moderate alcohol consumers also being smokers, and 90 (64) percent of male (female) heavy alcohol consumers also smoking (Zaridze et al., 2014).[55] Since the RLMS alcohol prices suffer from the same problems as the cigarette prices, we also merged Rosstat regional prices for vodka into our dataset.

Contrary to our expectations, our experiments with including vodka prices (both contemporaneous and lagged values) suggest that vodka and cigarettes are substitutes rather than complements. The empirical evidence on the cross-price elasticity between cigarette and alcohol consumption is far from conclusive but, in our case, the result likely reflects that the real substitution effects are taking place within the different categories of alcohol and this could be disguising the relationship between alcohol *per se* and cigarettes. Interestingly, the evolution of vodka prices over time is also opposite to that of cigarette prices, with real prices for vodka falling over time in the majority of regions as can be seen from Figure 6.5 below. Specifically, vodka prices are falling in most regions from 2008 onwards, whereas cigarette prices have been increasing in this period due to tax increases.

[55] Moderate drinking is defined as consuming 1 to <3 half-litre bottles of vodka per week, and heavy drinking as drinking more than 3 half litre bottles per week.

Figure 6.5 Real price of vodka by region



Turning next to our set of individual and household characteristics. As we saw in chapters 3 and 4, smoking participation differs by age, particularly for females. In our analysis of smoking over the life-course in chapter 3 we saw that, for both men and women, smoking rates rise steeply in the late teenage/early adolescence years and start falling in the late 30s/early 40s, with females on average starting later and quitting earlier in life. Age can thus be expected to show an inverted U-shape relationship with smoking participation, meaning that in our working-age sample age is positively related to smoking participation but the effect decreases with increasing age, reflecting for example individuals that give up smoking due to bad health. However, while for males, the similar life-course profiles of different birth cohorts suggest that the respondent's age mostly captures a true age effect (specifically the differential mortality of smokers in the older age groups), the strongly diverging female profiles, with prevalence rising from cohort to cohort, indicate that age also reflects a strong cohort effect for females. The cohort effect for females was also supported by the growing share of former smokers among younger women documented in chapter 4. Consumption intensity increases with age, except for the oldest working-age group (age 55-59) where consumption is slightly reduced compared to the preceding age group. To reflect the inverted U-shape relationship between age and smoking, we include age and age squared in our empirical model.

The strongly gendered nature of smoking referred to in the context of age above, has been a recurring theme. Specifically, chapter 4 highlighted different trends in smoking prevalence across different age groups by gender, with male smoking rates appearing to be going down at all ages, whereas prevalence showed both increasing and decreasing trends for females. Furthermore, while some of the socioeconomic characteristics of smokers are shared, most notably the educational gradient, the female smoking patterns indicate strong differences across regions and for different settlement types. In light of these differences, we estimate the demand models separately by gender so as to be able to tease out important policy implications which we anticipate may also differ by gender.

In our descriptive analysis in chapter 4 we saw that smoking prevalence showed a steep educational gradient among both genders, but that conditional on smoking, intensity levels were relatively similar across educational categories within gender. While we can think of education as increasing the individual's knowledge about the detrimental effects of smoking, there is evidence against this phenomenon in Russia. Indeed, according to the GATS survey in Russia, more educated individuals were more likely to believe that certain types of cigarettes are less harmful than others, suggesting that if it were for knowledge about the harmfulness of smoking, education might even have a positive effect on certain types of smoking in Russia (WHO, 2009). Thus, rather than representing knowledge about the harmfulness of smoking *per se*, education is likely to capture aspects of the socio-cultural environment that are shared by people with the same level of educational attainment, that is, a certain type of peer effect or social interaction in smoking. When thinking about the socio-cultural influences on individuals' preferences for smoking it is useful to refer back to Glaeser and Cutler's (2010) classification of social interactions in smoking from chapter 5: (1) direct social interactions, including social approval and stigma, (2) formation of beliefs through social learning, and (3) market-mediated spill-overs (e.g. through supply structures). The individual's educational attainment could proxy both direct social interactions, e.g. the entrenched pattern of negative health lifestyles among working-class men (who typically have a lower level of educational attainment) that we discussed in the third chapter, and beliefs acquired through social learning (as evidenced by the GATS survey results mentioned above). In our empirical specification, we include a categorical indicator of education – with the four categories being 'university degree and higher' (the reference category), 'Tec & Med' which includes respondents with a degree from a technical, medical, pedagogical or art college - considered as 'non-university' higher education in Russia (Norric, 2005), 'complete secondary education' which includes respondents with complete secondary education and those with complete secondary education plus some form of vocational training, and finally 'incomplete secondary education' which includes respondents with primary education only or primary education plus some form of vocational training.

In addition to education, we also control for individual occupation. The RLMS codes occupation according to the four-digit International Standard Classification of Occupations: ISCO-88, while taking into account the idiosyncrasies of the Russian labour market.[56] The four-digit codes can be collapsed into one-, two-, or three-digit codes. In our analysis we use a categorical indicator of occupation based on the one-digit codes with the following categories: (1) managerial and professional occupation (the reference category), (2) non-manual occupation, (3) manual occupation, (4) unskilled occupation, and (5) no occupation, for those who are not in the labour market. While occupation will partly reflect the respondent's educational level, it also captures characteristics of the working environment and with this another form of peer effect. For example, the common smoking breaks in manual occupations might make respondents in this occupational category both more likely to smoke and to smoke more intensively, whereas those working in an office environment might face greater constraints on smoking at their workplace.

Data at the household-level provide the most disaggregated measure of peer effects and social interactions in smoking. For example, an individual living together with a spouse, parent or other household member who smokes might both be more likely to smoke and, given he/she smokes, to consume more. For consumption, the immediate socio-cultural context will likely have a smaller effect at higher levels of intensity, where consumption is strongly driven by addiction. If this were true, we would expect variables that capture environmental influences (be it defined in terms of socioeconomic environment or living environment) to have smaller effects for males than for females given their higher daily consumption and thus supposedly higher degree of nicotine addiction. In our empirical model we include four variables to capture influences on individual smoking at the household level: (1) a categorical indicator for the number of other smokers in the

[56] For further information on the occupational coding see http://www.cpc.unc.edu/projects/rlms-hse/data/documentation/occupationalcoding.

household[57] (with zero other smokers as the reference category); (2) the number of adults in the household; (3) the number of children in the household, and (4) a categorical indicator for marital status (where single is the reference category). All other things being equal, we expect the number of other smokers in the household to be positively related to both participation and consumption. Since the number of other household smokers depends on household size and composition, we also include controls for the number of adults and children in the household so as to avoid a confounding of the 'other smokers' effects with household size. We expect both the number of adults and the number of children to be negatively related to smoking participation: a higher number of adults in the households typically signals pension-age individuals (who are less likely to smoke) living with their children, rather than several working-age individuals forming a household, and the presence of children should also reduce the likelihood of participation if we assume that parents want to protect their children from second-hand smoke. The relationship for marital status is more difficult to predict. Given that singles tend to be younger, we would expect participation to be higher in the other marital status categories (married, divorced, widowed) but, among females, the opposite might hold given the strong cohort effects reported earlier. Since smoking is perceived as a way to cope with stress among smokers, we would expect consumption (and potentially participation) to be higher for individuals who are divorced and widowed.

Preferences for smoking are also formed by factors that are shared by people living in the same area and thus being exposed to a similar extent to tobacco control policies, tobacco advertising, anti-smoking sentiment or other cultural factors that inhibit or promote smoking, such as e.g. religion. In our model we capture influences of the area an individual lives in at two levels. First, a categorical indicator for the size of the settlement, with the same definition of categories we used in chapter 4 (city larger than 500,000 inhabitants, city with 50,000 to 500,000 inhabitants, and small towns and rural areas). The size of the settlement determines the infrastructure available; including the amount and density of retail outlets where cigarettes can be purchased as well as tobacco advertising. In addition, the settlement indicator allows us to explore the effect of cigarette prices by size of settlement. This is particularly important since we saw in chapter 2 that

[57] Ideally, we would want to further distinguish between spousal or parental smoking. However, since the survey does not ask explicitly about this, the closest we can get is the number of other smokers in the household, which we can derive by combining the household identifiers and information on individuals' smoking status.

our regional-level cigarette price measure might underestimate the price level in rural areas, so that we expect the price effects to differ by settlement size in our model. As a second measure of environmental influence we include indicator variables for each of the 8 regions that divide Russia according to socioeconomic and cultural characteristics (this is the same definition as in chapter 4). To recap, the cigarette prices we use are measured at the level of the 38 primary sampling units (PSU), which are nested within these 8 broader regions. This means that in our demand model there is both between-PSU within region variation, and within-PSU temporal variation in prices.

Controlling for regional influences will be particularly important for females, since, as we have seen in chapter 4, female smoking differs considerably across the regions, with smoking prevalence in Moscow and St. Petersburg being up to 3 times higher than in other regions. Among other things, this reflects the more “Western” cultural norms in the two federal cities as well as their greater exposure to tobacco marketing.

Finally, since in chapter 4 we have identified several trends in smoking prevalence and intensity over time, we also include a linear time trend in our model. Table 6.3 at the end of this section provides a summary of all the covariates in our basic empirical model, including their measurement scale and the expected sign of the coefficients and marginal effects.

In addition to this basic specification, we also explore the effects of separately adding more controversial, potentially endogenous, regressors. These variables include: (1) a dummy variable indicating whether a household was in the top quartile of alcohol expenditure; (2) a categorical indicator of the feeling of power the individual feels he/she has compared to others in the society; and (3) a dummy variable, added to the consumption equation only, indicating whether an individual has smoked for 10 years or more.

As an alternative means of exploring the potential complementarity between alcohol and smoking, we also seek to account for an individual’s alcohol consumption when estimating cigarette demand. However, while the RLMS provides detailed information about alcohol consumption, such as consumption frequency and amount consumed of various types of alcohol per drinking episode, the high percentage of missing data would lead to a loss of more than one third of the sample size for both males and females. Therefore, as a second-best alternative we draw on the household expenditure data on alcohol and create an indicator variable for households that are in the top quartile in order to proxy for a heavy alcohol consumption household.

Smokers frequently report that smoking a cigarette relaxes them and helps them cope with stressful situations. While this has been shown to be an erroneous perception in that, rather than cigarettes having a calming effect per se, smokers feel better after a cigarette since this ends their (unpleasant) withdrawal symptoms, (Silverstein, 1982), it is the *perception* of cigarettes as a stress reliever that counts. Thus, individuals with a higher level of stress are more likely to smoke more intensively.[58] Moreover, previous research on the association between psychological distress and negative health behaviours in Russia found that women who were distressed were more likely to be smokers (Cockerham, 2006). In this study psychological distress was measured via 12 psychological distress symptoms, including for example ‘feeling you cannot overcome your difficulties’ or ‘feeling an impossibility to influence things’. These two items capture an individual’s ‘locus of control’. This is a concept in psychology that describes the extent to which individuals believe they can control events that affect them. People with an internal locus of control feel they have control over events that happen to them, whereas people with an external locus of control feel they do not have the power to control outside events (Lefcourt, 2014). While the RLMS does not directly ask about stress symptoms there is one question which we argue can be seen as capturing the individual’s locus of control:

> *And now, please imagine a nine-step ladder where on the bottom, the first step, stand people who are completely without rights, and on the highest step, the ninth, stand those who have a lot of power. On which of the nine steps are you personally standing today?*

While the question focuses on how respondents see their degree of power in relation to other people in society, someone who reports standing on one of the lower steps, that is who believes he/she is relatively powerless compared to others, can reasonably be expected to have a sense of having little control over things that happen to him/her. This

[58] Taking away this ‘myth’ of the calming effects of cigarettes can be an important way to help smokers quit. In fact, anti-smoking interventions are often centred on breaking the psychological dependence via for example finding alternative ways to cope with stress.

'power rank' variable is coded with values 1 to 9, where 1 reflects the lowest feeling of power.

As a third addition to the basic empirical model, we include a dummy variable in the consumption equation that indicates whether an individual has smoked for 10 years or more. While this can be seen as a way of accounting for addiction or habit formation within a static model, we should keep in mind that it could also introduce a potential endogeneity since the unobserved factors that influence consumption may also be correlated with factors that determine the longevity of smoking.

In all of our specifications, to account for the likely heteroskedasticity of the error terms, as well as for repeated observations on the same individual, we estimate all models using robust (Huber-White) standard errors that allow for clustering at the individual level.

Table 6.3 Regressors in the basic empirical model

Variable	Definition, measurement scale *reference category	Measurement level	Effect on smoking	Expected sign Participation	 Consumption
Price per packet of cigarettes	Average of price of domestic and foreign cigarette brands, in real terms, logged to reflect the non-linear relationship between price and quantity consumed.	Region	All else being equal, quantity demanded will fall as price increases.	negative	negative
Income	Equivalised income per capita. Income is measured at household level in the RLMS. To obtain the equivalised income per capita income we used the OECD equivalence scale.	Household	If cigarettes are a normal good, higher income will increase the quantity demanded. However, if people with higher income are more health-conscious, income will have a negative effect on participation.	positive or negative	positive
Age	Continuous (years)	Individual	Capturing the inverted U-shaped relationship between age and smoking	positive	positive
Age squared	Continuous (years)	Individual		negative	negative
Education	Educational attainment measued in four levels: (1) University degree* (2) Technical, medical, pedagogical, and art college (3) Complete secondary (4) Incomplete secondary	Individual	Captures both direct social interactions in smoking (e.g. norms and traditions) and beliefs shared by individual with similar socioeconomic characteristics, e.g. beliefs about less harmful cigarettes.	positive	positive
Occupation	Type of occupation grouped into five categories: (1) Managerial & professional* (2) Non-manual	Individual	Captures influence of working environment, e.g. fewer constraints on smoking at work in manual (blue-collar) occupations.	positive	positive

Variable	Definition, measurement scale *reference category	Measurement level	Effect on smoking	Expected sign Participation	 Consumption
	(3) Manual (4) Unskilled (5) No occupation				
N°of other smokers in the household	Categorical indicator for the number of other smokers in the household: (0) 0 other smokers* (1) 1 other smoker (2) 2 other smokers (3) 3 other smokers (4) 4-7 other smokers	Household	Captures peer effects at most disaggregated level. The presence of other smoking household members (e.g. parents, spouses) increases both the probability of smoking and the quantity consumed, with a higher number of other smokers increasing the magnitude of the effect.	positive	positive
Household has kids	Dummy variable for presence of children in the household	Household	If parents/family members want to protect their children from exposure to second-hand smoke, this should reduce the probability of smoking for individuals in households with children. If individuals do smoke, we would expect the quantity consumed to be lower, if for example individuals smoke outside to protect children.	negative	negative
Marital status	Categorical indicator with four categories: (1) Single* (2) Married (3) Divorced (4) Widowed	Individual	Given that singles are typically the younger respondents, we would expect smoking participation to be lowest in this category. To the extent that divorced or widowed smokers are more distressed than their single or married counterparts, their consumption should be higher.	positive	positive
Settlement size	Categorical indicator for size of the settlement the respondent resided in: (1) City > 500,000 inhabitants* (2) City 50,000-500,00 inhabitants (3) Towns <50,000 inhabitants & rural settlements	Community	Larger cities might provide a more smoking-friendly environment due to (1) a higher density of retail outlets selling cigarettes and with this lower prices, and (2) more intensive tobacco marketing, e.g. billboards	negative	negative

Variable	Definition, measurement scale *reference category	Measurement level	Effect on smoking	Expected sign Participation	 Consumption
Region	Categorical indicator dividing Russia into 8 regions according to socioecconomic and cultural criteria (indicator provided by the RLMS): (1) Moscow & St. Petersburg (2) North & North-Western (3) Central & Central Black Earth (4) Volga Basin & Volga Vyatski (5) North Caucasian (6) Ural (7) Western Siberian (8) Eastern Siberian & Far East	n.a.	In a country with an ethnically heterogenous population such as Russia with more than 160 different ethnic groups and indigenous peoples, controlling for regional differences in indispensible. For example, the North Caucasian regions typically display a better ‘health behaviour profile’ given the prohibitions on alcohol consumption and smoking in Islam..	negative (for females)	negative (for females)
Year	Linear time trend	n.a.	Capturing trends over time in cigarette consumption	negative (for males)	positive

Note: All categorical variables are inclued via STATA’s indicator variable notation (i.variable) which automatically adds the categories as a set of dummy variables.

6.4 RESULTS

Before we move on to the detail of the results, a short note on interpretation is in order, given that we are using both linear and non-linear models. In linear models, the coefficient β of a continuous variable x_k equals the marginal effect or marginal change of x_k, that is, the ratio of the change in the expected value of y to the change in x_k, when the change in x_k is infinitely small, holding all the other variables constant. For discrete variables the marginal change equals the discrete change in $E(y|x)$ when x changes by one unit, holding all other variables constant. Furthermore, the effect of a given change in x_k is the same for all values taken on by x_k and does not depend on the value of the other variables in the model. Interpretation of linear models therefore typically only requires reporting the estimated parameters (unless the model includes nonlinear features such as polynomial terms or interactions).

In nonlinear models, such as the probit model we are using in the participation equation, interpretation of the estimated coefficients is less straightforward given the rescaling of y from a dichotomous into a continuous (latent) variable y^* through the probit link function. The coefficients measure the change in the z-score of the standard normal distribution of y, meaning that the reported coefficient no longer captures the effect of a change in x_k. More important still, the change in y for a change in x_k is not constant but depends on the starting values of x_k and on the values of all the other variables in the model. Because the effect of x_k differs for each observation, there is a distribution of marginal effects in the sample, from which we must derive an informative summary measure. The appropriateness of such a summary measure for x_k depends strongly on the values at which we keep the other independent variables when evaluating the marginal effect of x_k (Long and Freese, 2014). A standard approach is to compute the marginal effects of x_k for every observation while keeping the other variables at their observed values and then computing the average of these effects. This is typically referred to as the Average Marginal Effect (AME). A second approach is to keep all other variables at their mean values, yielding the so-called Marginal Effect at the Mean (MEM). The drawback of this approach is that these averages might not correspond to any observed values in the population. Third, we can evaluate marginal effects keeping the other variables at particular values of interest, so-called Marginal Effects at Representative Values (MER). In what follows, our default report is of the AME, but we do analyse the distribution of marginal effects and differences between AME and MEM for key variables of interest such as price and income. Table 6-A in the appendix provides a summary of the interpretation of different types of independent variables for the linear and nonlinear models used in the participation and consumption equations. We now turn to the results.

6.4.1 BASE MODEL – PARTICIPATION

As a first step in analysing our participation models we examine, in Table 6.4, the distribution of the predicted probabilities of smoking for males and females. While the range of predicted probabilities is wide for both genders, the average predicted probability of being a smoker for males is more than 3 times that of females (.61 versus .19). Half of the observations for males have a probability of .63 of being a smoker (the median is very close to the mean), whereas among women half of the sample has a probability of around 6 percent (a more skewed distribution) of being a smoker, and only 10 percent of the sample have a probability larger than 50 percent.

Table 6.4 Predicted probabilities of being a current smoker (participation)

Pr(smokes)	Observations	Mean	Minimum	Maximum	Percentiles	
Males	27,528	.610199	.00165146	.99845147	5%	.1522011
					10%	.2186859
					25%	.4188341
					50%	**.6311723**
					75%	.8303451
					90%	.9635736
Females	29,182	.188982	.0009264	.99999821	5%	.0008275
					10%	.0029857
					25%	.0148332
					50%	**.0628035**
					75%	.2536344
					90%	.6663161

Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Controlling for age, age squared, the average price of domestic and foreign cigarette brands (real, logged), equivalised income per capita (real, logged), education, occupation, number of other smokers in household, number of adults in household, number of children in household, marital status, settlement size, region and time trend.
Pr(smokes) = predicted probabilities of being a current smoker

The plotted distribution of predicted probabilities in Figure 6.6 and Figure 6.7 below captures the differences in the distributions of the two samples. For men the highest frequency of predictions is close to one but overall predicted values are distributed relatively symmetrically and centred on the mean of .61, while for females by contrast, the overwhelming majority of predictions bunches at values just at and around zero. The heavy tails of the female distribution render the AME a less suitable summary measure of the distribution.

Figure 6.6 Predicted probabilities of participation (males)

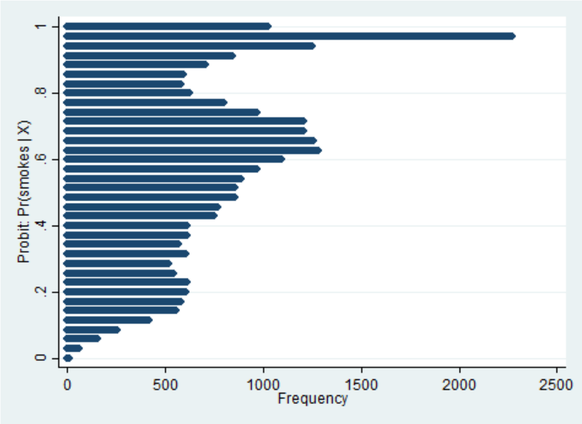
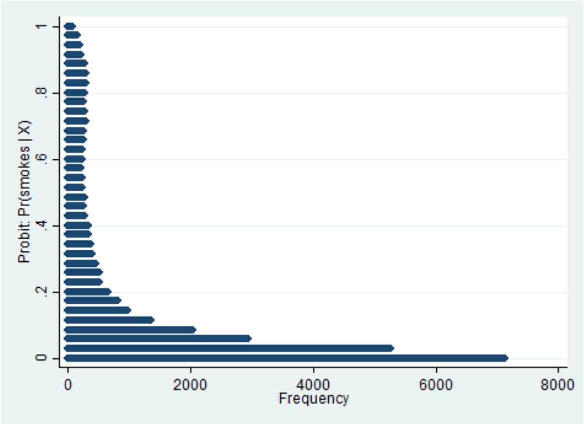


Figure 6.7 Predicted probabilities of participation (females)



As outlined above, in probit models the coefficients are not directly interpretable, other than that a positive/negative sign indicates that the variable increases/decreases the probability of smoking. Rather than using the parameters as in linear models, approaches to interpretation in nonlinear models are typically based on the predicted probabilities of the outcome (smoking), so that the marginal effects are calculated based on the predicted probabilities of smoking. For continuous variables such as price and income, the marginal effect is the partial derivative or instantaneous rate of change in the probability of smoking, while for factor variables such as education or occupation, the marginal effect measures the discrete change in the probability of smoking, that is the difference in prediction when the variable changes from one category to the other, such as from 0 to 1. For greater readability and ease of interpretation, we present the results separately for continuous and discrete regressors and, within discrete regressors, group variables thematically.[59]

MARGINAL EFFECTS FOR CONTINUOUS VARIABLES

Table 6.5 below presents the coefficients and average marginal effects along with their respective standard errors for the continuous regressors in our model, including our two principal variables of interest: price and income. Price has a negative effect for females but is not significant for males. For income the opposite holds true, with a negative effect for males and no effect for females. For smoking participation, the negative sign on income is in line with the Grossman model where higher income increases the demand for health, which would in turn reduce harmful behaviours such as smoking. The negative sign on the quadratic term for age confirms the inverted U-shape relationship between smoking participation and age, with the probability of smoking increasing with age, but at a decreasing rate.

Table 6.5 Marginal effects of continuous regressors for participation

Participation	**Males**		**Females**	
(participation = being a current smoker)	b (b_se)	margins (margins_se)	b (b_se)	margins (margins_se)
Average of price for domestic & foreign cigarette brands (real, logged)	-0.108	-0.031	-0.191*	-0.029*
	(0.078)	(0.022)	(0.104)	(0.016)
Equivalised household income (real, logged)	-0.085***	-0.024***	0.003	0.000
	(0.018)	(0.005)	(0.021)	(0.003)
Age in years	0.162***	0.005***	0.215***	-0.001***
	(0.010)	(0.001)	(0.015)	(0.000)
Age in years # Age in years	-0.002***	***	-0.003***	***
	(0.000)		(0.000)	
Observations	27,528		29,182	
Degrees of freedom	30		30	

Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Price = Average of price for domestic & foreign cigarette brands (real, logged)
Income = Equivalised income per capita (real, logged)
Controlling for education, occupation, number of other smokers in the household, number of adults in household, number of children in household, marital status, settlement size, region and time trend.

[59] The complete estimation results are presented in Table 6-B in the appendix.

Participation	**Males**		**Females**	
(participation = being a current smoker)	b (b_se)	margins (margins_se)	b (b_se)	margins (margins_se)

b: Regression coefficient; b_se: Standard error of regression coefficient
margins: average marginal effect; margins_se: standard error of average marginal effect
*** p<0.01 ** p<0.05 * p<0.1

The marginal effects of continuous variables, especially if measured on a log scale, as in the case of price and income, are less straightforward to interpret than in the case of discrete variables given the difficulty of understanding the meaning of a marginal or 'infinitely small' change in the independent variable. One approach to aiding interpretation, shown in Table 6.6 below, is to compare the marginal change to other amounts of change, such as a discrete change of 1 or a one standard deviation change. Holding all other variables at their observed values, a change of 1 in the log of price (the mean log price is 2.53) decreases the probability of smoking by 2.8 percent among women. For women, the marginal and unit changes are similar, which reflects that the probability curve is nearly linear for a change of 1 in log price. However, for price, the unit and marginal changes are potentially misleading because a unit discrete change corresponds to a change of nearly 4 standard deviations.

Table 6.6 Discrete and marginal changes of price and income on participation

	Males		Females	
Variable	Change	p-value	Change	p-value
Price				
+1 unit	-0.031	0.17	-0.028	0.052
+1 standard deviation	-0.006	0.168	-0.006	0.063
Marginal change	-0.031	0.167	-0.029	0.066
Income				
+1 unit	-0.024	0.000	0.000	0.896
+1 standard deviation	-0.02	0.000	0.000	0.896
Marginal change	-0.024	0.000	0.000	0.896
Age (years)				
+1 unit	0.004	0.000	-0.001	0.004
+1 standard deviation	-0.034	0.000	-0.037	0
Marginal change	0.005	0.000	-0.001	0.039
Average predictions of	0_No	1_Yes	0_No	1_Yes

	Males		Females	
Variable	Change	p-value	Change	p-value
being a current smoker	0.391	0.609	0.811	0.189

Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Price = Average of price for domestic & foreign cigarette brands (real, logged)
Income = Equivalised income per capita (real, logged)
Controlling for education, occupation, number of other smokers in the household, number of adults in household, number of children in household, marital status, settlement size, region and time trend.

For income, with a one unit change in log income (the mean is 3.23) decreases the probability of smoking by 2.4 percent for men but has no effect on participation among women.

Given the log scale of the price and income variables, Table 6.6 is still not very straightforward to interpret. In Table 6.7 below we adopt a more intuitive approach by examining the effect of increasing price and income from their 5th percentile values to their 95th percentile values. The table shows that changing price from its 5th percentile of 2.20 to the 95th percentile of 2.88 significantly decreases the average probability of a woman smoking by 2 percent, from 19.9 to 17.9 percent.

Table 6.7 Effects of changing price and income from their 5th to 95th percentile on participation

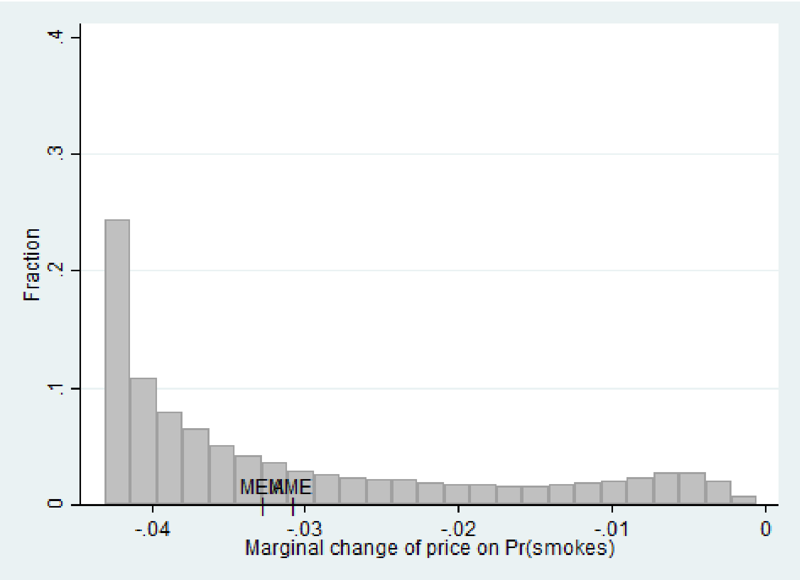
	Males				Females			
Variable	Change	From	To	p-value	Change	From	To	p-value
Price								
5% to 95%	-0.021	0.621	0.600	0.167	-0.020	0.199	0.179	0.066
Income								
5% to 95%	-0.062	0.644	0.582	0.000	0.001	0.188	0.189	0.896
Average predictions of being a current smoker	0_No		1_Yes		0_No		1_Yes	
	0.391		0.609		0.811		0.189	

Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Price = Average of price for domestic & foreign cigarette brands (real, logged)
Income = Equivalised income per capita (real, logged)
Controlling for education, occupation, number of other smokers in the household, number of adults in household, number of children in household, marital status, settlement size, region and time trend.

Increasing the log of real per capita income from its 5th percentile of 1.44 to the 95th percentile of 4.89 on average decreases the probability of smoking from 64.4 percent to 58.2 percent among men, a significant decrease of 6.2 percentage points.

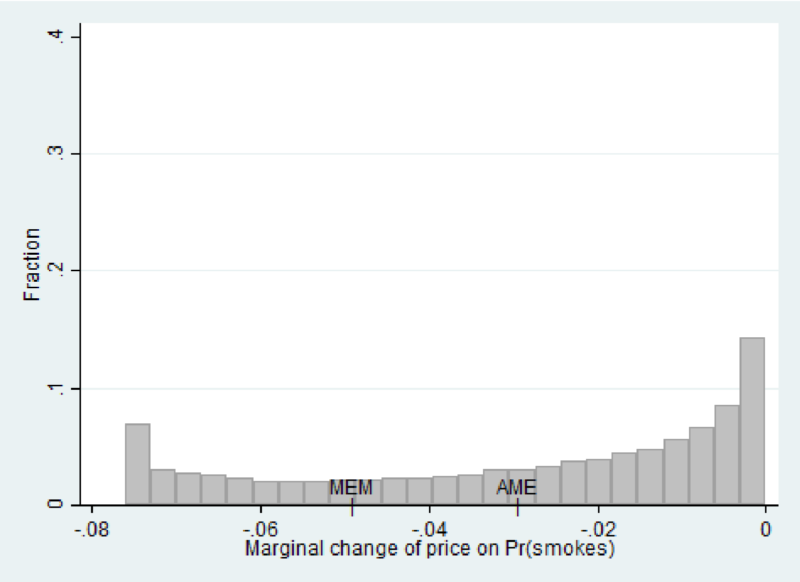
As mentioned before, the distribution of predicted probabilities for females suggests that the AME might not be an appropriate summary measure of the marginal effects. In order to examine this suspicion Figure 6.8 and Figure 6.9 below plot the distribution of marginal effects for the male and female sample respectively, indicating the position of the AME and MEM. For both genders, the distribution of marginal changes for price is highly skewed, ranging from -.044 to almost 0 for males, and from about -.078 to 0 for females. For males the distribution of marginal changes is skewed towards lower values (i.e. a higher magnitude of negative marginal changes), with slightly more than one quarter of observations falling around the highest negative prediction of -.06. While due to this skew the MEM is a slightly better indicator for most respondents than the AME, both the MEM and AME represent less than 5 percent of observations, and the AME of -.031 shown in Table 6.6 understates the effect of price for slightly more than half of the sample.

Figure 6.8 The distribution of marginal effects for price (males)



For females the distribution of marginal changes is skewed towards the higher, less negative values, with a bi-modal distribution at the extreme values of marginal changes, -.12 and 0. In contrast to males, the AME (-0.029) is a better summary measure of marginal changes compared to MEM, albeit the former understates the effect of price for more than 50 percent of the sample.

Figure 6.9 The distribution of marginal effects for price (females)



A similar distribution of marginal effects can be observed for income, plotted in Figure 6.10 and Figure 6.11 for males and females respectively.

Figure 6.10 The distribution of marginal effects for income (males)

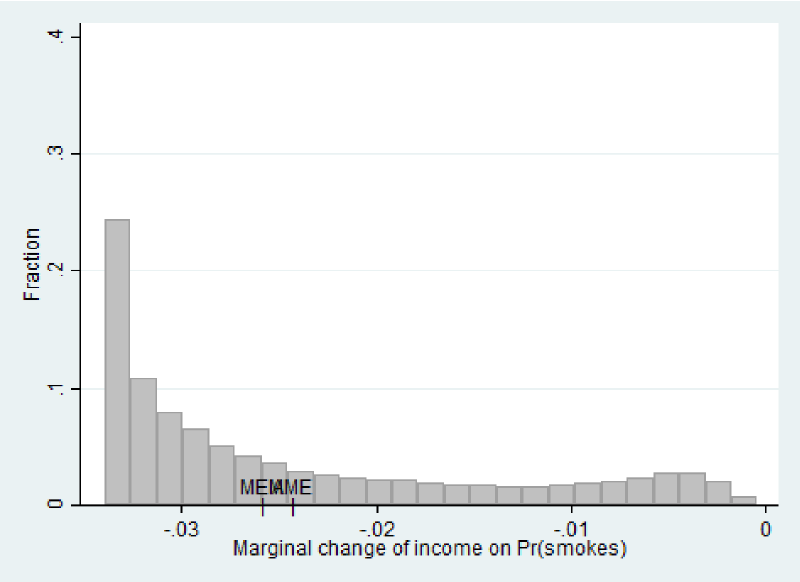
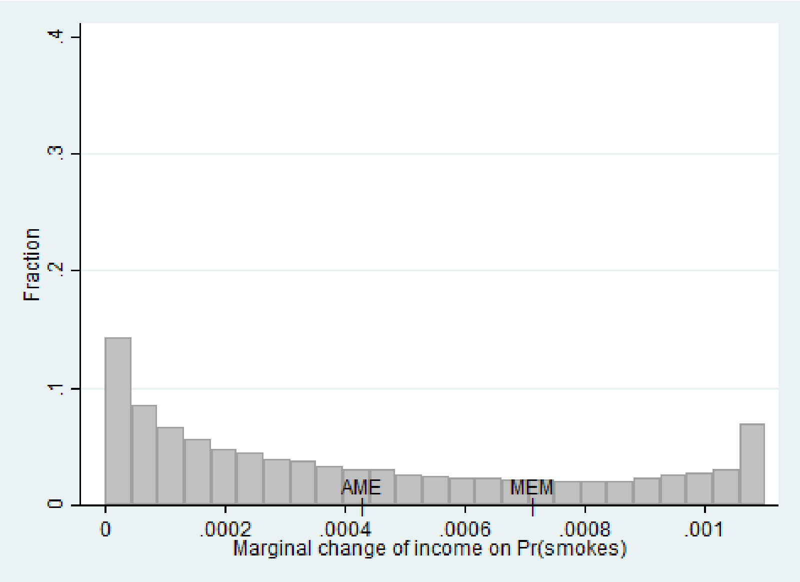


Figure 6.11 The distribution of marginal effects for income (females)



In summary, for both men and women, the AME is a less adequate summary measure of the marginal effects, with the bias running in opposite directions for males and females.

MARGINAL EFFECTS FOR DISCRETE VARIABLES

In chapter 4 we saw that for both genders, smoking participation showed a strong educational gradient. This gradient is confirmed in the results presented in Table 6.8 below, with the effects of education being significant at the 1 percent level for all educational categories. Since the highest educational level, university education, is the reference group, the positive coefficients/marginal effects mean that respondents with a lower level of education have a higher probability of smoking. For example, men with incomplete secondary education are 14.7 percent more likely to smoke compared to men who have a university degree. That is, if all men in the sample had incomplete secondary education only, the average predicted probability of smoking would increase by 14.7 percent. For females the effect is lower, with the probability of smoking being 7 percent higher for women with incomplete secondary education only. Again, this has to be interpreted in the context of much lower smoking probabilities in the female sample. In both cases the gradient is confirmed with respect to the higher categories of education (more on this below).

Table 6.8 Marginal effects of education and occupation on participation

Participation	**Males**		**Females**	
(participation = being a current smoker)	b (b_se)	margins (margins_se)	b (se)	margins (margins_se)
Technical, medical, pedagogical, art college	0.322***	0.095***	0.199***	0.029***
	(0.061)	(0.018)	(0.062)	(0.009)
Complete secondary education	0.442***	0.130***	0.243***	0.036***
	(0.053)	(0.015)	(0.063)	(0.009)
Incomplete secondary education	0.437***	0.129***	0.303***	0.046***
	(0.060)	(0.018)	(0.073)	(0.011)
Non-manual occupation	0.112	0.033	0.267***	0.042***
	(0.075)	(0.022)	(0.054)	(0.008)
Manual occupation	0.179***	0.052***	0.133	0.020
	(0.050)	(0.015)	(0.082)	(0.013)
Unskilled occupation	0.251***	0.072***	0.151*	0.023*
	(0.067)	(0.019)	(0.078)	(0.012)
No occupation	0.059	0.017	0.197***	0.030***
	(0.051)	(0.015)	(0.057)	(0.009)
Observations	27,528		29,182	

Reference categories: University education; Managerial and professional occupation
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Controlling for age, age squared, the average price of domestic and foreign cigarette brands (real, logged), equivalised income per capita (real, logged), number of other smokers in household, number of adults in household, number of children in household, marital status, settlement size, region and time trend.
b: Regression coefficient; b_se: Standard error of regression coefficient
margins: average marginal effect; margins_se: standard error of average marginal effect
*** p<0.01 ** p<0.05 * p<0.1

While for males being in a manual or unskilled occupation strongly increases the probability of smoking compared to working in a managerial or professional occupation, for females those working in a non-manual occupation have a considerably higher probability of smoking. In general, this reflects the different occupational choices between men and women with a lower skill-level than required at managerial or professional level, with men going into manual jobs and women into non-manual occupations, often in the education, healthcare and service sectors.

While Table 6.8 illustrates the educational gradient by showing that respondents in the lowest educational category have the highest probability of smoking compared to those in the highest, it does not show us very clearly how the lower educational categories compare to each other. Table 6.9 below therefore compares the marginal changes for all of the educational categories.

Table 6.9 Marginal changes for all educational categories on participation

Comparison	Change	From	To	p-value
Males				
Tec & Med* vs **University**	0.095	0.509	0.604	0.000
Complete secondary vs **University**	0.130	0.509	0.639	0.000
Incomplete secondary vs **University**	0.129	0.509	0.638	0.000
Complete secondary vs **Tec & Med**	0.035	0.604	0.639	0.016
Incomplete secondary vs **Tec & Med**	0.033	0.604	0.638	0.039
Incomplete secondary vs **Complete secondary**	-0.001	0.639	0.638	0.902
Females				
Tec & Med vs **University**	0.029	0.160	0.190	0.001
Complete secondary vs **University**	0.036	0.160	0.197	0.000
Incomplete secondary vs **University**	0.046	0.160	0.207	0.000
Complete secondary vs **Tec & Med**	0.007	0.190	0.197	0.414
Incomplete secondary vs **Tec & Med**	0.017	0.190	0.207	0.106
Incomplete secondary vs **Complete secondary**	0.010	0.197	0.207	0.233

*Tec & Med = Technical, medical, pedagogical, or art college
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Controlling for age, age squared, the average price of domestic and foreign cigarette brands (real, logged), equivalised income per capita (real, logged), occupation, number of other smokers in household, number of adults in household, number of children in household, marital status, settlement size, region and time trend.

For males, the comparisons among all combinations of educational groups confirm that the protective effect of education holds across all groups and, as suggested by the gradient in the descriptive statistics, decreases in magnitude between adjacent categories and as we move to lower educational levels, with the only exception being the comparison between the two lowest educational categories (complete and incomplete secondary education). For example, among men, having only incomplete secondary education increases the probability of smoking compared to all other educational categories, but the effect is 4 times higher compared to university education than to the adjacent category "Tec & Med" (0.129 versus 0.033). Similarly to males, women with university education are less likely to smoke compared to women with any other level of education. However, the differences in probability of smoking between the lower educational groups as not statistically significant. Overall, the strongest 'protective' effect seems to come from university education since even having the second highest level of education (Tec & Med) compared to university education increases the probability of smoking by 0.130, from 0.509 to 0.639 among men, and by 0.029 among women.

As expected, from the results in Table 6.8, the patterns of marginal changes between occupational groups are less clear (Table 6.10). For men, working in managerial and professional as well as other non-manual occupations reduces the probability of smoking compared to manual and unskilled occupational categories. Among females those in managerial and professional as well as manual occupations have lower probabilities of smoking. For both men and women, we suspect that these are related strongly to education. Indeed, when we run the model without the controls for occupation, the marginal effects on the educational variables are higher, though the results remain qualitatively unchanged. Without having any way of knowing definitively where the endogeneity lies, for now we leave occupation in our basic empirical specification.

Table 6.10 Marginal effects on participation for selected occupations

Comparison	Change	From	To	p-value
Males				
Manual occupation vs **ManProf occupation**	0.052	0.579	0.631	0.000
Unskilled occupation vs **ManProf occupation**	0.072	0.579	0.651	0.000
No occupation vs **ManProf occupation**	0.017	0.579	0.596	0.250
Unskilled occupation vs **Non-manual occupation**	0.040	0.611	0.651	0.099
No occupation vs **Manual occupation**	-0.035	0.631	0.596	0.002
Females				
Non-manual occupation vs **ManProf occupation**	0.042	0.168	0.209	0

Comparison	Change	From	To	p-value
Manual occupation vs **ManProf occupation**	0.02	0.168	0.188	0.112
Unskilled occupation vs **ManProf occupation**	0.023	0.168	0.19	0.058
No occupation vs **ManProf occupation**	0.03	0.168	0.198	0.001
Manual vs **Non-manual occupation**	-0.022	0.209	0.188	0.080

ManProf occupation = Managerial & professional occupation
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Controlling for age, age squared, the average price of domestic and foreign cigarette brands (real, logged), equivalised income per capita (real, logged), education, number of other smokers in household, number of adults in household, number of children in household, marital status, settlement size, region and time trend.

Turning next to the set of household characteristics capturing aspects of the respondents' immediate living environment. For both genders, living in a household with other smoking household members considerably increases the probability of smoking compared to living in households without other smokers, with all effects being significant at the 1 percent level and increasing with the number of other smokers.

Table 6.11 Marginal effects of household characteristics on participation

	Males		**Females**	
	b (b_se)	margins (margins_se)	b (se)	margins (margins_se)
1 other smoker in household	1.544***	0.425***	1.968***	0.445***
	(0.040)	(0.009)	(0.048)	(0.010)
2 other smokers in household	2.006***	0.483***	2.849***	0.686***
	(0.081)	(0.010)	(0.082)	(0.015)
3 other smokers in household	2.216***	0.501***	3.725***	0.836***
	(0.126)	(0.011)	(0.140)	(0.014)
4-7 other smokers in household	2.641***	0.522***	4.646***	0.904***
	(0.199)	(0.010)	(0.249)	(0.009)
Number of adults in household	-0.237***	-0.068***	-0.534***	-0.083***
	(0.016)	(0.004)	(0.026)	(0.003)
Number of children in household	-0.141***	-0.040***	-0.185***	-0.029***
	(0.019)	(0.005)	(0.026)	(0.004)
Married	0.238***	0.070***	-0.212***	-0.032***
	(0.053)	(0.016)	(0.062)	(0.009)
Divorced	0.356***	0.103***	0.276***	0.047***

	Males		**Females**	
	b (b_se)	margins (margins_se)	b (se)	margins (margins_se)
	(0.081)	(0.023)	(0.077)	(0.013)
Widowed	0.326*	0.095*	0.276***	0.047***
	(0.175)	(0.050)	(0.106)	(0.019)
Observations	27,528		29,182	

Reference categories: 0 other smokers; Single
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Controlling for age, age squared, the average price of domestic and foreign cigarette brands (real, logged), equivalised income per capita (real, logged), education, occupation, settlement size, region and time trend.
b: Regression coefficient; b_se: Standard error of regression coefficient
margins: average marginal effect; margins_se: standard error of average marginal effect
*** $p<0.01$ ** $p<0.05$ * $p<0.1$

Both the number of adults and of children decrease the probability of smoking, with the effect of adults being higher compared to children. The negative impact of the number of adults in the household could partly be an age effect: households with a higher number of adults will be more likely to have pension-age individuals who are less likely to be smokers. Respondents who are single have the lowest probability of smoking, which is likely a reflection of the age effect since respondents who are single also tend to be younger. Similarly, the stronger negative effect of the number of children may partly reflect an age effect in that, compared to men, females have higher smoking rates in the younger cohorts who are just starting their family planning.

In Table 6.12 below we further explore the marginal changes for the number of other smokers in the household. For both males and females, the biggest marginal change is at the switch from 0 to 1 other smoker: living together with one other smoking person compared to no other smokers increases the probability of smoking by 42.5 and 44.5 percent among men and women respectively. While one additional smoker still increases the probability of smoking, we can see that once there are more than two smoking members in the household, an additional smoker does not make a big difference for participation. Again, there is potential endogeneity in these observations since it is likely that smokers meet and form partnerships with other smokers, rather than non-smokers.

Table 6.12 Marginal changes of other smokers in the household on participation

Comparison	Change	From	To	p-value
Males				
1 vs 0 other smokers	0.425	0.460	0.885	0.000
2 vs 0 other smokers	0.483	0.460	0.944	0.000
3 vs 0 other smokers	0.501	0.460	0.961	0.000
4-7 vs 0 other smokers	0.522	0.460	0.983	0.000
2 vs 1 other smokers	0.058	0.885	0.944	0.000
3 vs 1 other smokers	0.076	0.885	0.961	0.000
4-7 vs 1 other smokers	0.097	0.885	0.983	0.000
3 vs 2 other smokers	0.017	0.944	0.961	0.091
4-7 vs 2 other smokers	0.039	0.944	0.983	0.000
4-7 vs 3 other smokers	0.022	0.961	0.983	0.022
Females				
1 vs 0 other smokers	0.445	0.067	0.512	0.000
2 vs 0 other smokers	0.686	0.067	0.753	0.000
3 vs 0 other smokers	0.836	0.067	0.904	0.000
4-7 vs 0 other smokers	0.904	0.067	0.971	0.000
2 vs 1 other smokers	0.241	0.512	0.753	0.000
3 vs 1 other smokers	0.392	0.512	0.904	0.000
4-7 vs 1 other smokers	0.459	0.512	0.971	0.000
3 vs 2 other smokers	0.150	0.753	0.904	0.000
4-7 vs 2 other smokers	0.218	0.753	0.971	0.000
4-7 vs 3 other smokers	0.068	0.904	0.971	0.000

Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Controlling for age, age squared, the average price of domestic and foreign cigarette brands (real, logged), equivalised income per capita (real, logged), education, occupation, number of adults in household, number of children in household, settlement size, region and time trend.

Our final set of explanatory variables are the indicators capturing aspects of the broader living environment, measured though (1) the size of the settlement a respondent resides in (determining among others the available infrastructure, including features of the local tobacco market such as retail outlets selling cigarettes and density of tobacco advertising), and (2) a regional indicator to capture cultural differences in attitudes towards smoking which are for example shaped by religious or ethnic backgrounds.

Table 6.13 Marginal effects of settlement size and region on participation

	Males		Females	
	b (b_se)	margins (margins_se)	b (se)	margins (margins_se)
City 50,000-500,000 inhabitants	0.031	0.009	-0.207***	-0.035***
	(0.054)	(0.015)	(0.060)	(0.010)
Town < 50,000 inhabitants & rural settlements	0.066	0.019	-0.486***	-0.076***
	(0.050)	(0.014)	(0.058)	(0.009)
North & Northwestern	0.084	0.024	0.160	0.030
	(0.103)	(0.030)	(0.104)	(0.019)
Central & Central Black Earth	0.033	0.009	-0.113	-0.019
	(0.079)	(0.023)	(0.088)	(0.015)
Volga Basin & Volga Vaytski	0.143*	0.041*	-0.591***	-0.089***
	(0.076)	(0.022)	(0.090)	(0.014)
North Caucasus	0.031	0.009	-0.405***	-0.064***
	(0.079)	(0.023)	(0.094)	(0.015)
Ural	0.063	0.018	-0.241***	-0.040***
	(0.083)	(0.024)	(0.093)	(0.016)
Western Siberia	0.098	0.028	-0.138	-0.024
	(0.091)	(0.026)	(0.099)	(0.017)
Eastern Siberia & Far Eastern	0.123	0.035	-0.154*	-0.026*
	(0.083)	(0.024)	(0.084)	(0.014)
Observations	27,528		29,182	

Reference categories: City >500,000 inhabitants; Moscow & St. Petersburg
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Controlling for age, age squared, the average price of domestic and foreign cigarette brands (real, logged), equivalised income per capita (real, logged), education, occupation, number of other smokers in household, number of adults in household, number of children in household, and time trend.
b: Regression coefficient; b_se: Standard error of regression coefficient
margins: average marginal effect; margins_se: standard error of average marginal effect
*** p<0.01 ** p<0.05 * p<0.1

Whereas the size of a settlement does not have any statistically significant effect on smoking participation in the male sample, women in both medium-sized cities and rural areas have a lower probability of smoking than women living in large cities. Women living in the Volga and Volga Vyatski, North Caucasus, Ural and Eastern Siberian regions have a lower probability of being a smoker compared to respondents in Moscow and St. Petersburg. Perhaps unexpectedly given the strong regional patterns of smoking prevalence among women that we observed in chapter 4, not all the regional indicators are significant. However, this suggests that there are underlying regional patterns in the observed or unobserved explanatory variables which are the cause of the regional disparities observed in the descriptive statistics.

MARGINAL EFFECTS FOR STYLISED INDIVIDUALS

As a final approach to interpreting the participation model we calculate marginal effects for a set of prototypical stylised respondents, which captures the spirit of the 'marginal effects at representative values (MER)' approach referred to earlier. It is important to note that when we are setting the values of the independent variables, we are constructing a hypothetical observation for which we derive one prediction. This is different from a subgroup of respondents who have a set of observations with a distribution that can be averaged to give an AME (Long and Freese, 2014). Therefore, in contrast to the AME where we kept the values of the other variables at their observed values, we now keep the independent variables which we do not set to a particular value at their means. When building the stylised types, we select combinations of values of the independent variables that, based on the descriptive analysis in chapter 4 and our knowledge of Russia, reflect 'prototypical' respondents, e.g. typically higher education and managerial and professional occupation go together with higher income. Table 6.14 below shows the predicted probabilities for five types of hypothetical respondents, separately by gender.

Table 6.14 Predicted probability of participation for stylised individuals

	Pr(smokes)	lower limit	upper limit
Males			
(1) Young uni manprof highinc bigcity Moscow	0.465	0.413	0.517
(2) Midage primary unskilled lowinc Moscow	0.824	0.779	0.870
(3) Young uni prof highinc bigcity Caucasus	0.478	0.423	0.532
(4) Midage primary unskilled lowinc rural Caucasus	0.848	0.811	0.886
(5) Young uni manual midinc city Ural	0.600	0.544	0.656
Females			
(1) Young uni manprof highinc bigcity Moscow	0.204	0.165	0.244
(2)Young primary unskilled lowinc Moscow	0.353	0.278	0.428
(3) Young uni manprof highinc bigcity Caucasus	0.109	0.078	0.140
(4) Young primary unskilled lowinc rural Caucasus	0.102	0.065	0.140
(5) Young uni non-manual midinc city Ural	0.156	0.118	0.195

Predicted probabilities of smoking for hypothetical individuals according to stylised characteristics: young=age 30; midage=age45; uni=university degree; primary=incomplete seondary education;

	Pr(smokes)	lower limit	upper limit

manprof=managerial & professional occupation; unskilled=unskilled occupation; non-manual=non-manual occupation; highinc=equivalised income per capita (real, logged) =9.1; lowinc= equivalised income per capita (real, logged) =7.3; midinc= equivalised income per capita (real, logged) =8.3; bigcity=city>500,000 inhabitants; city=city 50,000-500,000 inhabitants; rural=town<50,000 inhabitants & rural settlements; Moscow=Moscow & St. Petersburg region; Caucasus=North Caucasus region; Ural=Ural region
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Controlling for age, age squared, the average price of domestic and foreign cigarette brands (real, logged), equivalised household income (real, logged), education, occupation, number of other smokers in household, number of adults in household, number of children in household, marital status, settlement size, region and time trend.

For males, the highest predicted probabilities are for a middle-aged respondent, with primary education, working in an unskilled occupation, having a low income (corresponding to the 10th percentile), and living either in the Moscow & St. Petersburg region or in a rural settlement in the North Caucasus region. Overall, hypothetical respondents with similar characteristics except for region have very close predicted probabilities, which is in line with the lack of a strong regional pattern in male smoking. Moreover, none of the differences in predicted probabilities for the 5 stylised male respondents is statistically significant.

For females, we specify similar types, but focus on young women only. Among the two respondents with identical characteristics except for region (young with university education, in a managerial or professional occupation, with a higher income (corresponding to 90th percentile)), the respondent residing in the Moscow & St. Petersburg region has a considerably higher predicted probability than the respondent in the North Caucasus (0.204 versus 0.109). The difference is even larger between the two respondents with the opposite socioeconomic profile (respondents (2) and (4)), with the respondent residing in the North Caucasus region having a predicted probability of only 0.102, compared to 0.353 for the one in Moscow & St. Petersburg. Respondent (5), with university education but working in a non-manual occupation, with median income, and living in a medium-sized city in the Urals region has the third-lowest predicted probability. In contrast to the male examples, the differences in the predicted probabilities between the 5 hypothetical respondents are all statistically significant. While we need to be careful drawing conclusions based on these prototypes, for females there is a strong suggestion that the expected educational gradient may be absent, since two of the three respondents with university have a higher predicted probability of smoking than the respondents with primary education only. We will return to this idea later on.

Finally, the linear time trend is negative and significant for men, and close to zero and insignificant for women. This is in line with our findings from the descriptive analysis in chapter 4, where we observed decreases over time across all ages in the male sample but more diverse patterns for females.

6.4.2 Base model – consumption

As mentioned in the beginning of section 4, interpretation of linear models is considerably more straightforward compared to nonlinear models since the coefficients equal the marginal effects and the marginal effects are constant across observations. For greater readability we still group the variables thematically and present a selection of the most interesting effects for both genders. For the full results see to Tables 6-C and 6-D in the appendix.

To recap from the second section, we adopt 5 different linear estimation approaches in our consumption model: (1) OLS on the untransformed dependent variable (i.e. ignoring all of the problems outlined in the second section); (2) OLS on the log-transformed dependent variable (taking into account the strictly positive nature of y but ignoring measurement error), (3) a generalised linear model with Gaussian distribution and log link on the untransformed dependent variable (addressing the non-negativity of y but modelling the log-transformed mean of y rather than the mean of log-transformed y); (4) OLS on the midpoints (i.e. the observed heaping points, as one approach to accounting for measurement error but not explicitly the non-negativity of y), and (5) interval regression (as an alternative approach to accounting for measurement error but not explicitly the non-negativity of y). For the generalised linear model, we report both the percent change (to be compared to model (2)) and unit changes that are comparable to all the other models. Our second, nonlinear, approach is the ordered probit. While, similar to the probit model, coefficients in the ordered probit model are not directly interpretable, a positive (negative) sign of the coefficient indicates that an increase in the independent variable moves the probability mass towards the higher (lower) consumption categories. In order to check whether the linear and nonlinear approaches yield consistent results we therefore report the ordered probit coefficients in the last column alongside the results from the linear models.

Marginal effects for price, income and age

Table 6.15 below shows the marginal effects for price, income, and age. The two key variables of interest, price and income, are with the expected signs, negative and positive respectively, and significant at the 1 or 5 percent level, except for income in the female sample. Yet, the log transformation of price and income makes their interpretation less straightforward than variables in their original scale. For the estimators that report coefficients on the original scale of the dependent variable (i.e. units of cigarette consumption), a one percent increase in a log-transformed independent variable x_k is interpreted as reducing/increasing mean cigarette consumption by approximately β*(ln(101/100) units. This gives the semi-elasticity of price and applies to all models except for (2) and (3a) in Table 6.15. Thus, according to the OLS on the untransformed cigarette counts (1), a one percent increase in price is associated with a -1.377*(ln(101/100) reduction in average consumption among men, approximately 0.01337 cigarettes less per day. That is, a 10 percent increase in price reduces the average daily quantity consumed by about 0.1337 cigarettes. The effects are similar in magnitude for the other ‘unit’ models, with the GLM giving a slightly higher effect (as to be expected given that it accounts for the strictly positive nature of the dependent variable), and the midpoint and interval regressions yielding slightly lower effects. However, once converted into units of cigarette consumption, the differences are negligibly small (second and third position after the comma).

In the two models that use a log-scale for the dependent variable, either by directly transforming into logs or estimating the log of mean consumption, the coefficient/marginal effect gives the percent change in average daily cigarette consumption for a one percent increase in an independent variable (which is the standard price elasticity). Thus, according to models (2) and (3a)[60] a one percent increase in price is associated with a 0.088/0.085 percent reduction in average daily consumption, or, for a 10 percent increase in price, quantity consumed falls by 0.9 percent. This is in line with the results from the unit models since average daily consumption among men is about 17 cigarettes, so that 1 percent corresponds to 0.17 cigarettes. While this is a very low cigarette price elasticity in international comparisons, it is in line with the previous literature on Russia (Lance et al., 2004). Furthermore, a one percent increase in price is a highly unlikely reality since this would amount to only 0.12 roubles (the average real price over the period is 12 roubles).

[60] To retrieve the percent change for the GLM, we specify the margins, predict(xb) option in Stata 13.

Table 6.15 Marginal effects of price, income and age on consumption

	linear	linear y strictly positive			linear heaping		nonlinear
Consumption	(1) reg y	(2) reg log(y)	(3a) glm (%)	(3b) glm (unit)	(4) reg midp.	(5) intreg	(6) oprobit
	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	b (b_se)
Males							
Price	-1.377***	-0.088***	-0.085***	-1.422***	-1.384***	-1.409***	-0.230***
	(0.475)	(0.034)	(0.029)	(0.487)	(0.459)	(0.470)	(0.067)
Income	0.263**	0.005	0.018**	0.310**	0.258**	0.258**	0.024
	(0.129)	(0.008)	(0.008)	(0.140)	(0.120)	(0.124)	(0.017)
Age in years	0.138***	0.010***	0.008***	0.126***	0.132***	0.136***	0.090***
	(0.010)	(0.001)	(0.001)	(0.010)	(0.010)	(0.010)	(0.009)
Observations	16,804	16,804	16,804	16,804	16,804	16,804	16,804
Females							
Price	-1.742**	-0.130*	-0.160**	-1.770**	-1.343**	-1.896**	-0.262**
	(0.730)	(0.068)	(0.071)	(0.794)	(0.585)	(0.740)	(0.120)
Income	0.211	0.014	0.023*	0.255*	0.199	0.224	0.038
	(0.140)	(0.014)	(0.013)	(0.149)	(0.121)	(0.143)	(0.025)
Age in years	0.103***	0.010***	0.010***	0.093***	0.083***	0.101***	0.079***
	(0.016)	(0.002)	(0.002)	(0.015)	(0.014)	(0.017)	(0.018)

Consumption	linear	linear y strictly positive			linear heaping		nonlinear
	(1) reg y	(2) reg log(y)	(3a) glm (%)	(3b) glm (unit)	(4) reg midp.	(5) intreg	(6) oprobit
	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	b (b_se)
Observations	5,470	5,470	5,470	5,470	5,470	5,470	5,470

Table header: (1) reg y = OLS on the untransformed dependent variable; (2) reg log(y) = OLS on the log-transformed dependent variable, (3a) glm(%) = generalised linear model with Gaussian distribution and log link on the untransformed dependent variable (exponentiated coefficients); , (3b) glm(unit) = generalised linear model with Gaussian distribution and log link on the untransformed dependent variable; (4) reg midp. = OLS on the midpoints of cigarette consumption; (5) intreg = interval regression; (6) oprobit = ordered probit; margins: average marginal effect; (margins_se): standard error of average marginal effect

Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Price = Average of price for domestic & foreign cigarette brands, in real terms, logged.
Income = Equivalised income per capita (real, logged)
Controlling for education, occupation, number of other smokers in household, number of adults in household, number of children in household, marital status, settlement size, region and time trend.
*** p<0.01 ** p<0.05 * p<0.1

For females the marginal effects of price are slightly higher and significant at the 5 percent level and with greater differences between the different estimators. For the OLS on untransformed cigarette counts, a one percent increase in price is associated with a reduction in average consumption of approximately 0.0174 cigarettes, or 0.174 for a 10 percent increase. In the female sample, the midpoint and interval regression results diverge more than in the male sample, with the midpoint regression giving the lowest semi-elasticity estimate of approximately 0.01343 cigarettes less per day. This could indicate that the midpoints are a worse approximation of true consumption for females since a greater share of female smokers report consumption below 10 cigarettes per day. In this interval a substantial share of responses fall on non-heaped values so that imputing a heaped consumption value for all the respondents that report in non-heaped values will lead to a greater distortion. In the two models which report the direct price elasticity, a one percent increase in price is associated with a 0.130/0.160 percent reduction in average daily consumption, or, for a 10 percent increase in price, quantity consumed falls by 1.3/1.6 percent respectively. As with the male models, the results between the percent and unit changes are in line with each other: average daily consumption among female smokers is approximately 11 cigarettes, so 1.6 percent corresponds to 0.176 cigarettes. In both the male and the female sample, the sign of the price coefficient from the ordered probit is in line with the linear models.

Turning now to the effects of income. In model (1) a one percent increase in income is associated with a 0.263*(ln(101/100) increase in consumption among men, approximately 0.00263 cigarettes. That is, a 10 percent increase in income leads to approximately 0.0263 more cigarettes being consumed per day. The GLM, midpoint and interval regression yield slightly lower results, but again, the difference is small (0.0310 and 0.0258 cigarettes more for a 10 percent rise in income). This is in line with the models which report the elasticity where a one percentage increase in income is associated with a 0.005 and 0.018 percent increase on cigarettes consumed among men, i.e. for a 10 percentage increase in price, quantity consumed increases by about 0.2 percent in the GLM model. For females, the marginal effects for income are only significant in the two GLM models, albeit only at the 10 percent level.

In order to compare the effects of price and income on participation and consumption, we also calculate the marginal effects on consumption when changing the values of these variables from their 5^{th} to 95^{th} percentiles, based on the results from the interval regression. When changing the average Rosstat price from its 5th to 95th percentile, average consumption falls by about 0.9 cigarettes for men, and about 1.3 cigarettes for women (see Table 6.16 below). The same change applied to per capita income leads to an increase in predicted consumption by 0.7 and 0.6 cigarettes for males and females respectively. It would seem to be clear from these results, that the large price increases foreseen by the new Russian smoking policies, will result in small but meaningful reductions in smoking among smokers.

Table 6.16 Marginal effects of prices and income on predicted daily consumption

	Males				Females			
Variable	Change	From	To	p-value	Change	From	To	p-value
Price								
5% to 95%	-0.938	17.204	16.266	0.003	-1.283	11.677	10.394	0.010
Income								
5% to 95%	0.655	16.383	17.039	0.037	0.617	10.662	11.279	0.119
Average predicted daily consumption	16.738				11.001			

Based on model (5): Interval regression
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender. Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Price = Average of price for domestic & foreign cigarette brands (real, logged).
Income = Equivalised income per capita (real, logged)
Controlling for education, occupation, number of other smokers in household, number of adults in household, number of children in household, marital status, settlement size, region and time trend.

MARGINAL EFFECTS FOR EDUCATION AND OCCUPATION

Table 6.17 below shows the marginal effects for selected categories of education and occupation. For males, respondents in the two lowest educational categories (complete secondary and incomplete secondary education) on average consume 1.2 and 1.9 cigarettes more per day respectively compared to respondents with university education. This is in line with the two models that report percentage changes (semi-elasticities), which give an increase of 9.1 (7.2) and 13.1 (11.3) percent in quantity consumed respectively for these categories (e.g. 11.3 percent corresponds to 1.9 cigarettes per day in average male consumption). The effects of occupation are less pronounced, with men working in manual and unskilled occupations on average consuming less than 1 cigarette more per day (0.9) compared to men in managerial or professional occupations. The fact that those without occupation on average consume less is likely a reflection of the age effect since this group is largely composed of young respondents still in education and older working age men and women who have taken early retirement.

For females, daily consumption levels do not appear to differ significantly between respondents with different levels of education, except for those with incomplete secondary education only, who consume about 1.3 cigarettes more than respondents with university education. Similar to the results for prices and income, the estimates from the midpoint regression diverge from those of the other linear models, suggesting this approach is less appropriate for the female sample. In contrast to the male sample, women with no occupation on average consume about 1.4 cigarettes more than women in managerial or professional occupations.

Table 6.17 Marginal effects of education and occupation on predicted daily consumption

Consumption	(1) reg y margins (margins_se)	(2) reg log(y) margins (margins_se)	(3a) glm (%) margins (margins_se)	(3b) glm (unit) margins (margins_se)	(4) reg midp. margins (margins_se)	(5) intreg margins (margins_se)	(6) oprobit b (b_se)
Males							
Technical, medical, pedagogical, or art college	0.825**	0.057*	0.049**	0.787**	0.822**	0.846**	0.131**
	(0.397)	(0.029)	(0.024)	(0.390)	(0.385)	(0.394)	(0.056)
Complete secondary education	1.266***	0.091***	0.072***	1.180***	1.200***	1.243***	0.181***
	(0.355)	(0.025)	(0.022)	(0.351)	(0.344)	(0.352)	(0.049)
Incomplete secondary education	1.944***	0.131***	0.113***	1.870***	1.873***	1.927***	0.278***
	(0.386)	(0.027)	(0.024)	(0.383)	(0.375)	(0.384)	(0.054)
Manual occupation	0.862***	0.081***	0.050**	0.855**	0.870***	0.877***	0.134***
	(0.321)	(0.023)	(0.020)	(0.328)	(0.307)	(0.315)	(0.045)
Unskilled occupation	0.900**	0.085***	0.052**	0.895**	0.891**	0.890**	0.148***
	(0.386)	(0.027)	(0.023)	(0.396)	(0.370)	(0.380)	(0.055)
No occupation	-0.905***	-0.063**	-0.055**	-0.890**	-0.822**	-0.874**	-0.133***
	(0.349)	(0.025)	(0.022)	(0.360)	(0.332)	(0.342)	(0.049)
Observations	16,804	16,804	16,804	16,804	16,804	16,804	16,804
Females							
Technical, medical, pedagogical, or art college	0.225	0.030	0.012	0.130	0.161	0.234	0.052
	(0.500)	(0.050)	(0.051)	(0.529)	(0.418)	(0.503)	(0.086)

Consumption	(1) reg y margins (margins_se)	(2) reg log(y) margins (margins_se)	(3a) glm (%) margins (margins_se)	(3b) glm (unit) margins (margins_se)	(4) reg midp. margins (margins_se)	(5) intreg margins (margins_se)	(6) oprobit b (b_se)
Complete secondary education	0.881*	0.102**	0.079	0.853	0.594	0.830	0.140
	(0.519)	(0.049)	(0.051)	(0.544)	(0.424)	(0.525)	(0.087)
Incomplete secondary education	1.408**	0.165***	0.121**	1.341**	1.069**	1.309**	0.242**
	(0.556)	(0.053)	(0.053)	(0.576)	(0.464)	(0.565)	(0.095)
Non-manual occupation	1.121***	0.139***	0.101***	1.079***	0.904***	1.050***	0.187***
	(0.382)	(0.039)	(0.037)	(0.392)	(0.322)	(0.384)	(0.066)
Unskilled occupation	1.688***	0.171***	0.150***	1.640***	1.467***	1.705***	0.294***
	(0.575)	(0.054)	(0.051)	(0.567)	(0.469)	(0.579)	(0.095)
No occupation	1.469***	0.151***	0.137***	1.486***	1.116***	1.425***	0.225***
	(0.433)	(0.041)	(0.041)	(0.441)	(0.347)	(0.439)	(0.071)
Observations	5,470	5,470	5,470	5,470	5,470	5,470	5,470

Table header: (1) reg y = OLS on the untransformed dependent variable; (2) reg log(y) = OLS on the log-transformed dependent variable, (3a) glm(%) generalised linear model with Gaussian distribution and log link on the untransformed dependent variable (exponentiated coefficients); , (3b) glm(unit) generalised linear model with Gaussian distribution and log link on the untransformed dependent variable; (4) reg midp. = OLS on the midpoints of cigarette consumption; (5) intreg = interval regression; (6) oprobit = ordered probit; margins: average marginal effect; (margins_se): standard error of average marginal effect

Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Reference categories: university education, managerial and professional occupation

Controlling for age, age squared, the average price of domestic and foreign cigarette brands (real, logged), equivalised income per capita (real, logged), number of other smokers in household, number of adults in household, number of children in household, marital status, settlement size, region and time trend.
*** p<0.01 ** p<0.05 * p<0.1

MARGINAL EFFECTS FOR HOUSEHOLD CHARACTERISTICS

Table 6.18 below presents the marginal effects for selected household characteristics. For both genders, living in a household with other smokers increases average daily consumption. While living in a household with one smoking member compared to no other smokers increases consumption by about 0.5 and 0.8 cigarettes per day for males and females respectively, the effects increase quite steeply with additional smokers. Men in households with 3 other smokers consume 1.8 cigarettes more per day. For females, the effect is even stronger, with about 2.9 cigarettes more consumed per day. Proportionately, the effects are much larger for women given that their average daily consumption is lower (11 cigarettes compared to 17 for males), suggesting that smoking intensity might be influenced more strongly by the immediate social environment for females.

Similar to the participation model, the number of adults and children in the household (not shown in the table) have a small negative and statistically significant effect on smoking intensity for either gender. As concerns marital status, married and divorced men consume about 1 and 1.5 cigarettes more per day compared to men who are single, potentially again reflecting an age component. For women, respondents who are divorced or widowed consume more compared to single women, amounting to about 1.1 and 1.6 cigarettes per day.

Table 6.18 Marginal effects of household characteristics on predicted daily consumption

Consumption	(1) reg y margins (margins_se)	(2) reg log(y) margins (margins_se)	(3a) glm (%) margins (margins_se)	(3b) glm (unit) margins (margins_se)	(4) reg midp. margins (margins_se)	(5) intreg margins (margins_se)	(6) oprobit b (b_se)
Males							
1 other smoker in household	0.497**	0.034**	0.030**	0.498**	0.525***	0.530**	0.073**
	(0.211)	(0.014)	(0.013)	(0.215)	(0.203)	(0.208)	(0.029)
2 other smokers in household	1.362***	0.101***	0.082***	1.414***	1.346***	1.376***	0.206***
	(0.327)	(0.021)	(0.020)	(0.353)	(0.304)	(0.313)	(0.043)
3 other smokers in household	1.832***	0.156***	0.110***	1.921***	1.836***	1.846***	0.290***
	(0.463)	(0.031)	(0.028)	(0.498)	(0.453)	(0.463)	(0.066)
4-7 other smokers in household	2.285***	0.195***	0.139***	2.450***	2.395***	2.390***	0.411***
	(0.666)	(0.049)	(0.040)	(0.746)	(0.644)	(0.663)	(0.101)
Married	0.926***	0.064***	0.058***	0.950***	0.965***	0.974***	0.147***
	(0.275)	(0.020)	(0.018)	(0.293)	(0.270)	(0.276)	(0.041)
Divorced	1.467***	0.099***	0.088***	1.478***	1.431***	1.482***	0.191***
	(0.410)	(0.026)	(0.024)	(0.415)	(0.392)	(0.402)	(0.055)
Observations	16,804	16,804	16,804	16,804	16,804	16,804	16,804
Females							
1 other smoker in household	0.798**	0.086**	0.074**	0.783**	0.609**	0.774**	0.133**

Consumption	(1) reg y margins (margins_se)	(2) reg log(y) margins (margins_se)	(3a) glm (%) margins (margins_se)	(3b) glm (unit) margins (margins_se)	(4) reg midp. margins (margins_se)	(5) intreg margins (margins_se)	(6) oprobit b (b_se)
	(0.353)	(0.035)	(0.035)	(0.363)	(0.284)	(0.357)	(0.060)
2 other smokers in household	1.758***	0.182***	0.163***	1.804***	1.356***	1.697***	0.286***
	(0.459)	(0.044)	(0.044)	(0.486)	(0.374)	(0.468)	(0.078)
3 other smokers in household	2.929***	0.294***	0.265***	3.095***	2.156***	2.852***	0.460***
	(0.726)	(0.062)	(0.068)	(0.855)	(0.536)	(0.742)	(0.110)
4-7 other smokers in household	2.621***	0.302***	0.238***	2.736***	2.074***	2.488***	0.458***
	(0.857)	(0.084)	(0.077)	(0.961)	(0.768)	(0.885)	(0.158)
Divorced	1.133**	0.125***	0.106***	1.172***	0.892**	1.093**	0.205**
	(0.440)	(0.045)	(0.041)	(0.454)	(0.384)	(0.450)	(0.080)
Widowed	1.622**	0.128*	0.149**	1.674**	1.088*	1.605**	0.233*
	(0.776)	(0.071)	(0.065)	(0.768)	(0.636)	(0.792)	(0.129)
Observations	5,470	5,470	5,470	5,470	5,470	5,470	5,470

Table header: (1) reg y = OLS on the untransformed dependent variable; (2) reg log(y) = OLS on the log-transformed dependent variable, (3a) glm(%) generalised linear model with Gaussian distribution and log link on the untransformed dependent variable (exponentiated coefficients); , (3b) glm(unit) generalised linear model with Gaussian distribution and log link on the untransformed dependent variable; (4) reg midp. = OLS on the midpoints of cigarette consumption; (5) intreg = interval regression; (6) oprobit = ordered probit; margins: average marginal effect; (margins_se): standard error of average marginal effect

Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Reference categories: 0 other smokers, single

Controlling for age, age squared, the average price of domestic and foreign cigarette brands (real, logged), equivalised income per capita (real, logged), education, occupation, number of adults in household, number of children in household, settlement size, region and time trend..
*** p<0.01 ** p<0.05 * p<0.1

MARGINAL EFFECTS FOR REGION

Lastly, we examine some of the regional patterns in smoking intensity. As shown in Table 6.19 below, men who live in the Volga and Ural regions have a lower average daily consumption compared to smokers in Moscow and St. Petersburg, consuming about 1.6 cigarettes less per day. As to be expected from the descriptive analysis in chapter 4, there is a stronger regional patterning of consumption among females. Women who live in the Volga, Ural, Caucasus, and Eastern Siberian regions smoke between 1.2 and 2.8 cigarettes less than women in Moscow and St. Petersburg, with the highest effect in the Volga region.

As a final note before exploring some of the consumption results in the ordered probit model, we also comment briefly on the year effects. In contrast to participation, the linear time trend is positive and significant in both samples and more strongly so females. This is in line with the descriptive statistics in chapter 4, which suggested increasing consumption intensity over the survey period. Taken together with the results for participation this suggests that for men participation decreased over time, but those who smoke do so more intensively in 2010 compared to 2001. While time trends in participation are ambiguous for females, consumption intensity seems to have increased over time for females too.

Table 6.19 Marginal effects for region on predicted daily consumption

Consumption	(1) reg y margins (margins_se)	(2) reg log(y) margins (margins_se)	(3a) glm (%) margins (margins_se)	(3b) glm (unit) margins (margins_se)	(4) reg midp. margins (margins_se)	(5) intreg margins (margins_se)	(6) oprobit b (b_se)
Males							
Volga Basin & Volga Vaytski	-1.576***	-0.090***	-0.092***	-1.540***	-1.612***	-1.641***	-0.233***
	(0.420)	(0.030)	(0.025)	(0.426)	(0.409)	(0.417)	(0.060)
Ural	-1.593***	-0.089***	-0.095***	-1.598***	-1.622***	-1.638***	-0.240***
	(0.479)	(0.034)	(0.029)	(0.490)	(0.463)	(0.473)	(0.068)
Observations	16,804	16,804	16,804	16,804	16,804	16,804	16,804
Females							
Volga Basin & Volga Vaytski	-2.840***	-0.314***	-0.243***	-2.609***	-2.366***	-2.813***	-0.512***
	(0.617)	(0.063)	(0.063)	(0.653)	(0.543)	(0.621)	(0.115)
Caucasus	-1.392**	-0.195***	-0.116*	-1.327*	-1.000*	-1.244*	-0.224**
	(0.641)	(0.066)	(0.060)	(0.675)	(0.556)	(0.649)	(0.114)
Ural	-1.919***	-0.207***	-0.167***	-1.860***	-1.498***	-1.871***	-0.299***
	(0.598)	(0.062)	(0.054)	(0.599)	(0.511)	(0.603)	(0.106)
Eastern Siberia & Far Eastern	-1.350**	-0.167***	-0.101**	-1.162**	-1.036**	-1.226**	-0.213**
	(0.543)	(0.053)	(0.048)	(0.556)	(0.443)	(0.547)	(0.090)
Observations	5,470	5,470	5,470	5,470	5,470	5,470	5,470

Consumption	(1) reg y margins (margins_se)	(2) reg log(y) margins (margins_se)	(3a) glm (%) margins (margins_se)	(3b) glm (unit) margins (margins_se)	(4) reg midp. margins (margins_se)	(5) intreg margins (margins_se)	(6) oprobit b (b_se)

Table header: (1) reg y = OLS on the untransformed dependent variable; (2) reg log(y) = OLS on the log-transformed dependent variable, (3a) glm(%) generalised linear model with Gaussian distribution and log link on the untransformed dependent variable (exponentiated coefficients); , (3b) glm(unit) generalised linear model with Gaussian distribution and log link on the untransformed dependent variable; (4) reg midp. = OLS on the midpoints of cigarette consumption; (5) intreg = interval regression; (6) oprobit = ordered probit; margins: average marginal effect; (margins_se): standard error of average marginal effect

Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender. Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level. Reference category: Moscow & St. Petersburg

Controlling for age, age squared, the average price of domestic and foreign cigarette brands (real, logged), equivalised income per capita (real, logged), education, occupation, number of other smokers in household, number of adults in household, number of children in household, marital status, settlement size, and time trend.
*** p<0.01 ** p<0.05 * p<0.1

MARGINAL EFFECTS FOR ORDERED PROBIT MODEL OF CONSUMPTION

As a final step in interpreting our basic two-part model, we examine the marginal effects in the ordered probit model of cigarette consumption, which similarly to the probit models for participation, are interpreted based on predicted probabilities, separately for each of the consumption categories. One intention behind adopting the non-linear, ordered probit approach is to complement the analysis of marginal mean effects of our linear consumption models by examining the effects of our explanatory variables at different levels of consumption intensity. The advantage of being able to examine marginal effects along the distribution of cigarette consumption comes at the cost of less straightforward interpretation, which leads us to adopt a similar approach as in the probit models of participation, relying predominantly on tables with discrete and marginal changes as well as graphs of predicted probabilities. For the full results of the ordered probit models see Tables 6-E and 6-F in the appendix for males and females respectively.

As with the probit models of smoking participation, we begin our analysis by examining the predicted probabilities for the different categories of cigarette consumption.[61] Table 6.20 below shows the distribution of predicted probabilities for males and females.

Table 6.20 Predicted probabilities in the cigarette consumption categories

	Males			Females		
Category	Mean	Minimum	Maximum	Mean	Minimum	Maximum
5cig	0.1071	0.0125	0.5051	0.3277	0.0650	0.8055
10cig	0.2219	0.0714	0.3334	0.3549	0.1607	0.3711
15cig	0.1331	0.0731	0.1477	0.1151	0.0200	0.1491
20cig/18+cig	0.4389	0.1029	0.5369	0.2023	0.0138	0.5683
23+cig	0.0990	0.0033	0.3224			
Observations	16,804			5,470		

Categories: 5cig = 1-7 cigarettes; 10cig = 8-12 cigarettes; 15cig = 13-17 cigarettes; 18+cig = 18 and more cigarettes (for females); 20cig = 18-22 cigarettes; 23+cig =23 and more cigarettes (for males)
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender. Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Controlling for age, age squared, the average price of domestic and foreign cigarette brands (real, logged),

[61] Given the lower consumption intensity among females, we had to group the cigarette counts into fewer categories for females (with 18 and above cigarettes per day constituting the highest category), since ordered probit models face problems in converging if the categories have very few observations. For example, only 2 percent of females in our sample report smoking more than 20 cigarettes per day.

equivalised income per capita (real, logged), education, occupation, number of other smokers in household, number of adults in household, number of children in household, marital status, settlement size, region, and time trend.

As expected, given the previous results on the differences in consumption intensity by gender, the highest predicted probability for males is in the 20 cigarette category (0.54), while for females it lies in the lowest category representing values around 5 cigarettes of daily consumption (0.81), although the highest mean prediction for females is in the 10 cigarette category. In general, the prediction ranges are slightly wider for females, but less pronounced than in the participation models. In order to examine the distribution of predictions, Figure 6.12 and Figure 6.13 below plot the predicted probabilities per category for males and females respectively. Figure 6.12 shows that the 20 cigarettes consumption category has the highest predicted probability among men, with the majority of predictions clustering at the upper end, around 50 percent predicted probability, which is what we would expect given that, as can be seen from Table 6.20, 44 percent of men in our estimation sample report smoking one packet of cigarettes per day. The lowest predicted probabilities are in the two extreme categories (5 cigarettes and more than 23 cigarettes per day), reflecting the lower observed proportions of observations in these categories.

Figure 6.12 Predicted probabilities for different consumption categories (males)

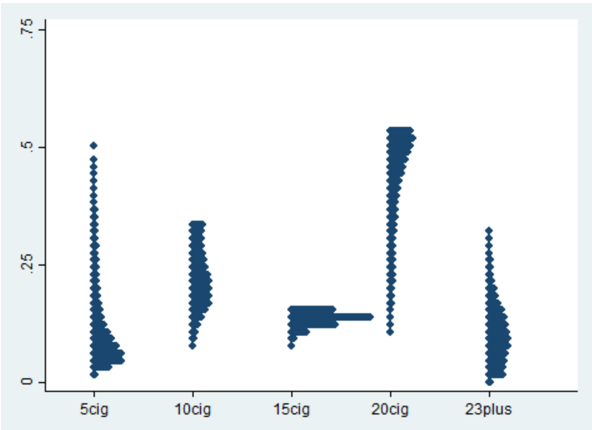
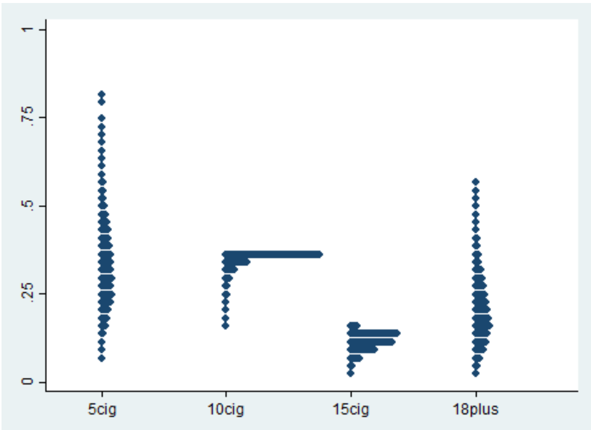


Figure 6.13 Predicted probabilities for different consumption categories (females)



The distribution of predicted probabilities for the 15 cigarettes category sticks out in that it is much more concentrated on a few values compared to all other categories, and masses at the higher prediction values. This likely reflects the fact that, as can be seen from Table 6.21, there are more people exiting into the next higher category (20 cigarettes) than entering from the category below.

Table 6.21 Distribution of cigarette consumption in estimation sample

Category	Frequency	Percent	Cumulative
Males			
5cig	1,805	10.74	10.74
10cig	3,371	22.20	32.94
15cig	2,222	13.22	46.17
20cig	7,384	43.94	90.11
23+cig	1,662	9.89	100.00
Total	16,804	100.00	
Females			
5cig	1,793	32.78	32.78
10cig	1,941	35.48	68.26
15cig	629	11.50	79.76
18+cig	1,107	20.24	100.00
Total	5,470	100.00	

Categories: 5cig = 1-7 cigarettes; 10cig = 8-12 cigarettes; 15cig = 13-17 cigarettes; 18+cig = 18 and more cigarettes (for females); 20cig = 18-22 cigarettes; 23+cig =2 3 and more cigarettes (for males)
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54)

In line with the lower average consumption among females, with one third of observations below half a packet, the highest predicted probabilities are in the 5 cigarette category, albeit with a very wide range.[62] In the 10 and 15 cigarette categories the range of predicted probabilities is much smaller compared to the other two categories. This is a common phenomenon in the middle categories, since whereas the predictions in the highest and lowest category are only bound by 0 and 1, in the middle categories the distance between the estimated cutpoints implies the maximum predicted probability (Long and Freese, 2014). For example, the difference between the second and third cutpoint in the female model is 0.4, which implies that the predicted probabilities cannot be higher than 0.4.

Turning next to the effects of prices and income at different levels of consumption intensity. Table 6.22 shows the marginal changes in predicted probabilities in each category when changing the price and income from their 5th to 95th percentiles. Since the

[62] This likely also reflects the fact that the lowest consumption category has a slightly larger interval than the other categories, including values of 1-7 cigarettes per day, whereas the other categories contain an interval of 5 cigarettes.

probabilities must sum to one, the marginal effects for each variable must sum to zero across the predicted probabilities, that is the values in the 'from' and 'to' rows in Table 6.22 each sum to zero. Another feature related to the statistical construction of the ordered probit model is the sign change in the predicted probabilities, also referred to as 'single-crossing theorem' (Winkelmann and Boes, 2006): as one moves from the probability of the smallest outcome to the probability of the largest outcome, the marginal effects are either first negative and then positive (in case of a positive coefficient for that variable), or first positive and then turn negative (in the case of a negative coefficient). This property is linked to the fact that the linear index of regressors, $x_i\beta$, is a common element in the cumulative probability function for each outcome category. In other words, we obtain the predicted probabilities for the different categories by shifting the probability curve (which has the same slope for each category) to the right on the linear index, according to the estimated threshold values/cutpoints for the different values of our categorical indicator. This is the so-called 'parallel regression assumption' of ordered choice models.

Changing the average price of cigarettes (real, logged) from its 5th percentile of 2.19 to its 95th percentile of 2.89 decreases the probability of being in the top two categories by 3.2 and 2.5 percent respectively among males. In other words, prices reduce consumption only for those at higher levels of consumption. For females, changing the price from the 5th to 95th percentile reduces the probability of being in the upper two consumption categories, i.e. of smoking 13 cigarettes or more per day. The strongest effect is in the top category, where the predicted probability falls by 4.8 percent, from .228 to .180. The proposed price increases in Russia are therefore not only likely to reduce cigarette consumption per se, but are likely to do so among those smokers that are doing the most health damage to themselves. If this is the case, the marginal benefits of the price increase policy are likely to be positive and understated by straightforward reporting of the price elasticity.

Table 6.22 Marginal effects for prices and income (ordered probit)

Variable	5cig	10cig	15cig	20cig	23+cig
Males					
Price					
Change 5% to 95%	0.026	0.025	0.005	-0.032	-0.025
From	0.094	0.209	0.130	0.454	0.112
To	0.121	0.235	0.136	0.423	0.087

Variable	5cig	10cig	15cig	20cig	23+cig
P-value	0.001	0.001	0.001	0.001	0.001
Income					
Change 5% to 95%	-0.011	-0.010	-0.002	0.013	0.010
From	0.113	0.228	0.134	0.432	0.093
To	0.102	0.217	0.132	0.445	0.104
P-value	0.149	0.149	0.148	0.149	0.148

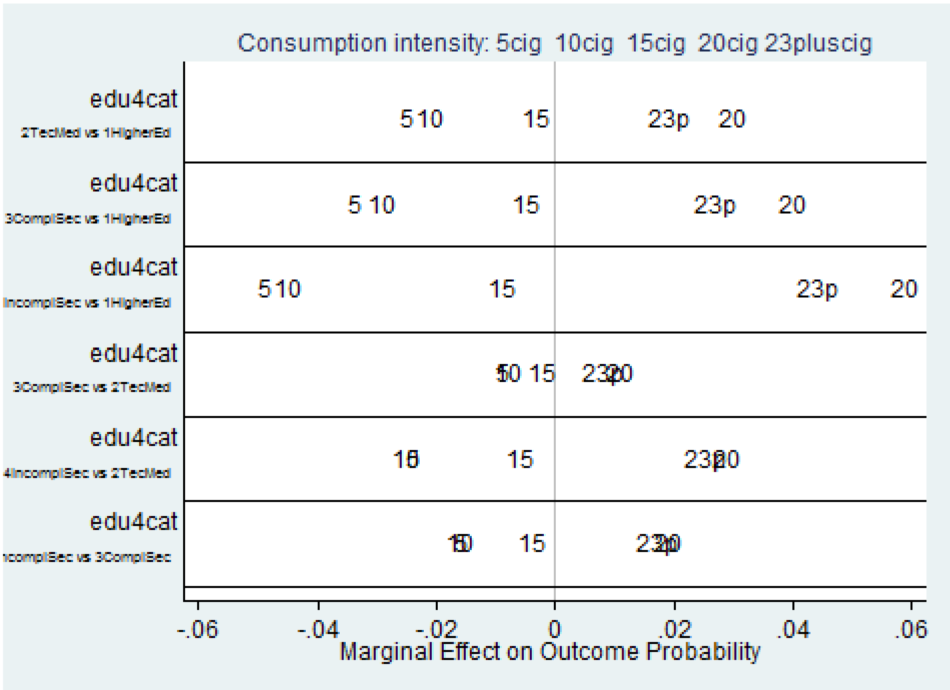
Variable	5cig	10cig	15cig	18+cig
Females				
Price				
Change 5% to 95%	0.061	0.000	-0.013	-0.048
From	0.296	0.354	0.122	0.228
To	0.357	0.354	0.109	0.180
P-value	0.028	0.725	0.028	0.030
Income				
Change 5% to 95%	-0.036	0.001	0.008	0.028
From	0.348	0.354	0.111	0.187
To	0.311	0.355	0.118	0.215
P-value	0.121	0.509	0.123	0.120

Categories: 5cig = 1-7 cigarettes; 10cig = 8-12 cigarettes; 15cig = 13-17 cigarettes; 18+cig = 18 and more cigarettes (for females); 20cig = 18-22 cigarettes; 23+cig =2 3 and more cigarettes (for males)
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender. Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Price = Average of price for domestic & foreign cigarette brands (real, logged)
Income = Equivalised income per capita (real, logged)
Controlling for age, age squared, education, occupation, number of other smokers in household, number of adults in household, number of children in household, marital status, settlement size, region, and time trend.

A similar pattern, with the opposite sign, holds for changes in income from the 5th to 95th percentile, with the probability of being in the top two consumption categories increasing by 1.3 and 1.0 percent respectively among men, and 1 and 2.8 percent among women. However, none of these changes are statistically significant. Since the effect of income was very small in the linear consumption models, it is likely that the ordered probit cannot pick up any effect when we look at larger consumption categories.

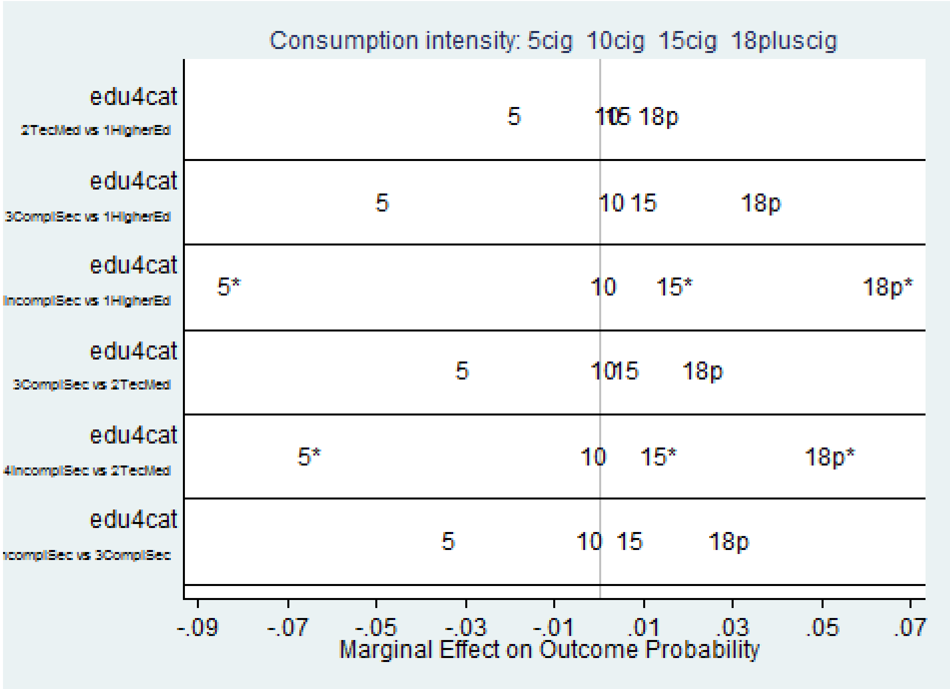
As a final set of results we focus on the effects of peers/social interactions on cigarette consumption, first as potentially proxied by education and second, as measured by the number of other smokers in the household. Figure 6.14 and Figure 6.15 below plot the marginal effects of the four educational categories on the predicted probabilities for each category of cigarette consumption. The numbers (5, 10, 15 etc) inside the plot area represent the categories of cigarette consumption, and each row compares two educational categories with each other. For example, the first row in Figure 6.14 compares the marginal effects of having complete secondary plus vocational education versus having a university degree on the outcome probabilities for the different consumption categories. Since the marginal effects are plotted on the x-axis, the greater the distance between the numbers is, the larger is the marginal effect. For males, the marginal effects are significant for all categories, therefore we have omitted the significance markers from this graph to allow for enhanced readability. For females, only some of the marginal changes are significant, as indicated by the *symbol in the graph.

Figure 6.14 Marginal effects of education for ordered probit model (males)



In line with the results from the linear consumption models, the largest differences in consumption are between men with university education and the three lower educational categories (shown in the first three rows of Figure 6.14). Compared to those with university degree, men with the lowest educational attainment are about 5 percent less likely to be in the 5 and 10 cigarettes consumption categories, and 4-6 percent more likely to be in the highest two categories. For females, a similar pattern holds true, but there appear to be greater differences also within the lower educational categories, e.g. having incomplete secondary education only increases the probability of being in the top consumption category by 0.065 compared to having university education, and by 0.029 compared to having complete secondary plus vocational education.

Figure 6.15 Marginal effects of education for ordered probit model (females)



Given that comparing all categories of the indicator for other smokers in the household for all 5 (4) consumption categories would lead to a very hard to read table, in Table 6.23 below we restrict our comparison to that between the zero other smokers group and the other categories. For men, all marginal effects are significant, albeit relatively small. However, it has to be kept in mind that we are now looking at broader categories of consumption intensity. For example, in the linear models, a man living in a household with 4-7 other smokers on average consumed about 2 cigarettes more per day compared to a man living in a household without other smokers. However, such changes are not necessarily picked up well by the ordered probit since they can occur within the same consumption category, e.g. from 19 to 21 cigarettes per day. This explains why not all of the marginal effects in the female sample are significant, whereas they were significant in the linear models. However, in line with the results from the linear models, the marginal effects are larger for females, again suggesting that female smoking (both in terms of participation and intensity) is more susceptible to the social environment.

Table 6.23 Marginal effects of other smokers in the household (ordered probit)

Variable	5cig	10cig	15cig	20cig	23+cig
Males					
1 vs 0 other smokers	-0.013	-0.012	-0.002	0.015	0.012
p-value	0.012	0.012	0.014	0.011	0.013
2 vs 0 other smokers	-0.033	-0.034	-0.008	0.040	0.036
p-value	0.000	0.000	0.000	0.000	0.000
3 vs 0 other smokers	-0.045	-0.049	-0.012	0.052	0.053
p-value	0.000	0.000	0.000	0.000	0.000
4-7 vs 0 other smokers	-0.059	-0.069	-0.020	0.067	0.081
p-value	0.000	0.000	0.002	0.000	0.001

Variable	5cig	10cig	15cig	18+cig
Females				
1 vs 0 other smokers	-0.047	0.004	0.010	0.034
p-value	0.027	0.139	0.029	0.021
2 vs 0 other smokers	-0.098	0.002	0.020	0.077
p-value	0.000	0.619	0.000	0.000
3 vs 0 other smokers	-0.152	-0.009	0.030	0.131
p-value	0.000	0.207	0.000	0.000
4-7 vs 0 other smokers	-0.047	0.004	0.010	0.034
p-value	0.027	0.139	0.029	0.021

Categories: 5cig = 1-7 cigarettes; 10cig = 8-12 cigarettes; 15cig = 13-17 cigarettes; 18+cig = 18 and more cigarettes (for females); 20cig = 18-22 cigarettes; 23+cig =2 3 and more cigarettes (for males)
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender. Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Controlling for age, age squared, the average price of domestic and foreign cigarette brands (real, logged), equivalised income per capita (real, logged), education, occupation, number of adults in household, number of children in household, marital status, settlement size, region, and time trend.

6.4.3 Base model with different price measures

Since the prices of cigarettes are one of our key variables of interest, we also check the robustness of our base model results under various different price measures. To recap, the price that we have used to date is the average of the Rosstat prices for domestic and foreign cigarette brands, in real terms, and logged. In this section we now examine the stability of the results when using: (1) the Rosstat price for domestic cigarette brands, (2) the RLMS low price for domestic cigarette brands, (3) the Rosstat price for foreign cigarette brands, and (4) the RLMS low price for foreign cigarette brands – all prices are again in real terms and logged. We begin by comparing the different price measures in the participation equation in Table 6.24 below.[63]

In the male participation model only the average and two domestic cigarette prices are significant. In particular, the Rosstat prices for domestic brands appear to have a stronger negative effect on smoking participation compared to the other prices, with the probability of smoking decreasing by 0.09 for a change of 1 in the log of price. For females, the average price and the Rosstat prices for both domestic and foreign brands are significant. We note that for females, the Rosstat price for domestic brands enters with the wrong (i.e. positive) sign; something which is difficult to interpret but may capture the tendency for females to turn to cheaper domestic cigarettes when prices in general rise.

Table 6.24 Marginal effects of price and income on participation when using different prices measures

Participation (=probability of current smoking)	(1) Average Rosstat	(2) Domestic Rosstat	(3) Domestic low RLMS	(4) Foreign Rosstat	(5) Foreign low RLMS
	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)
Males					
Price	-0.031	-0.088***	-0.026***	-0.015	0.002
	(0.022)	(0.026)	(0.007)	(0.018)	(0.006)
Income	-0.024***	-0.025***	-0.027***	-0.024***	-0.029***
	(0.005)	(0.005)	(0.006)	(0.005)	(0.006)
Observations	27,528	27,528	24,750	27,528	22,102
Females					
Price	-0.029*	0.047***	-0.005	-0.031**	-0.001
	(0.016)	(0.017)	(0.005)	(0.013)	(0.004)
Income	0.000	0.000	-0.003	0.001	-0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Observations	29,182	29,182	26,165	29,182	23,479

[63] For the full results see Tables 6-G and 6-H in the appendix for participation, and 6-I and 6-J for consumption. In all models the coefficients for the remaining covariates remain consistent and in line with the main results reported in the text. Slightly larger changes occur for the region and time dummies, which is to be expected given that the different prices will also capture regional characteristics and exhibit different trends over time. For example, the coefficients for the time dummies are larger in the model with the domestic Rosstat prices, which is in line with the stronger effects of tax increases for domestic cigarette brands.

Participation (=probability of current smoking)	(1) Average Rosstat	(2) Domestic Rosstat	(3) Domestic low RLMS	(4) Foreign Rosstat	(5) Foreign low RLMS
	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)

Price measures (all in real terms and logged) : (1) the average the Rosstat prices for domestic and foreign cigarette brands, (2) Rosstat price for domestic cigarette brands, (3) RLMS low price for domestic cigarette brands, (4) Rosstat price for foreign cigarette brands, (5) RLMS low price for foreign cigarette brands
Income = Equivalised income per capita (real, logged)
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Controlling for age, age squared, education, occupation, number of other smokers in household, number of adults in household, number of children in household, marital status, settlement size, region and time trend.
*** p<0.01 ** p<0.05 * p<0.1

Since the Rosstat prices have less variability and thus a narrower range compared to the RLMS prices, the marginal effects in Table 6.24 are distorted by differences in the distribution of prices. For example, a change of 1 in the log scale exceeds the range of the Rosstat domestic prices, since the minimum and maximum values are 1.54 and 2.25. As an alternative interpretation, Table 6.25 therefore shows the effects of the different price measures on the probability of smoking when we change the respective price from its 5th to 95th percentile, thus reflecting the possible range for each price variable. While this leaves the qualitative results unchanged, the marginal effects of the Rosstat price for domestic brands are now halved in magnitude (-0.045), whereas the marginal effects of the Rosstat low prices for domestic brands are slightly higher (-0.041) compared to Table 6.24. Both domestic price measures give stronger effects than the average price based on domestic and foreign brands, and the prices for foreign brands do not have a statistically significant effect. These results are in line with what we would expect given that men tend to smoke the domestic (economy) brands, so that they should be more sensitive to price changes for domestic brands. That is, we might have some corner solution zeroes here, some males may be forced to abstain if prices at the lower end of the price spectrum increase.

Table 6.25 Effect of changing price from the 5th to 95th percentile on participation for different price measures

	Males				Females			
Variable	Change	From	To	p-value	Change	From	To	p-value
(1) Average Rosstat								
5% to 95%	-0.021	0.621	0.600	0.167	-0.020	0.199	0.179	0.066
(2) Domestic Rosstat								
5% to 95%	-0.045	0.634	0.589	0.001	0.024	0.176	0.200	0.006
(3) Domestic low RLMS								
5% to 95%	-0.041	0.628	0.587	0.001	-0.008	0.178	0.170	0.383
(4) Foreign Rosstat								
5% to 95%	-0.013	0.617	0.604	0.407	-0.026	0.202	0.176	0.017
(5) Foreign low RLMS								
5% to 95%	0.004	0.607	0.610	0.750	-0.001	0.179	0.178	0.900
Average predictions of being a current smoker	0_No		1_Yes		0_No		1_Yes	
	0.391		0.609		0.811		0.189	

Price measures (all in real terms and logged) : (1) the average the Rosstat prices for domestic and foreign cigarette brands, (2) Rosstat price for domestic cigarette brands, (3) RLMS low price for domestic cigarette brands, (4) Rosstat price for foreign cigarette brands, (5) RLMS low price for foreign cigarette brands
Income = Equivalised income per capita (real, logged)
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Controlling for age, age squared, income, education, occupation, number of other smokers in household, number of adults in household, number of children in household, marital status, settlement size, region and time trend.

For females, the Rosstat prices for foreign cigarettes have the largest effect on participation (-0.026), however, smaller in magnitude compared to the effect of domestic brands for males. Similarly to the male case, this is in line with what we would expect to see, as female consumption is more oriented towards the medium and premium price segments. These results suggest that the greater price responsiveness of women is dependent on the price measure used, with men showing a greater responsiveness when using prices reflective of the economy segment of the market.

Table 6.26 below shows the effects of different price measures on consumption, estimated with interval regression, so that the price coefficients yield the semi-elasticities of consumption with respect to price. That is, a one percent increase in the average price (column 1) is associated with a -1.409*(ln(101/100) reduction in consumption among men, approximately. -0.01409, or about 0.1409 cigarettes less for a 10 percent increase in price. The only other significant price measure for males is for the Rosstat price for foreign brands, which would suggest that the very small consumption adjustments with respect to price take place in the upper price segment. Taken together with the results for participation, this would imply that higher prices for more expensive brands tend to reduce consumption (or lead to 'switching down' to cheaper, domestic brands), whereas higher prices among the cheaper brands reduce participation.

Table 6.26 Predicted daily cigarette consumption with different price measures

Consumption	Average Rosstat	Domestic Rosstat	Domestic low RLMS	Foreign Rosstat	Foreign low RLMS
Interval regression	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)
Males					
Price	-1.409***	1.040**	-0.116	-1.278***	-0.124
	(0.470)	(0.525)	(0.183)	(0.373)	(0.133)
Observations	16,804	16,804	15,089	16,804	13,450
Females					
Price	-1.896**	0.838	0.173	-1.685***	0.342
	(0.740)	(0.751)	(0.282)	(0.596)	(0.218)
Observations	5,470	5,470	4,504	5,470	4,127

Price measures (all in real terms and logged) : (1) the average the Rosstat prices for domestic and foreign cigarette brands, (2) Rosstat price for domestic cigarette brands, (3) RLMS low price for domestic cigarette brands, (4) Rosstat price for foreign cigarette brands, (5) RLMS low price for foreign cigarette brands
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated with interval regression and using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Controlling for age, age squared, equivalised income per capita (real, logged), education, occupation, number of other smokers in household, number of adults in household, number of children in household, marital status, settlement size, region and time trend.
margins: average marginal effect; margins_se: standard error of average marginal effect
*** p<0.01 ** p<0.05 * p<0.1

Female consumption is slightly more responsive to price, especially given their lower average daily consumption, with average consumption decreasing by about 0.1896 cigarettes for a 10 percent increase in the Rosstat average price, and a slightly lower effect for the Rosstat foreign price (0.1685 for a 10 percent increase). For a better comparison of the effect sizes with the participation models, Table 6.27 also compares the effects when changing prices from the 5th to 95th percentiles. For males, mean consumption falls by 1.068 cigarettes when we change the Rosstat prices for foreign cigarettes from their

5th to 95th percentile which is minimally larger than for the Rosstat average price. The same holds true in the female sample, where mean consumption falls by 1.283 and 1.404 for the Rosstat average and Rosstat foreign prices. Again, given the lower average consumption among women (17 versus 11 cigarettes), the consumption adjustments are proportionately larger in the female sample.

Table 6.27 Effect of changing price from the 5th to 95th percentile on predicted daily cigarette consumption with different price measures

	Males				Females			
Variable	Change	From	To	p-value	Change	From	To	p-value
(1) Average Rosstat								
5% to 95%	-0.938	17.204	16.266	0.003	-1.283	11.677	10.394	0.010
(2) Domestic Rosstat								
5% to 95%	0.525	16.455	16.981	0.047	0.390	10.793	11.183	0.265
(3) Domestic low RLMS								
5% to 95%	-0.178	16.742	16.564	0.527	0.267	10.551	10.819	0.539
(4) Foreign Rosstat								
5% to 95%	-1.068	17.293	16.225	0.001	-1.404	11.747	10.344	0.005
(5) Foreign low RLMS								
5% to 95%	-0.222	16.759	16.537	0.352	0.591	10.387	10.977	0.117

Price measures (all in real terms and logged) : (1) the average the Rosstat prices for domestic and foreign cigarette brands, (2) Rosstat price for domestic cigarette brands, (3) RLMS low price for domestic cigarette brands, (4) Rosstat price for foreign cigarette brands, (5) RLMS low price for foreign cigarette brands
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated with interval regression and using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Controlling for age, age squared, equivalised income per capita (real, logged), education, occupation, number of other smokers in household, number of adults in household, number of children in household, marital status, settlement size, region and time trend.

6.4.4 FURTHER SPECIFICATION CHECKS

Having examined in detail the results of our basic specification of the two part model, we now briefly turn to the results when separately adding three more speculative and potentially endogenous regressors: (1) A dummy variable indicating whether the individual lived in a household in the top quartile of alcohol expenditure, (2) an indicator for the feeling of power the individual feels he/she has compared to others in society, and

(3) a dummy variable indicating whether the individual has smoked for 10 or more years, added to the consumption equation only. Table 6.28 presents the results for the three variables for males and females. For the full results see Tables 6-K through 6-P in the appendix. In all cases, the results for the other coefficients remain qualitatively consistent with the base model specification.

Table 6.28 Base model with alcohol spending, power rank and smoking length

	Participation	Consumption			
	(1) probit	(2) reg y	(3) reg midpoint	(4) intreg	(5) oprobit
	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	b/ (b_se)
Males					
Top quartile alcohol	0.022***	0.586***	0.553***	0.570***	0.082***
	(0.008)	(0.163)	(0.157)	(0.161)	(0.023)
Power rank	-0.010***	-0.227***	-0.230***	-0.233***	-0.037***
	(0.002)	(0.052)	(0.049)	(0.050)	(0.007)
5% to 95%	*-0.062*			*-1.406*	
p-value	*(0.000)*			*(0.000)*	
Smoking 10 years or more		2.134***	2.045***	2.102***	0.329***
		(0.315)	(0.306)	(0.314)	(0.047)
Females					
Top quartile alcohol	0.033***	0.398*	0.404**	0.399*	0.089**
	(0.005)	(0.222)	(0.188)	(0.224)	(0.038)
Power rank	-0.002	-0.121*	-0.134**	-0.140*	-0.029**
	(0.001)	(0.072)	(0.060)	(0.073)	(0.012)
5% to 95%	*-0.010*			*-0.690*	
p-value	*(0.282)*			*(0.059)*	
Smoking 10 years or more		2.209***	1.929***	2.226***	0.436***
		(0.318)	(0.285)	(0.325)	(0.064)

Top quartile alcohol = dummy variable for individuals living in a houshold that is in the top quartile of alcohol expenditure
Power rank = indicator capturing feeling of power respondent believes he/she has compared to others, taking on values 1 to 9, where 1 reflects the lowest feeling of power
Smoking 10 years or more = dummy variable taking on 1 if the individual has been smoking for 10 years or more (based on reported start age)
Table header: (1) probit = probit regression for probability of being a current smoker; (2) reg y = OLS on the untransformed dependent variable (daily cigarette consumption); (3) reg midp. = OLS on the midpoints of cigarette consumption; (4) intreg = interval regression; (5) oprobit = ordered probit regression on categorical indicator of cigarette consumption; b: Regression coefficient; (b_se): Standard error of regression coefficient; margins: average marginal effect; (margins_se): standard error of average marginal effect

Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-

	Participation	Consumption			
	(1) probit	(2) reg y	(3) reg midpoint	(4) intreg	(5) oprobit
	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	b/ (b_se)

59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Controlling for age, age squared, the average price of domestic and foreign cigarette brands (real, logged), Equivalised income per capita (real, logged), education, occupation, number of other smokers in household, number of adults in household, number of children in household, settlement size, region and time trend.
*** p<0.01 ** p<0.05 * p<0.1

Being in the top quartile of alcohol expenditure increases the probability of smoking by 2.2 and 3.3 percent among males and females respectively, and increases consumption by about half a cigarette.

The variable indicating the feeling of power (measured on a 10-point scale with 10 signifying the highest feeling of power) as our proxy for stress is significant and with the expected negative sign in the participation model for both males, albeit with relatively small effects, and not significant for females. An increase of 1 in the feeling of power decreases the predicted probability of smoking by 1 percent for males, and when evaluated as a change from the 5th to 95th percentile of the power rank variable (corresponding to a change from 1 to 7 on the 10-point scale), by 6.2 percent. That is, all else being equal, a higher feeling of stress/powerlessness seems to reduce the probability of smoking among men, while having no effect on female participation. For consumption, the effects are also with the expected negative sign and significant for both genders. Evaluated as a change from the 5th to the 95th percentile for the interval regression, mean consumption falls by 1.406 and 0.690 cigarettes for men and women respectively, which given the lower average predicted consumption among women (11 versus 17 cigarettes among men), represents a proportionately larger effect for females.

Finally, as expected, adding a dummy variable indicating whether an individual smokes 10 years or more, has a strong and positive effect, increasing mean consumption by about 2 cigarettes for both men and women, which is comparable in size to the effects of living in a household with several other smokers compared to no other smokers. We will pick up on this theme in the subsequent chapter.

6.4.5 COMPARING LINEAR VERSUS COUNT ESTIMATORS FOR THE CONSUMPTION MODELS

Our motivation for estimating the consumption models within a linear rather than a non-linear, count data framework was based on the strong degree of heaping, and thus measurement error, in the dependent variable, which can bias non-linear models such as Poisson or negative binomial regression. From our comparison between linear estimators that ignore the heaping problem (such as OLS) and those that try to address it (regression on the observed heaping points and interval regression) we saw that the differences between the estimators are small, typically at the second and third decimal, which suggests that contrary to our prior belief, heaping is less problematic for estimation than expected, at least for linear estimators. Given that, in the absence of measurement error, count data models would be more suitable (efficient) for addressing the non-negative, integer-valued nature of our dependent variable, we also compare our linear estimators to the two standard count data estimators – Poisson and negative binomial regression. Reassuringly, the results for the count data estimators (presented in Tables 6-Q and 6-R in the appendix) are qualitatively consistent with the linear estimators, with the differences typically no larger than .1 in absolute value (i.e. a tenth of a cigarette). The count estimators give slightly lower coefficients than the linear models, and with count, the Poisson results are marginally lower compared to the negative binomial model. To illustrate the differences between linear and count estimators, Table 6.29 below shows the marginal effects with their respective standard errors for prices and income, as well as the effects for a change from the 5th to 95th percentile of these variables and the average predicted cigarette consumption for each estimator. This shows that the differences between the estimators are negligibly small, beyond the second decimal place.

Table 6.29 The effects of prices and income for linear and count estimators

Consumption	(1) reg y	(2) reg midp.	(3) intreg	(4) poisson	(5) neg. binomial
	margins/ margins_se	margins/ margins_se	margins/ margins_se	margins/ margins_se	margins/ margins_se
Males					
Price	-1.377***	-1.384***	-1.409***	-1.349***	-1.296***
	(0.475)	(0.459)	(0.470)	(0.477)	(0.476)
Change from 5th to 95th percentile	*-0.917*	*-0.921*	*-0.938*	*-0.898*	*-0.862*
p-value	*0.004*	*0.003*	*0.003*	*0.005*	*0.007*

Consumption	(1) reg y	(2) reg midp.	(3) intreg	(4) poisson	(5) neg. binomial
	margins/ margins_se	margins/ margins_se	margins/ margins_se	margins/ margins_se	margins/ margins_se
Income	0.263**	0.258**	0.258**	0.251*	0.209*
	(0.129)	(0.120)	(0.124)	(0.130)	(0.125)
Change from 5th to 95th percentile	*0.668*	*0.655*	*0.655*	*0.637*	*0.531*
p-value	*0.041*	*0.032*	*0.037*	*0.053*	*0.092*
Average predicted consumption	16.828	16.789	16.738	16.828	16.832
Females					
Price	-1.742**	-1.817**	-1.896**	-1.717**	-1.674**
	(0.730)	(0.710)	(0.740)	(0.724)	(0.696)
Change from 5th to 95th percentile	*-1.18*	*-1.23*	*-1.28*	*-1.17*	*-1.14*
p-value	*0.02*	*0.01*	*0.01*	*0.02*	*0.02*
Income	0.211	0.216	0.224	0.211	0.182
	(0.140)	(0.137)	(0.143)	(0.141)	(0.137)
Change from 5th to 95th percentile	*0.58*	*0.60*	*0.62*	*0.58*	*0.50*
p-value	*0.13*	*0.12*	*0.12*	*0.13*	*0.18*
Average predicted consumption	11.074	11.239	11.001	11.074	11.075

Table header: (1) reg y = OLS on the untransformed dependent variable; (2) reg midp. = OLS on the midpoints of cigarette consumption; (3) intreg = interval regression; (4) poisson = poisson regression on the untransformed dependent variable; (5) = negative binomial on the untransformed dependent variable;
b: Regression coefficient; (b_se): Standard error of regression coefficient
margins: average marginal effect; (margins_se): standard error of average marginal effect
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
Price = Average of price for domestic & foreign cigarette brands (real, logged)
Income = Equivalised income per capita (real, logged)
Controlling for education, occupation, number of other smokers in the household, number of adults in household, number of children in household, marital status, settlement size, region and time trend.
*** p<0.01 ** p<0.05 * p<0.1

6.4.6 Selection model

In section 5.2.1 we discussed the different assumptions that we made in order to arrive at our preferred estimation approach. In short, underlying the results presented in this chapter are assumptions of first order dominance (no corner solutions) and of independence of the error terms in the respective parts of the two-part model. We have no doubt about the appropriateness of the first assumption, but we acknowledge that the second assumption is, at least in part, a pragmatic result of the difficulties that we face in identifying valid exclusion restrictions to identify the participation decision, in a two-part model with correlated errors (sample selection model).

The basic idea of a sample selection model is that the outcome variable, cigarette consumption in our case, is only observed if some criterion (smoker or not) is met. The model therefore has two stages. In the first stage, the dichotomous 'smoker' variable determines whether the level of cigarette consumption is observed. In the second stage, the level of consumption is modelled, conditional on the first stage, and including the inverse mills ratio from the first equation. The error structure across the two estimates is assumed to have a correlation *rho*, which we essentially assume to be 0 in the results presented in this chapter. If *rho* is non-zero, then the estimates of the OLS equation will not be consistent. The most important element of these sample selection models is not the fact that observations on the dependent variable are only available for the sample of smokers, but rather that the selection is not random with respect to cigarette consumption. For example, there may be some unobserved variable, such as the individuals' rate of discounting the future, relevant to cigarette consumption levels, which is more or less concentrated among the non-smoking population.

The practical problem that we face though, is in identifying an observable variable (or more than one) that will identify the model. That is, we need a variable in our data that is a good predictor of whether an individual smokes or not but does not contribute towards the determination of the level of smoking, conditional on smoking. In the absence of good instruments exogenous to the survey, or information on parental/family background of the RLMS respondents, we are left with few options. One possible option is to argue that the presence of children in the household might determine participation but not subsequent consumption. In estimating this model, we find some empirical support for it in that, for males (but not for females), the presence of children does indeed determine participation but not consumption. If we are to believe in this strategy, then we also find strong evidence of correlation between the error terms and, since the coefficient on *rho* is positive, this suggests that unobserved factors that make selection more likely (e.g. high discount factor) also influence smoking levels positively. To this extent the sign of the coefficient for *rho* makes sense.

However, we are not convinced that this identification strategy stands up to closer scrutiny. It is clearly not valid for females and it is sensitive to specification with males and therefore we have limited confidence in its appropriateness. Moreover, in estimating the selection model using this instrument, the qualitative results are not changed, so the purpose of presenting the results would be to argue about the size of the coefficients. While the latter is clearly important, it only serves to emphasize that we would need to have very strong faith in our identifying strategy to go down this route. In the absence of such faith, we simply note that the task of estimating a robust sample selection model is one for a future piece of work, as and when, more plausible identifying variables can be drawn upon.

6.5 DISCUSSION

The main focus of this chapter was on identifying appropriate modelling strategies to account for the limited dependent variable nature of cigarette consumption as well as the potential problems related to measurement error in our dependent variable as evidenced by the 'heaping' of reported consumption values in multiples of five. In light of the large proportion of zeroes, particularly for females, and the fact that from a conceptual point of view the zeroes are a separate quantity of interest, the standard approach for estimating static demand models in the empirical literature is to separate observed consumption into a participation and a consumption decision, each with their own data generating process, rather than merely adjusting a single equation model to admit a larger proportion of zeroes, such as in the Tobit model. The double-hurdle approach, which was developed by Jones (1989a) building on earlier work by Cragg (1971), nests four different specifications of such a two-part structure, with the precise specification of the model depending on the assumptions regarding (1) the types of zero observations in the data (genuine non-smoking and/or corner solutions) and (2) the relationship between the unobserved factors and thus error terms in the two parts. In order to decide about (1), we referred back to the RLMS questionnaires and our observed data which suggested that in the static context, corner solutions are unlikely to be present given that (a) we do not observe any zeroes for those who say they currently smoke, and (b) the very low prices observed in the period under consideration. Particularly in the female case, where 80 percent of respondents are non-smokers, estimating cigarette demand while leaving the zeroes for the non-smokers in the sample seems flawed conceptually as this would imply treating 4/5th of respondents as being at a corner solution or as current smokers with mismeasured cigarette consumption.

This left us with a choice between estimating the two parts independently or with a correlated error structure, i.e. adjusting the consumption equation for the probability of being a smoker. In the end, this choice was dictated largely by practical considerations regarding the absence of a suitable identification strategy for a selection model. We conclude that the task of estimating a robust sample selection model is one for a future piece of work, as and when, more plausible identifying variables can be drawn upon.

Our results for the preferred two-part model suggest that, in addition to the conceptual appeal, the separation between participation and consumption is also important empirically since the qualitative results and magnitude of effects between the two decisions differ. For example, education appears to matter more for participation than for consumption conditional on being a smoker, particularly among men.

The effect of our two key variables of interest, the price of cigarettes and income, are low, but not unimportant, compared to other covariates in the model. For males/females a 10 percent increase in price reduces the average daily quantity consumed by about 0.13/0.17 cigarettes. In percentage terms this equates to approximate 2 percent for males and something approaching 1.9 percent for females. While these are quite low cigarette price elasticities in the international context, they are consistent with the previous literature on Russia, and since the Russian government has pledged some rather steep price increases in the future, our results suggest that such policies will result in small but meaningful reductions in smoking consumption.

As ever, the devil is in the detail, and our analysis of the distribution of marginal effects for the participation model suggested that average marginal effects underestimate the effect of prices and income for about half of the sample for males, while the opposite is true for females. This means that the finding that females are more responsive to price than males could be distorted by using a less appropriate summary measure for the marginal effects, and should therefore be interpreted with a degree of caution. Our experimentation with different price measures further highlighted that male participation is relatively more sensitive to the prices for domestic (typically economy) brands, whereas at the intensive margin male consumption seems to respond more to prices for foreign brands, which are typically in the medium- and premium price segments. These results fit with the casual observation that Russian men tend to smoke the cheaper, domestic brands, so that increases in the prices for these brands, which were relatively stronger than for foreign brands after the excise tax increase in 2008, could lead some men to quit or force them to a corner solution. For females, only the prices for foreign brands yielded significant effects in addition to our standard price measure consisting of the average of the prices for domestic and foreign brands. This too, is in line with anecdotal evidence on women preferring the higher-priced foreign brands. Notwithstanding the potential impact that substantive price changes can have though, participation and demand seem to be much more responsive to social factors than economic ones, as captured by the large positive effects of the number of other household smokers on both participation and consumption, for both men and women.

As concerns the choice of estimator for the consumption model, the negligible differences in estimates between the different linear estimators suggest that even the strong degree of heaping present in our data does not seem to be an important problem empirically. As expected, OLS on the untransformed cigarette counts, which ignores both the non-negative, integer-valued nature of the dependent variable, yields the largest effects, but is not far off from the other models. The results from the models that use the log-transformed dependent variable (OLS on log y and GLM on y) yield the same qualitative results as the models that use the untransformed counts, and among the two estimators the GLM model is preferable since it avoids the retransformation problem and yields more conservative results. Overall, in view of the less straight-forward interpretation of models with logged dependent variables, we recommend using the untransformed counts. We also compared our set of linear estimators to the two standard count data estimators, Poisson and negative binomial regression, which lend further support to the finding that the heaping is a minor problem empirically. Overall, it seems that once the zeroes are separated from the positive observations, the choice between linear and count data estimators is a matter of taste and should be seen in conjunction with other aims of the analysis, with the results cross-checked against the range of estimators to establish robustness.

In addition to our linear consumption models, we also estimated an ordered probit model to examine the effects of our covariates along the distribution of cigarette consumption and to complement the linear predictions of mean effects. Overall, it appears that there is relatively little gain from such a model in that the much more complex interpretation does not necessarily justify the additional insights gained. That having been said, once again as a robustness test, it is a useful exercise. For example, in the male sample, changes typically affect the top two categories (20 cigarettes and ≥ 23 cigarettes), which is likely driven by the fact that 43 percent of reported male consumption falls on one packet per day. For females, the marginal effects predominantly shift probability mass between the two lowest consumption categories, which is a reflection of the lower average consumption in the female sample. In both cases though this supports the earlier finding regarding the impact of price but additionally suggests that the price impact may affect consumption where the marginal benefits of reducing it are the largest.

The relatively uninformative results of the ordered probit model may be due to the fact that heaping constitutes the rule of reporting rather than the exception, so that there is little gain from grouping values around the heaping points in multiples of 5. Furthermore, the underlying quantitative meaning of the categorical consumption indicator makes the results much more intuitive in the interval regression, which achieves the same as ordered probit in the linear context.

Finally, separately adding three more speculative but potentially important regressors to our base model specification (being in the top quartile of alcohol expenditure, power rank, and smoking 10 years or more) did not change any of the qualitative results for the other covariates model. We also confirmed that there are likely complementarities with alcohol, that stress is an important driver of consumption and that smoking longevity (persistence) is important to account for.

6.6 Conclusion

In this chapter we focused on microeconometric approaches to dealing with the limited dependent variable nature of cigarette consumption in the context of a static demand model and treated our data as a pooled cross-section. We separated observed cigarette consumption into a participation decision, estimated with a probit model, and a consumption decision, estimated with various linear and count data estimators. We find that both participation and consumption are responsive to price, but consistent with the previous findings for Russia, the effects are rather small. Rather than driven by economic forces though, both smoking participation and cigarette consumption respond strongly to the social environment, as is evidenced by the large effects of other household smokers as well as education (which can also be conceptualised as a proxy for peer effects). While on the empirical side, the separation into participation and consumption is important, the heaping problem is of minor importance for the choice of estimator, at least for the separate two-part model.

In the following chapter, we build on this and interrogate these findings in a framework within which we allow for the persistence of smoking within individuals.

Chapter 6 Appendices

6-A Overview of different estimators for two-part model

Estimator	Conceptual approach	Interpretation of marginal effects
Participation: Probit	Probability of smoking $\Pr(y > 0\mid\text{x})$	Marginal effect for a variable x_k depends on the values of all the other variables x_i in the model Average marginal effects (AME): Compute the marginal effect of x_k for each observation at its observed values x_i – in the thesis we present AMEs Marginal effect at the mean (MEM): Compute the marginal effect of x_k with all variables held at their means Marginal effects at representative values (MER): Compute the marginal effect of x_k with variables held at specific values that are selected for being especially instructive for the question considered in the analysis. Continuous x_k: A one unit increase in x_k reduces/increases the probability of smoking by AME percent. Log-transformed x_k: A one percent increase in x_k reduces/increases the probability of smoking by AME percent. Binary x_k: A discrete change in x_k (from 0 to 1) reduces/increases the probability of smoking by AME percent. Categorical x_k: A discrete change from the base category to the category under consideration reduces/increases the probability of smoking by AME percent.

	Estimator	Conceptual approach	Interpretation of marginal effects
	Consumption		
(1)	OLS on y	Ignoring the strictly positive nature of y and heaping $E(y\|x)$	Marginal effect = coefficient (β) Continuous x_k: A one unit increase in x_k reduces/increases mean cigarette consumption by β units (cigarettes). Log-transformed x_k: A one percent increase in x_k reduces/increases mean cigarette consumption by approximately β *(ln(101/100) units. Binary x_k: A discrete change in x_k (from 0 to 1) reduces/increases mean cigarette consumption by β units. Categorical x_k: A discrete change from the base category to the category under consideration reduces/increases mean cigarette consumption by β units.
(2)	OLS on $\log(y)$	Addressing the strictly positive nature of y but ignoring heaping $E(\log(y)\|x)$	Marginal effect = coefficient (β) Continuous x_k: β *100 gives the percent change in y for a unit change in x_k Log-transformed x_k: A one percent increase in x_k reduces/increases mean cigarette consumption by approximately β *(ln(101/100) units. Binary x_k: A discrete change in x_k (from 0 to 1) reduces/increases mean cigarette consumption by β percent. Categorical x_k: A discrete change from the base category to the category under consideration reduces/increases mean cigarette consumption by β percent.
(3)	GLM with Gaussian distribution and log link on y	Addressing the strictly positive nature of y but ignoring heaping. Avoids retransformation problem in (2) by means of the link funtion, that is it models the log mean of the untransformend dependent variable $\log E(y\|x)$, rather than modelling the mean of $E(\log(y)\|x)$.	Coefficient = change in log of $E(y)$); two types of marginal effects a) Marginal effect of the linear prediction = xxponentiated coefficient. Yields percent change in y – comparable to approach (2) b) Marginal effect for the expected value of y Yields unit change in y – comparable to approaches (1), (4) and (5).

	Estimator	Conceptual approach	Interpretation of marginal effects
(4)	OLS on midpoints of y	Addresses the heaping by pretending that we know consumption only takes place in multiples of 5, i.e. imposing the closest heaped value for every respondent who does not report in a multiple of 5. Does not explicitly account for the nonnegativity of y. $E(midpoint(y)\|x)$.	Same as for (1)
(5)	Interval regression on $ylower$ $yupper$	Conceptually opposite approach to (4) . Addresses heaping by assuming we assume to know the interval limits (defined through the lower and upper limit dependent variables) into which consumption falls, but not the exact value. Also accounts for nonnegativity of y. Conceptually the same as an ordered probit model with known thresholds. $E(ylower, yupper\|x)$.	Same as for (1)
(6)	Ordered probit on categorial indicator of y	Standard ordered probit with first threshold fixed at 0 and variance normalised to 1 – nonlinear approach. Similar to (5) but without assuming underlying quantitative meaning for y^*, that is, treating consumption in terms of ordered categories of smoking intensity. $E(y^*\|x)$.	Positive β indicates that a one unit/percent/discrete change in x_k:increases the probability of being in a higher category of y (i.e. shifts out the probability mass into higher categories) Negative β indicates that a one unit/percent/discrete change in x_k:decreases the probability of being in a higher category of y (i.e. shifts the probability mass towards the lower categories) Marginal effect for a variable x_k depends on the values of all the other variables x_i in the model and, in addition to probit, needs to be evaluated separately for each outcome category. AME; MEM and MER apply in the same way as for probit. Continuous x_k: A one unit increase in x_k reduces/increases the probability of being in outcome category J by AME percent.

Estimator	Conceptual approach	Interpretation of marginal effects
		Log-transformed x_k: A one percent increase in x_k reduces/ increases the probability of being in outcome category J by AME percent. Binary x_k: A discrete change in x_k (from 0 to 1) reduces/ increases the probability of being in outcome category J by AME percent. Categorical x_k: A discrete change from the base category to the category under consideration reduces/ increases the probability of being in outcome category J by AME percent.

6-B BASE MODEL OF CIGARETTE DEMAND – PARTICIPATION

Participation	Males		Females	
	b (b_se)	margins (margins_se)	b (se)	margins (margins_se)
Average of price for domestic & foreign cigarette brands (real, logged)	-0.108	-0.031	-0.191*	-0.029*
	(0.078)	(0.022)	(0.104)	(0.016)
Equivalised income per capita (real, logged)	-0.085***	-0.024***	0.003	0.000
	(0.018)	(0.005)	(0.021)	(0.003)
Age in years	0.162***	0.005***	0.215***	-0.001***
	(0.010)	(0.001)	(0.015)	(0.000)
Age in years # Age in years	-0.002***	***	-0.003***	***
	(0.000)		(0.000)	
University education	0.000	0.000	0.000	0.000
	(.)	(0.000)	(.)	(0.000)
Technical, medical, pedagogical, art college	0.322***	0.095***	0.199***	0.029***
	(0.061)	(0.018)	(0.062)	(0.009)
Complete secondary education	0.442***	0.130***	0.243***	0.036***
	(0.053)	(0.015)	(0.063)	(0.009)
Incomplete secondary education	0.437***	0.129***	0.303***	0.046***
	(0.060)	(0.018)	(0.073)	(0.011)
Managerial & professional occupation	0.000	0.000	0.000	0.000
	(.)	(0.000)	(.)	(0.000)
Non-manual occupation	0.112	0.033	0.267***	0.042***
	(0.075)	(0.022)	(0.054)	(0.008)
Manual occupation	0.179***	0.052***	0.133	0.020
	(0.050)	(0.015)	(0.082)	(0.013)
Unskilled occupation	0.251***	0.072***	0.151*	0.023*
	(0.067)	(0.019)	(0.078)	(0.012)
No occupation	0.059	0.017	0.197***	0.030***
	(0.051)	(0.015)	(0.057)	(0.009)
0 other smokers in household	0.000	0.000	0.000	0.000
	(.)	(0.000)	(.)	(0.000)
1 other smoker in household	1.544***	0.425***	1.968***	0.445***
	(0.040)	(0.009)	(0.048)	(0.010)
2 other smokers in household	2.006***	0.483***	2.849***	0.686***
	(0.081)	(0.010)	(0.082)	(0.015)
3 other smokers in household	2.216***	0.501***	3.725***	0.836***
	(0.126)	(0.011)	(0.140)	(0.014)

Participation	**Males**		**Females**	
	b (b_se)	margins (margins_se)	b (se)	margins (margins_se)
4-7 other smokers in household	2.641***	0.522***	4.646***	0.904***
	(0.199)	(0.010)	(0.249)	(0.009)
Number of adults in the household	-0.237***	-0.068***	-0.534***	-0.083***
	(0.016)	(0.004)	(0.026)	(0.003)
Number of children in the household	-0.141***	-0.040***	-0.185***	-0.029***
	(0.019)	(0.005)	(0.026)	(0.004)
Single	0.000	0.000	0.000	0.000
	(.)	(0.000)	(.)	(0.000)
Married	0.238***	0.070***	-0.212***	-0.032***
	(0.053)	(0.016)	(0.062)	(0.009)
Divorced	0.356***	0.103***	0.276***	0.047***
	(0.081)	(0.023)	(0.077)	(0.013)
Widowed	0.326*	0.095*	0.276***	0.047***
	(0.175)	(0.050)	(0.106)	(0.019)
City > 500,000 inhabitants	0.000	0.000	0.000	0.000
	(.)	(0.000)	(.)	(0.000)
City 50,000-500,000 inhabitants	0.031	0.009	-0.207***	-0.035***
	(0.054)	(0.015)	(0.060)	(0.010)
Town <50,000 inhabitants & rural settlements	0.066	0.019	-0.486***	-0.076***
	(0.050)	(0.014)	(0.058)	(0.009)
Moscow & St. Petersburg	0.000	0.000	0.000	0.000
	(.)	(0.000)	(.)	(0.000)
North & Northwestern	0.084	0.024	0.160	0.030
	(0.103)	(0.030)	(0.104)	(0.019)
Central & Central Black Earth	0.033	0.009	-0.113	-0.019
	(0.079)	(0.023)	(0.088)	(0.015)
Volga Basin & Volga Vaytski	0.143*	0.041*	-0.591***	-0.089***
	(0.076)	(0.022)	(0.090)	(0.014)
Caucasus	0.031	0.009	-0.405***	-0.064***
	(0.079)	(0.023)	(0.094)	(0.015)
Ural	0.063	0.018	-0.241***	-0.040***
	(0.083)	(0.024)	(0.093)	(0.016)
Western Siberia	0.098	0.028	-0.138	-0.024
	(0.091)	(0.026)	(0.099)	(0.017)
Eastern Siberia & Far Eastern	0.123	0.035	-0.154*	-0.026*
	(0.083)	(0.024)	(0.084)	(0.014)
Year	-0.012***	-0.004***	0.007	0.001
	(0.004)	(0.001)	(0.005)	(0.001)

Participation	**Males**		**Females**	
	b (b_se)	margins (margins_se)	b (se)	margins (margins_se)
Constant	-1.813***	***	-2.950***	***
	(0.314)		(0.411)	
Observations	27,528		29,182	
Degrees of freedom	30		30	

Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
b: Regression coefficient; b_se: Standard error of regression coefficient
margins: average marginal effect; margins_se: standard error of average marginal effect
*** p<0.01 ** p<0.05 * p<0.1

6-C Base model of cigarette demand – Consumption (males)

Consumption (males)	linear	linear: y strictly positive			linear: heaping		nonlinear
	(1) reg y margins (margins_se)	(2) reg log(y) margins (margins_se)	(3a) glm (%) margins (margins_se)	(3b) glm (unit) margins (margins_se)	(4) reg midp. margins (margins_se)	(5) intreg margins (margins_se)	(6) oprobit b (b_se)
Average of price for domestic & foreign cigarette brands (real, logged)	-1.377***	-0.088***	-0.085***	-1.422***	-1.384***	-1.409***	-0.230***
	(0.475)	(0.034)	(0.029)	(0.487)	(0.459)	(0.470)	(0.067)
Equivalised income per capita (real, logged)	0.263**	0.005	0.018**	0.310**	0.258**	0.258**	0.024
	(0.129)	(0.008)	(0.008)	(0.140)	(0.120)	(0.124)	(0.017)
Age in years	0.138***	0.010***	0.008***	0.126***	0.132***	0.136***	0.090***
	(0.010)	(0.001)	(0.001)	(0.010)	(0.010)	(0.010)	(0.009)
Age in years # Age in years	***	***	***	***	***	***	-0.001***
							(0.000)
University education	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
Technical, medical, pedagogical, art college	0.825**	0.057*	0.049**	0.787**	0.822**	0.846**	0.131**
	(0.397)	(0.029)	(0.024)	(0.390)	(0.385)	(0.394)	(0.056)
Complete secondary education	1.266***	0.091***	0.072***	1.180***	1.200***	1.243***	0.181***
	(0.355)	(0.025)	(0.022)	(0.351)	(0.344)	(0.352)	(0.049)
Incomplete secondary education	1.944***	0.131***	0.113***	1.870***	1.873***	1.927***	0.278***

Consumption (males)	linear	linear: y strictly positive			linear: heaping		nonlinear
	(1) reg y margins (margins_se)	(2) reg log(y) margins (margins_se)	(3a) glm (%) margins (margins_se)	(3b) glm (unit) margins (margins_se)	(4) reg midp. margins (margins_se)	(5) intreg margins (margins_se)	(6) oprobit b (b_se)
	(0.386)	(0.027)	(0.024)	(0.383)	(0.375)	(0.384)	(0.054)
Managerial & professional occupation	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
Non-manual occupation	-0.044	0.008	-0.006	-0.097	-0.062	-0.048	-0.022
	(0.512)	(0.037)	(0.033)	(0.542)	(0.492)	(0.504)	(0.070)
Manual occupation	0.862***	0.081***	0.050**	0.855**	0.870***	0.877***	0.134***
	(0.321)	(0.023)	(0.020)	(0.328)	(0.307)	(0.315)	(0.045)
Unskilled occupation	0.900**	0.085***	0.052**	0.895**	0.891**	0.890**	0.148***
	(0.386)	(0.027)	(0.023)	(0.396)	(0.370)	(0.380)	(0.055)
No occupation	-0.905***	-0.063**	-0.055**	-0.890**	-0.822**	-0.874**	-0.133***
	(0.349)	(0.025)	(0.022)	(0.360)	(0.332)	(0.342)	(0.049)
0 other smokers in household	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
1 other smoker in household	0.497**	0.034**	0.030**	0.498**	0.525***	0.530**	0.073**
	(0.211)	(0.014)	(0.013)	(0.215)	(0.203)	(0.208)	(0.029)
2 other smokers in household	1.362***	0.101***	0.082***	1.414***	1.346***	1.376***	0.206***
	(0.327)	(0.021)	(0.020)	(0.353)	(0.304)	(0.313)	(0.043)
3 other smokers in household	1.832***	0.156***	0.110***	1.921***	1.836***	1.846***	0.290***

Consumption (males)	linear	linear: y strictly positive			linear: heaping		nonlinear
	(1) reg y margins (margins_se)	(2) reg log(y) margins (margins_se)	(3a) glm (%) margins (margins_se)	(3b) glm (unit) margins (margins_se)	(4) reg midp. margins (margins_se)	(5) intreg margins (margins_se)	(6) oprobit b (b_se)
	(0.463)	(0.031)	(0.028)	(0.498)	(0.453)	(0.463)	(0.066)
4-7 other smokers in household	2.285***	0.195***	0.139***	2.450***	2.395***	2.390***	0.411***
	(0.666)	(0.049)	(0.040)	(0.746)	(0.644)	(0.663)	(0.101)
Number of adults in household	-0.236**	-0.012*	-0.016**	-0.264**	-0.276***	-0.267***	-0.040***
	(0.103)	(0.007)	(0.007)	(0.111)	(0.095)	(0.098)	(0.013)
Number of children in household	-0.294***	-0.028***	-0.016**	-0.270**	-0.303***	-0.315***	-0.049***
	(0.107)	(0.008)	(0.007)	(0.116)	(0.104)	(0.107)	(0.015)
Single	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
Married	0.926***	0.064***	0.058***	0.950***	0.965***	0.974***	0.147***
	(0.275)	(0.020)	(0.018)	(0.293)	(0.270)	(0.276)	(0.041)
Divorced	1.467***	0.099***	0.088***	1.478***	1.431***	1.482***	0.191***
	(0.410)	(0.026)	(0.024)	(0.415)	(0.392)	(0.402)	(0.055)
Widowed	1.209	0.077	0.064	1.058	0.958	1.013	0.098
	(1.269)	(0.066)	(0.068)	(1.166)	(1.157)	(1.201)	(0.146)
City > 500,000 inhabitants	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
City 50,000-500,000 inhabitants	-0.262	-0.007	-0.014	-0.230	-0.281	-0.280	-0.027
	(0.312)	(0.022)	(0.019)	(0.321)	(0.303)	(0.309)	(0.044)

Consumption (males)	linear	linear: y strictly positive			linear: heaping		nonlinear
	(1) reg y	(2) reg log(y)	(3a) glm (%)	(3b) glm (unit)	(4) reg midp.	(5) intreg	(6) oprobit
	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	b (b_se)
Town <50,000 inhabitants & rural settlements	0.075	0.002	0.009	0.150	0.033	0.048	-0.010
	(0.297)	(0.020)	(0.018)	(0.309)	(0.288)	(0.295)	(0.040)
Moscow & St. Petersburg	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
North & Northwestern	0.124	0.012	0.006	0.109	0.014	0.025	-0.009
	(0.583)	(0.039)	(0.034)	(0.594)	(0.571)	(0.581)	(0.082)
Central & Central Black Earth	-0.236	-0.009	-0.011	-0.198	-0.313	-0.297	-0.047
	(0.437)	(0.031)	(0.025)	(0.441)	(0.424)	(0.433)	(0.061)
Volga Basin & Volga Vaytski	-1.576***	-0.090***	-0.092***	-1.540***	-1.612***	-1.641***	-0.233***
	(0.420)	(0.030)	(0.025)	(0.426)	(0.409)	(0.417)	(0.060)
Caucasus	-0.771	-0.082**	-0.044	-0.751	-0.799*	-0.824*	-0.153**
	(0.496)	(0.036)	(0.030)	(0.510)	(0.479)	(0.490)	(0.069)
Ural	-1.593***	-0.089***	-0.095***	-1.598***	-1.622***	-1.638***	-0.240***
	(0.479)	(0.034)	(0.029)	(0.490)	(0.463)	(0.473)	(0.068)
Western Siberia	-0.520	-0.018	-0.026	-0.443	-0.610	-0.598	-0.090
	(0.509)	(0.035)	(0.030)	(0.529)	(0.491)	(0.501)	(0.070)
Eastern Siberia & Far Eastern	-0.757	-0.035	-0.040	-0.687	-0.912**	-0.902**	-0.138**
	(0.461)	(0.032)	(0.027)	(0.473)	(0.446)	(0.457)	(0.064)

	linear	linear: y strictly positive			linear: heaping		nonlinear
Consumption (males)	(1) reg y margins (margins_se)	(2) reg log(y) margins (margins_se)	(3a) glm (%) margins (margins_se)	(3b) glm (unit) margins (margins_se)	(4) reg midp. margins (margins_se)	(5) intreg margins (margins_se)	(6) oprobit b (b_se)
Year	0.046	0.005**	0.003	0.043	0.050*	0.051*	0.010**
	(0.028)	(0.002)	(0.002)	(0.030)	(0.026)	(0.027)	(0.004)
Constant	4.111**	1.701***	2.004***	2.004***	4.657**	4.201**	
	(1.982)	(0.142)	(0.124)	(0.124)	(1.901)	(1.956)	
Constant						2.000***	
						(0.012)	
Cut1							0.427
							(0.279)
Cut2							1.289***
							(0.279)
Cut3							1.661***
							(0.280)
Cut4							3.128***
							(0.282)
Observations	16,804	16,804	16,804	16,804	16,804	16,804	16,804
Degrees of freedom	30	30	30	30	30	30	30

(1) reg y = OLS on the untransformed dependent variable; (2) reg log(y) = OLS on the log-transformed dependent variable, (3a) glm(%) generalised linear model with Gaussian distribution and log link on the untransformed dependent variable (exponentiated coefficients); , (3b) glm(unit) generalised linear model with Gaussian distribution and log link on the untransformed dependent variable; (4) reg midp. = OLS on the midpoints of cigarette consumption; (5) intreg = interval regression; (6) oprobit = ordered probit

Consumption (males)	linear	linear: y strictly positive			linear: heaping		nonlinear
	(1) reg y	(2) reg log(y)	(3a) glm (%)	(3b) glm (unit)	(4) reg midp.	(5) intreg	(6) oprobit
	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	b (b_se)

Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender. Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
b: Regression coefficient; b_se: Standard error of regression coefficient
margins: average marginal effect; margins_se: standard error of average marginal effect; *** p<0.01 ** p<0.05 * p<0.1

6-D Base model of cigarette demand – Consumption (females)

Consumption (females)	linear	linear: y strictly positive			linear: heaping		nonlinear
	(1) reg y	(2) reg log(y)	(3a) glm (%)	(3b) glm (unit)	(4) reg midp.	(5) intreg	(6) oprobit
	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	b (b_se)
Average of price for domestic & foreign cigarette brands (real, logged)	-1.742**	-0.130*	-0.160**	-1.770**	-1.343**	-1.896**	-0.262**
	(0.730)	(0.068)	(0.071)	(0.794)	(0.585)	(0.740)	(0.120)
Equivalised income per capita (real, logged)	0.211	0.014	0.023*	0.255*	0.199	0.224	0.038
	(0.140)	(0.014)	(0.013)	(0.149)	(0.121)	(0.143)	(0.025)
Age in years	0.103***	0.010***	0.010***	0.093***	0.083***	0.101***	0.079***
	(0.016)	(0.002)	(0.002)	(0.015)	(0.014)	(0.017)	(0.018)
Age in years # Age in years	***	***	***	***	***	***	-0.001***

Consumption (females)	linear	linear: y strictly positive			linear: heaping		nonlinear
	(1) reg y margins (margins_se)	(2) reg log(y) margins (margins_se)	(3a) glm (%) margins (margins_se)	(3b) glm (unit) margins (margins_se)	(4) reg midp. margins (margins_se)	(5) intreg margins (margins_se)	(6) oprobit b (b_se)
							(0.000)
University education	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
Technical, medical, pedagogical, art college	0.225	0.030	0.012	0.130	0.161	0.234	0.052
	(0.500)	(0.050)	(0.051)	(0.529)	(0.418)	(0.503)	(0.086)
Complete secondary education	0.881*	0.102**	0.079	0.853	0.594	0.830	0.140
	(0.519)	(0.049)	(0.051)	(0.544)	(0.424)	(0.525)	(0.087)
Incomplete secondary education	1.408**	0.165***	0.121**	1.341**	1.069**	1.309**	0.242**
	(0.556)	(0.053)	(0.053)	(0.576)	(0.464)	(0.565)	(0.095)
Managerial & professional occupation	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
Non-manual occupation	1.121***	0.139***	0.101***	1.079***	0.904***	1.050***	0.187***
	(0.382)	(0.039)	(0.037)	(0.392)	(0.322)	(0.384)	(0.066)
Manual occupation	1.032*	0.149***	0.091*	0.957*	0.895*	0.923*	0.194**
	(0.531)	(0.053)	(0.050)	(0.534)	(0.473)	(0.544)	(0.097)
Unskilled occupation	1.688***	0.171***	0.150***	1.640***	1.467***	1.705***	0.294***
	(0.575)	(0.054)	(0.051)	(0.567)	(0.469)	(0.579)	(0.095)
No occupation	1.469***	0.151***	0.137***	1.486***	1.116***	1.425***	0.225***
	(0.433)	(0.041)	(0.041)	(0.441)	(0.347)	(0.439)	(0.071)

Consumption (females)	linear	linear: y strictly positive			linear: heaping		nonlinear
	(1) reg y	(2) reg log(y)	(3a) glm (%)	(3b) glm (unit)	(4) reg midp.	(5) intreg	(6) oprobit
	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	b (b_se)
0 other smokers in household	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
1 other smoker in household	0.798**	0.086**	0.074**	0.783**	0.609**	0.774**	0.133**
	(0.353)	(0.035)	(0.035)	(0.363)	(0.284)	(0.357)	(0.060)
2 other smokers in household	1.758***	0.182***	0.163***	1.804***	1.356***	1.697***	0.286***
	(0.459)	(0.044)	(0.044)	(0.486)	(0.374)	(0.468)	(0.078)
3 other smokers in household	2.929***	0.294***	0.265***	3.095***	2.156***	2.852***	0.460***
	(0.726)	(0.062)	(0.068)	(0.855)	(0.536)	(0.742)	(0.110)
4-7 other smokers in household	2.621***	0.302***	0.238***	2.736***	2.074***	2.488***	0.458***
	(0.857)	(0.084)	(0.077)	(0.961)	(0.768)	(0.885)	(0.158)
Number of adults in household	-0.363***	-0.038***	-0.033**	-0.360**	-0.288**	-0.354**	-0.062**
	(0.138)	(0.014)	(0.013)	(0.147)	(0.119)	(0.141)	(0.025)
Number of children in household	-0.348**	-0.026	-0.033**	-0.366**	-0.222	-0.366**	-0.047
	(0.168)	(0.016)	(0.017)	(0.185)	(0.144)	(0.170)	(0.029)
Single	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
Married	0.530	0.048	0.057	0.617	0.480	0.598*	0.114*
	(0.356)	(0.038)	(0.035)	(0.371)	(0.314)	(0.362)	(0.067)

Consumption (females)	linear	linear: y strictly positive			linear: heaping		nonlinear
	(1) reg y	(2) reg log(y)	(3a) glm (%)	(3b) glm (unit)	(4) reg midp.	(5) intreg	(6) oprobit
	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	b (b_se)
Divorced	1.133**	0.125***	0.106***	1.172***	0.892**	1.093**	0.205**
	(0.440)	(0.045)	(0.041)	(0.454)	(0.384)	(0.450)	(0.080)
Widowed	1.622**	0.128*	0.149**	1.674**	1.088*	1.605**	0.233*
	(0.776)	(0.071)	(0.065)	(0.768)	(0.636)	(0.792)	(0.129)
City > 500,000 inhabitants	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
City 50,000-500,000 inhabitants	-0.702*	-0.025	-0.065*	-0.719*	-0.649*	-0.837**	-0.129*
	(0.415)	(0.044)	(0.039)	(0.434)	(0.358)	(0.418)	(0.076)
Town <50,000 inhabitants & rural settlements	-0.443	0.007	-0.037	-0.410	-0.416	-0.553	-0.069
	(0.419)	(0.043)	(0.039)	(0.436)	(0.364)	(0.425)	(0.076)
Moscow & St. Petersburg	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
North & Northwestern	-1.122	-0.155**	-0.087	-1.006	-0.880	-1.029	-0.187
	(0.693)	(0.067)	(0.063)	(0.722)	(0.570)	(0.702)	(0.116)
Central & Central Black Earth	-1.101*	-0.172***	-0.084	-0.976	-0.852	-0.985	-0.204*
	(0.626)	(0.061)	(0.055)	(0.638)	(0.527)	(0.636)	(0.109)
Volga Basin & Volga Vaytski	-2.840***	-0.314***	-0.243***	-2.609***	-2.366***	-2.813***	-0.512***
	(0.617)	(0.063)	(0.063)	(0.653)	(0.543)	(0.621)	(0.115)
Caucasus	-1.392**	-0.195***	-0.116*	-1.327*	-1.000*	-1.244*	-0.224**

Consumption (females)	linear	linear: y strictly positive			linear: heaping		nonlinear
	(1) reg y	(2) reg log(y)	(3a) glm (%)	(3b) glm (unit)	(4) reg midp.	(5) intreg	(6) oprobit
	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	b (b_se)
	(0.641)	(0.066)	(0.060)	(0.675)	(0.556)	(0.649)	(0.114)
Ural	-1.919***	-0.207***	-0.167***	-1.860***	-1.498***	-1.871***	-0.299***
	(0.598)	(0.062)	(0.054)	(0.599)	(0.511)	(0.603)	(0.106)
Western Siberia	-0.327	-0.083	-0.007	-0.080	-0.525	-0.285	-0.120
	(0.761)	(0.069)	(0.072)	(0.869)	(0.588)	(0.772)	(0.120)
Eastern Siberia & Far Eastern	-1.350**	-0.167***	-0.101**	-1.162**	-1.036**	-1.226**	-0.213**
	(0.543)	(0.053)	(0.048)	(0.556)	(0.443)	(0.547)	(0.090)
Year	0.115***	0.017***	0.009**	0.103**	0.108***	0.107***	0.025***
	(0.039)	(0.004)	(0.004)	(0.042)	(0.034)	(0.040)	(0.007)
Constant	1.648	1.193***	1.465***	1.465***	3.412	2.136	
	(2.736)	(0.269)	(0.264)	(0.264)	(2.265)	(2.771)	
Constant						1.825***	
						(0.023)	
Cut1							1.169**
							(0.467)
Cut2							2.135***
							(0.467)
Cut3							2.511***

Consumption (females)	**linear**	**linear: y strictly positive**			**linear: heaping**		**nonlinear**
	(1) reg y	(2) reg log(y)	(3a) glm (%)	(3b) glm (unit)	(4) reg midp.	(5) intreg	(6) oprobit
	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	b (b_se)
							(0.468)
Observations	5,470	5,470	5,470	5,470	5,470	5,470	5,470
Degrees of freedom	30	30	30	30	30	30	30

(1) reg y = OLS on the untransformed dependent variable; (2) reg log(y) = OLS on the log-transformed dependent variable, (3a) glm(%) generalised linear model with Gaussian distribution and log link on the untransformed dependent variable (exponentiated coefficients); , (3b) glm(unit) generalised linear model with Gaussian distribution and log link on the untransformed dependent variable; (4) reg midp. = OLS on the midpoints of cigarette consumption; (5) intreg = interval regression; (6) oprobit = ordered probit
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender. Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
b: Regression coefficient; b_se: Standard error of regression coefficient
margins: average marginal effect; margins_se: standard error of average marginal effect; *** p<0.01 ** p<0.05 * p<0.1

6-E Ordered probit – marginal effects for all outcomes (males)

Consumption (males) Average marginal effects	Coefficient b (b_se)	5cig margins (margins_se)	10cig margins (margins_se)	15cig margins (margins_se)	20cig. margins (margins_se)	23plus margins (margins_se)
Average of price for domestic & foreign cigarette brands (real, logged)	-0.230***	0.0391***	0.0383***	0.00791***	-0.0474***	-0.0379***
	(0.0670)	(0.0114)	(0.0112)	(0.00234)	(0.0138)	(0.0111)
Equivalised income per capita (real, logged)	0.0243	-0.00415	-0.00405	-0.000838	0.00502	0.00402
	(0.0168)	(0.00286)	(0.00280)	(0.000583)	(0.00346)	(0.00279)
Age in years	0.0895***	-0.00464***	-0.00260***	0.0000673	0.00508***	0.00210***
	(0.00856)	(0.000333)	(0.000247)	(0.0000893)	(0.000358)	(0.000234)
Age in years # Age in years	-0.000932***					
	(0.000111)					
University education	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
Technical, medical, pedagogical, art college	0.131**	-0.0251**	-0.0207**	-0.00297**	0.0299**	0.0188**
	(0.0564)	(0.0110)	(0.00886)	(0.00127)	(0.0130)	(0.00802)
Complete secondary education	0.181***	-0.0338***	-0.0290***	-0.00461***	0.0405***	0.0269***
	(0.0494)	(0.00983)	(0.00763)	(0.00102)	(0.0116)	(0.00686)
Incomplete secondary education	0.278***	-0.0494***	-0.0454***	-0.00855***	0.0592***	0.0442***

Consumption (males) Average marginal effects	Coefficient b (b_se)	5cig margins (margins_se)	10cig margins (margins_se)	15cig margins (margins_se)	20cig. margins (margins_se)	23plus margins (margins_se)
	(0.0536)	(0.0102)	(0.00844)	(0.00149)	(0.0120)	(0.00807)
Managerial & professional occupation	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
Non-manual occupation	-0.0217	0.00387	0.00367	0.000664	-0.00484	-0.00336
	(0.0697)	(0.0125)	(0.0118)	(0.00210)	(0.0156)	(0.0107)
Manual occupation	0.134***	-0.0217***	-0.0232***	-0.00522***	0.0273***	0.0228***
	(0.0452)	(0.00774)	(0.00775)	(0.00160)	(0.00973)	(0.00735)
Unskilled occupation	0.148***	-0.0238***	-0.0256***	-0.00588***	0.0299***	0.0254***
	(0.0546)	(0.00895)	(0.00945)	(0.00218)	(0.0112)	(0.00935)
No occupation	-0.133***	0.0252***	0.0219***	0.00320**	-0.0311***	-0.0192***
	(0.0486)	(0.00897)	(0.00813)	(0.00137)	(0.0111)	(0.00733)
0 other smokers in household	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
1 other smoker in household	0.0726**	-0.0127**	-0.0119**	-0.00235**	0.0152**	0.0118**
	(0.0289)	(0.00503)	(0.00474)	(0.000960)	(0.00600)	(0.00473)
2 other smokers in household	0.206***	-0.0332***	-0.0344***	-0.00805***	0.0396***	0.0361***
	(0.0430)	(0.00660)	(0.00716)	(0.00192)	(0.00764)	(0.00806)
3 other smokers in household	0.290***	-0.0446***	-0.0487***	-0.0125***	0.0524***	0.0535***
	(0.0663)	(0.00895)	(0.0112)	(0.00353)	(0.00991)	(0.0138)
4-7 other smokers in household	0.411***	-0.0588***	-0.0691***	-0.0198***	0.0667***	0.0810***
	(0.101)	(0.0114)	(0.0167)	(0.00629)	(0.0109)	(0.0237)

Consumption (males) Average marginal effects	Coefficient b (b_se)	5cig margins (margins_se)	10cig margins (margins_se)	15cig margins (margins_se)	20cig. margins (margins_se)	23plus margins (margins_se)
Number of adults in household	-0.0401***	0.00684***	0.00669***	0.00138***	-0.00828***	-0.00663***
	(0.0134)	(0.00228)	(0.00223)	(0.000466)	(0.00275)	(0.00222)
Number of children in household	-0.0486***	0.00828***	0.00809***	0.00167***	-0.0100***	-0.00803***
	(0.0154)	(0.00263)	(0.00257)	(0.000538)	(0.00319)	(0.00255)
Single	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
Married	0.147***	-0.0261***	-0.0247***	-0.00448***	0.0325***	0.0228***
	(0.0407)	(0.00751)	(0.00693)	(0.00113)	(0.00954)	(0.00602)
Divorced	0.191***	-0.0331***	-0.0324***	-0.00628***	0.0412***	0.0305***
	(0.0550)	(0.00936)	(0.00952)	(0.00202)	(0.0119)	(0.00906)
Widowed	0.0976	-0.0179	-0.0163	-0.00271	0.0222	0.0147
	(0.146)	(0.0254)	(0.0248)	(0.00478)	(0.0318)	(0.0232)
City > 500,000 inhabitants	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
City 50,000-500,000 inhabitants	-0.0274	0.00468	0.00456	0.000939	-0.00566	-0.00452
	(0.0441)	(0.00753)	(0.00735)	(0.00152)	(0.00911)	(0.00729)
Town <50,000 inhabitants & rural settlements	-0.00961	0.00163	0.00161	0.000339	-0.00197	-0.00160
	(0.0404)	(0.00683)	(0.00675)	(0.00143)	(0.00826)	(0.00675)
Moscow & St. Petersburg	0.000	0.000	0.000	0.000	0.000	0.000

Consumption (males) Average marginal effects	Coefficient b (b_se)	5cig margins (margins_se)	10cig margins (margins_se)	15cig margins (margins_se)	20cig. margins (margins_se)	23plus margins (margins_se)
	(.)	(.)	(.)	(.)	(.)	(.)
North & Northwestern	-0.00933	0.00137	0.00161	0.000441	-0.00164	-0.00178
	(0.0816)	(0.0120)	(0.0141)	(0.00385)	(0.0143)	(0.0155)
Central & Central Black Earth	-0.0465	0.00697	0.00799	0.00212	-0.00841	-0.00867
	(0.0611)	(0.00905)	(0.0105)	(0.00283)	(0.0109)	(0.0115)
Volga Basin & Volga Vaytski	-0.233***	0.0392***	0.0391***	0.00837***	-0.0477***	-0.0390***
	(0.0603)	(0.00974)	(0.0102)	(0.00253)	(0.0118)	(0.0107)
Caucasus	-0.153**	0.0245**	0.0260**	0.00615**	-0.0298**	-0.0269**
	(0.0694)	(0.0110)	(0.0118)	(0.00290)	(0.0134)	(0.0123)
Ural	-0.240***	0.0404***	0.0402***	0.00852***	-0.0491***	-0.0400***
	(0.0679)	(0.0112)	(0.0114)	(0.00268)	(0.0136)	(0.0118)
Western Siberia	-0.0903	0.0139	0.0155	0.00392	-0.0169	-0.0164
	(0.0697)	(0.0107)	(0.0120)	(0.00308)	(0.0129)	(0.0128)
Eastern Siberia & Far Eastern	-0.138**	0.0219**	0.0235**	0.00565**	-0.0266**	-0.0244**
	(0.0645)	(0.0101)	(0.0110)	(0.00274)	(0.0123)	(0.0116)
Year	0.00959**	-0.00163**	-0.00160**	-0.000330**	0.00198**	0.00158**
	(0.00384)	(0.000658)	(0.000641)	(0.000132)	(0.000799)	(0.000632)
Cut1	0.427					
	(0.279)					
Cut2	1.289***					
	(0.279)					

Consumption (males) Average marginal effects	Coefficient b (b_se)	5cig margins (margins_se)	10cig margins (margins_se)	15cig margins (margins_se)	20cig. margins (margins_se)	23plus margins (margins_se)
Cut3	1.661***					
	(0.280)					
Cut4	3.128***					
	(0.282)					
Observations	16,804	16,804	16,804	16,804	16,804	16,804
Degrees of freedom	30	30	30	30	30	30

Categories: 5cig=1-7 cigarettes; 10cig=8-12 cigarettes; 15cig=13-17 cigarettes; 20cig=18-22 cigarettes; 23+cig=23 and more cigarettes
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender. Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.

6-F ORDERED PROBIT – MARGINAL EFFECTS FOR ALL OUTCOMES (FEMALES)

Consumption (females) Average marginal effects	Coefficient b (b_se)	5cig margins (margins_se)	10cig margins (margins_se)	15cig margins (margins_se)	18plus margins (margins_se)
Average of price for domestic & foreign cigarette brands (real, logged)	-0.262**	0.0902**	-0.00111	-0.0186**	-0.0705**
	(0.120)	(0.0412)	(0.00206)	(0.00851)	(0.0325)
Equivalised income per capita (real, logged)	0.0382	-0.0131	0.000162	0.00271	0.0103

Consumption (females) Average marginal effects	Coefficient b (b_se)	5cig margins (margins_se)	10cig margins (margins_se)	15cig margins (margins_se)	18plus margins (margins_se)
	(0.0246)	(0.00846)	(0.000307)	(0.00175)	(0.00664)
Age in years	0.0788***	-0.00615***	0.00107***	0.00135***	0.00372***
	(0.0179)	(0.00107)	(0.000289)	(0.000237)	(0.000718)
Age in years # Age in years	-0.000913***				
	(0.000249)				
University education	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)
Technical, medical, pedagogical, art college	0.0519	-0.0185	0.00163	0.00394	0.0129
	(0.0863)	(0.0309)	(0.00302)	(0.00658)	(0.0213)
Complete secondary education	0.140	-0.0493	0.00256	0.0103	0.0364*
	(0.0869)	(0.0308)	(0.00283)	(0.00653)	(0.0219)
Incomplete secondary education	0.242**	-0.0831**	0.000713	0.0171**	0.0653***
	(0.0946)	(0.0328)	(0.00314)	(0.00682)	(0.0249)
Managerial & professional occupation	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)
Non-manual occupation	0.187***	-0.0662***	0.00458*	0.0140***	0.0476***
	(0.0664)	(0.0236)	(0.00275)	(0.00508)	(0.0167)
Manual occupation	0.194**	-0.0684**	0.00454*	0.0145**	0.0494*
	(0.0968)	(0.0337)	(0.00273)	(0.00715)	(0.0254)
Unskilled occupation	0.294***	-0.102***	0.00244	0.0211***	0.0783***

Consumption (females) Average marginal effects	Coefficient b (b_se)	5cig margins (margins_se)	10cig margins (margins_se)	15cig margins (margins_se)	18plus margins (margins_se)
	(0.0947)	(0.0320)	(0.00374)	(0.00658)	(0.0263)
No occupation	0.225***	-0.0790***	0.00422	0.0166***	0.0582***
	(0.0712)	(0.0251)	(0.00278)	(0.00537)	(0.0182)
0 other smokers in household	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)
1 other smoker in household	0.133**	-0.0474**	0.00376	0.0101**	0.0336**
	(0.0597)	(0.0214)	(0.00254)	(0.00462)	(0.0146)
2 other smokers in household	0.286***	-0.0984***	0.00152	0.0203***	0.0766***
	(0.0784)	(0.0268)	(0.00306)	(0.00558)	(0.0210)
3 other smokers in household	0.460***	-0.152***	-0.00938	0.0296***	0.131***
	(0.110)	(0.0342)	(0.00743)	(0.00636)	(0.0333)
4-7 other smokers in household	0.458***	-0.151***	-0.00921	0.0295***	0.131***
	(0.158)	(0.0476)	(0.0115)	(0.00832)	(0.0495)
Number of adults in household	-0.0617**	0.0212**	-0.000261	-0.00438**	-0.0166**
	(0.0252)	(0.00868)	(0.000498)	(0.00180)	(0.00676)
Number of children in household	-0.0473	0.0163	-0.000200	-0.00336	-0.0127
	(0.0292)	(0.0100)	(0.000388)	(0.00206)	(0.00788)
Single	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)
Married	0.114*	-0.0403*	0.00233	0.00857*	0.0294*

Consumption (females) Average marginal effects	Coefficient b (b_se)	5cig margins (margins_se)	10cig margins (margins_se)	15cig margins (margins_se)	18plus margins (margins_se)
	(0.0667)	(0.0239)	(0.00218)	(0.00514)	(0.0169)
Divorced	0.205**	-0.0712**	0.00133	0.0149**	0.0550**
	(0.0802)	(0.0280)	(0.00248)	(0.00592)	(0.0215)
Widowed	0.233*	-0.0802*	0.000526	0.0166*	0.0631*
	(0.129)	(0.0433)	(0.00411)	(0.00877)	(0.0369)
City > 500,000 inhabitants	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)
City 50,000-500,000 inhabitants	-0.129*	0.0447*	-0.000750	-0.00927*	-0.0347*
	(0.0758)	(0.0261)	(0.00127)	(0.00544)	(0.0203)
Town <50,000 inhabitants & rural settlements	-0.0686	0.0234	0.000233	-0.00479	-0.0188
	(0.0759)	(0.0259)	(0.000699)	(0.00531)	(0.0208)
Moscow & St. Petersburg	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)
North & Northwestern	-0.187	0.0618	0.00499	-0.0123	-0.0546
	(0.116)	(0.0386)	(0.00374)	(0.00776)	(0.0336)
Central & Central Black Earth	-0.204*	0.0676*	0.00491	-0.0135*	-0.0590*
	(0.109)	(0.0364)	(0.00372)	(0.00732)	(0.0316)
Volga Basin & Volga Vaytski	-0.512***	0.181***	-0.0116	-0.0380***	-0.131***
	(0.115)	(0.0413)	(0.0101)	(0.00923)	(0.0277)
Caucasus	-0.224**	0.0744*	0.00471	-0.0149*	-0.0642**

Consumption (females) Average marginal effects	Coefficient b (b_se)	5cig margins (margins_se)	10cig margins (margins_se)	15cig margins (margins_se)	18plus margins (margins_se)
	(0.114)	(0.0382)	(0.00382)	(0.00782)	(0.0322)
Ural	-0.299***	0.101***	0.00285	-0.0207***	-0.0835***
	(0.106)	(0.0360)	(0.00423)	(0.00744)	(0.0297)
Western Siberia	-0.120	0.0387	0.00442	-0.00751	-0.0356
	(0.120)	(0.0392)	(0.00435)	(0.00770)	(0.0355)
Eastern Siberia & Far Eastern	-0.213**	0.0709**	0.00483	-0.0142**	-0.0616**
	(0.0898)	(0.0297)	(0.00390)	(0.00599)	(0.0261)
Year	0.0248***	-0.00855***	0.000105	0.00176***	0.00668***
	(0.00713)	(0.00246)	(0.000200)	(0.000527)	(0.00189)
Cut1	1.169**				
	(0.467)				
Cut2	2.135***				
	(0.467)				
Cut3	2.511***				
	(0.468)				
Observations	5,470	5,470	5,470	5,470	5,470
Degrees of freedom	30	30	30	30	30

Categories: 5cig=1-7 cigarettes; 10cig=8-12 cigarettes; 15cig=13-17 cigarettes; 18+cig=18 and more cigarettes
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender. Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.

6-G Participation with different price measures (males)

Participation (males)	(1) Average Rosstat	(2) Domestic Rosstat	(3) Domestic low RLMS	(4) Foreign Rosstat	(5) Foreign low RLMS
Probit	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)
Price	-0.031	-0.088***	-0.026***	-0.015	0.002
	(0.022)	(0.026)	(0.007)	(0.018)	(0.006)
Age in years	0.005***	0.005***	0.005***	0.005***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age in years # Age in years	***	***	***	***	***
Equivalised income per capita (real, logged)	-0.024***	-0.025***	-0.027***	-0.024***	-0.029***
	(0.005)	(0.005)	(0.006)	(0.005)	(0.006)
University education	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Technical, medical, pedagogical, art college	0.095***	0.094***	0.094***	0.095***	0.091***
	(0.018)	(0.018)	(0.019)	(0.018)	(0.019)
Complete secondary education	0.130***	0.129***	0.131***	0.130***	0.128***
	(0.015)	(0.015)	(0.016)	(0.015)	(0.017)
Incomplete secondary education	0.129***	0.127***	0.126***	0.129***	0.125***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.019)
Managerial & professional occupation	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Non-manual occupation	0.033	0.032	0.036	0.033	0.044*
	(0.022)	(0.022)	(0.023)	(0.022)	(0.023)
Manual occupation	0.052***	0.052***	0.052***	0.052***	0.059***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.016)
Unskilled occupation	0.072***	0.073***	0.067***	0.072***	0.066***
	(0.019)	(0.019)	(0.020)	(0.019)	(0.021)
No occupation	0.017	0.018	0.017	0.018	0.018
	(0.015)	(0.015)	(0.016)	(0.015)	(0.017)
0 other smokers in household	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
1 other smoker in household	0.425***	0.425***	0.431***	0.425***	0.435***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)

Participation (males)	(1) Average Rosstat	(2) Domestic Rosstat	(3) Domestic low RLMS	(4) Foreign Rosstat	(5) Foreign low RLMS
Probit	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)
2 other smokers in household	0.483***	0.483***	0.487***	0.484***	0.492***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
3 other smokers in household	0.501***	0.501***	0.519***	0.501***	0.520***
	(0.011)	(0.011)	(0.010)	(0.011)	(0.010)
4-7 other smokers in household	0.522***	0.522***	0.525***	0.522***	0.528***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Number of adults in household	-0.068***	-0.067***	-0.069***	-0.068***	-0.070***
	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)
Number of children in household	-0.040***	-0.039***	-0.040***	-0.040***	-0.042***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
Single	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Married	0.070***	0.068***	0.070***	0.070***	0.071***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.017)
Divorced	0.103***	0.104***	0.103***	0.103***	0.099***
	(0.023)	(0.023)	(0.024)	(0.023)	(0.025)
Widowed	0.095*	0.097*	0.109**	0.094*	0.108*
	(0.050)	(0.049)	(0.052)	(0.049)	(0.054)
City > 500,000 inhabitants	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
City 50,000-500,000 inhabitants	0.009	0.011	0.005	0.009	0.009
	(0.015)	(0.015)	(0.016)	(0.015)	(0.016)
Town <50,000 inhabitants & rural settlements	0.019	0.022	0.015	0.019	0.015
	(0.014)	(0.014)	(0.014)	(0.014)	(0.015)
Moscow & St. Petersburg	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
North & Northwestern	0.024	0.011	-0.029	0.026	-0.024
	(0.030)	(0.030)	(0.032)	(0.030)	(0.032)
Central & Central Black Earth	0.009	-0.006	-0.048*	0.011	-0.037
	(0.023)	(0.023)	(0.026)	(0.023)	(0.026)
Volga Basin & Volga Vaytski	0.041*	0.027	-0.022	0.042*	-0.006
	(0.022)	(0.022)	(0.025)	(0.022)	(0.025)

Participation (males)	(1) Average Rosstat	(2) Domestic Rosstat	(3) Domestic low RLMS	(4) Foreign Rosstat	(5) Foreign low RLMS
Probit	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)
Caucasus	0.009	-0.005	-0.049*	0.009	-0.042
	(0.023)	(0.023)	(0.025)	(0.023)	(0.026)
Ural	0.018	0.002	-0.039	0.020	-0.024
	(0.024)	(0.024)	(0.027)	(0.024)	(0.027)
Western Siberia	0.028	0.013	-0.040	0.027	-0.034
	(0.026)	(0.026)	(0.029)	(0.026)	(0.030)
Eastern Siberia & Far Eastern	0.035	0.028	-0.021	0.036	-0.012
	(0.024)	(0.024)	(0.027)	(0.024)	(0.027)
Year	-0.004***	-0.003***	-0.002*	-0.004***	-0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	-1.813***	-1.473***	-1.724***	-1.938***	-1.773***
	(0.314)	(0.306)	(0.265)	(0.302)	(0.275)
Observations	27,528	27,528	24,750	27,528	22,102
Degrees of freedom	30	30	30	30	30

Price measures (all in real terms and logged) : (1) the average the Rosstat prices for domestic and foreign cigarette brands, (2) Rosstat price for domestic cigarette brands, (3) RLMS low price for domestic cigarette brands, (4) Rosstat price for foreign cigarette brands, (5) RLMS low price for foreign cigarette brands
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
margins: average marginal effect; margins_se: standard error of average marginal effect
*** p<0.01 ** p<0.05 * p<0.1

6-H PARTICIPATION WITH DIFFERENT PRICE MEASURES (FEMALES)

Participation (females)	(1) Average Rosstat	(2) Domestic Rosstat	(3) Domestic low RLMS	(4) Foreign Rosstat	(5) Foreign low RLMS
Probit	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)
Price	-0.029*	0.047***	-0.005	-0.031**	-0.001
	(0.016)	(0.017)	(0.005)	(0.013)	(0.004)
Age in years	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age in years # Age in years	***	***	***	***	***
Equivalised income per capita (real, logged)	0.000	0.000	-0.003	0.001	-0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)

Participation (females)	(1) Average Rosstat	(2) Domestic Rosstat	(3) Domestic low RLMS	(4) Foreign Rosstat	(5) Foreign low RLMS
Probit	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)
University education	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Technical, medical, pedagogical, art college	0.029***	0.030***	0.035***	0.030***	0.037***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)
Complete secondary education	0.036***	0.037***	0.039***	0.037***	0.042***
	(0.009)	(0.009)	(0.010)	(0.009)	(0.010)
Incomplete secondary education	0.046***	0.048***	0.047***	0.046***	0.049***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)
Managerial & professional occupation	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Non-manual occupation	0.042***	0.041***	0.035***	0.042***	0.035***
	(0.008)	(0.008)	(0.009)	(0.008)	(0.009)
Manual occupation	0.020	0.019	0.020	0.020	0.015
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Unskilled occupation	0.023*	0.023*	0.021*	0.023*	0.021*
	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)
No occupation	0.030***	0.029***	0.030***	0.030***	0.029***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
0 other smokers in household	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
1 other smoker in household	0.445***	0.445***	0.449***	0.444***	0.451***
	(0.010)	(0.010)	(0.011)	(0.010)	(0.011)
2 other smokers in household	0.686***	0.688***	0.702***	0.685***	0.702***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.016)
3 other smokers in household	0.836***	0.837***	0.851***	0.836***	0.853***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
4-7 other smokers in household	0.904***	0.904***	0.914***	0.904***	0.912***
	(0.009)	(0.009)	(0.008)	(0.009)	(0.008)
Number of adults in household	-0.083***	-0.083***	-0.086***	-0.082***	-0.088***
	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)
Number of children in household	-0.029***	-0.029***	-0.030***	-0.029***	-0.031***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)

Participation (females)	(1) Average Rosstat	(2) Domestic Rosstat	(3) Domestic low RLMS	(4) Foreign Rosstat	(5) Foreign low RLMS
Probit	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)
Single	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Married	-0.032***	-0.030***	-0.039***	-0.032***	-0.036***
	(0.009)	(0.009)	(0.010)	(0.009)	(0.010)
Divorced	0.047***	0.047***	0.042***	0.047***	0.044***
	(0.013)	(0.013)	(0.014)	(0.013)	(0.014)
Widowed	0.047***	0.048***	0.037**	0.048***	0.036*
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
City > 500,000 inhabitants	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
City 50,000-500,000 inhabitants	-0.035***	-0.037***	-0.034***	-0.035***	-0.036***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Town <50,000 inhabitants & rural settlements	-0.076***	-0.076***	-0.072***	-0.076***	-0.069***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)
Moscow & St. Petersburg	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
North & Northwestern	0.030	0.038**	0.020	0.032*	0.023
	(0.019)	(0.019)	(0.022)	(0.019)	(0.022)
Central & Central Black Earth	-0.019	-0.011	-0.028	-0.017	-0.030
	(0.015)	(0.016)	(0.019)	(0.015)	(0.019)
Volga Basin & Volga Vaytski	-0.089***	-0.082***	-0.095***	-0.087***	-0.094***
	(0.014)	(0.014)	(0.018)	(0.014)	(0.018)
Caucasus	-0.064***	-0.060***	-0.072***	-0.061***	-0.075***
	(0.015)	(0.015)	(0.018)	(0.015)	(0.019)
Ural	-0.040***	-0.026*	-0.044**	-0.039**	-0.041**
	(0.016)	(0.016)	(0.019)	(0.015)	(0.019)
Western Siberia	-0.024	-0.022	-0.037*	-0.020	-0.030
	(0.017)	(0.017)	(0.020)	(0.017)	(0.020)
Eastern Siberia & Far Eastern	-0.026*	-0.020	-0.034*	-0.025*	-0.033*
	(0.014)	(0.014)	(0.018)	(0.014)	(0.018)
Year	0.001	0.001*	0.003***	0.001	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	-2.950***	-4.052***	-3.283***	-2.870***	-3.305***
	(0.411)	(0.391)	(0.362)	(0.393)	(0.372)

Participation (females)	(1) Average Rosstat	(2) Domestic Rosstat	(3) Domestic low RLMS	(4) Foreign Rosstat	(5) Foreign low RLMS
Probit	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)
Observations	29,182	29,182	26,165	29,182	23,479
Degrees of freedom	30	30	30	30	30

Price measures (all in real terms and logged) : (1) the average the Rosstat prices for domestic and foreign cigarette brands, (2) Rosstat price for domestic cigarette brands, (3) RLMS low price for domestic cigarette brands, (4) Rosstat price for foreign cigarette brands, (5) RLMS low price for foreign cigarette brands
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
margins: average marginal effect; margins_se: standard error of average marginal effect
*** p<0.01 ** p<0.05 * p<0.1

6-I CONSUMPTION WITH DIFFERENT PRICE MEASURES (MALES)

Consumption (males)	(1) Average Rosstat	(2) Domestic Rosstat	(3) Domestic low RLMS	(4) Foreign Rosstat	(5) Foreign low RLMS
Interval regression	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)
Price	-1.409***	1.040**	-0.116	-1.278***	-0.124
	(0.470)	(0.525)	(0.183)	(0.373)	(0.133)
Age in years	0.136***	0.135***	0.134***	0.136***	0.130***
	(0.010)	(0.010)	(0.011)	(0.010)	(0.011)
Age in years # Age in years	***	***	***	***	***
Equivalised income per capita (real, logged)	0.258**	0.270**	0.254*	0.260**	0.302**
	(0.124)	(0.124)	(0.131)	(0.124)	(0.134)
University education	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Technical, medical, pedagogical, art college	0.846**	0.841**	1.011**	0.855**	1.019**
	(0.394)	(0.394)	(0.417)	(0.394)	(0.425)
Complete secondary education	1.243***	1.256***	1.465***	1.248***	1.489***
	(0.352)	(0.352)	(0.374)	(0.352)	(0.384)
Incomplete secondary education	1.927***	1.954***	2.155***	1.932***	2.227***
	(0.384)	(0.385)	(0.408)	(0.384)	(0.422)
Managerial & professional occupation	0.000	0.000	0.000	0.000	0.000

Consumption (males)	(1) Average Rosstat	(2) Domestic Rosstat	(3) Domestic low RLMS	(4) Foreign Rosstat	(5) Foreign low RLMS
Interval regression	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Non-manual occupation	-0.048	-0.058	0.175	-0.049	0.422
	(0.504)	(0.502)	(0.548)	(0.504)	(0.563)
Manual occupation	0.877***	0.885***	0.862**	0.869***	0.962***
	(0.315)	(0.315)	(0.340)	(0.315)	(0.347)
Unskilled occupation	0.890**	0.897**	0.848**	0.884**	1.057**
	(0.380)	(0.379)	(0.407)	(0.379)	(0.421)
No occupation	-0.874**	-0.847**	-0.912**	-0.881**	-0.801**
	(0.342)	(0.342)	(0.366)	(0.342)	(0.372)
0 other smokers in household	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
1 other smoker in household	0.530**	0.537***	0.393*	0.524**	0.384*
	(0.208)	(0.208)	(0.218)	(0.208)	(0.227)
2 other smokers in household	1.376***	1.402***	1.195***	1.368***	1.118***
	(0.313)	(0.315)	(0.323)	(0.313)	(0.332)
3 other smokers in household	1.846***	1.873***	1.765***	1.832***	1.742***
	(0.463)	(0.463)	(0.502)	(0.463)	(0.530)
4-7 other smokers in household	2.390***	2.360***	1.850**	2.389***	2.070**
	(0.663)	(0.662)	(0.808)	(0.662)	(0.812)
Number of adults in household	-0.267***	-0.275***	-0.229**	-0.264***	-0.261**
	(0.098)	(0.099)	(0.108)	(0.098)	(0.111)
Number of children in household	-0.315***	-0.325***	-0.351***	-0.319***	-0.325***
	(0.107)	(0.108)	(0.115)	(0.107)	(0.119)
Single	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Married	0.974***	1.027***	1.082***	0.976***	1.067***
	(0.276)	(0.277)	(0.291)	(0.276)	(0.300)
Divorced	1.482***	1.458***	1.660***	1.476***	1.641***
	(0.402)	(0.403)	(0.425)	(0.402)	(0.452)
Widowed	1.013	1.013	1.278	1.010	1.405
	(1.201)	(1.198)	(1.231)	(1.199)	(1.161)
City > 500,000 inhabitants	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
City 50,000-500,000 inhabitants	-0.280	-0.321	-0.305	-0.292	-0.379

Consumption (males)	(1) Average Rosstat	(2) Domestic Rosstat	(3) Domestic low RLMS	(4) Foreign Rosstat	(5) Foreign low RLMS
Interval regression	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)
	(0.309)	(0.310)	(0.312)	(0.309)	(0.317)
Town <50,000 inhabitants & rural settlements	0.048	0.045	0.041	0.024	0.033
	(0.295)	(0.295)	(0.300)	(0.295)	(0.313)
Moscow & St. Petersburg	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
North & Northwestern	0.025	0.265	0.471	0.095	0.502
	(0.581)	(0.585)	(0.669)	(0.582)	(0.678)
Central & Central Black Earth	-0.297	-0.082	0.045	-0.214	0.119
	(0.433)	(0.438)	(0.545)	(0.434)	(0.543)
Volga Basin & Volga Vaytski	-1.641***	-1.481***	-1.369**	-1.563***	-1.451***
	(0.417)	(0.419)	(0.538)	(0.418)	(0.530)
Caucasus	-0.824*	-0.812*	-0.550	-0.730	-0.562
	(0.490)	(0.485)	(0.585)	(0.493)	(0.589)
Ural	-1.638***	-1.261***	-1.183**	-1.576***	-1.079*
	(0.473)	(0.481)	(0.579)	(0.473)	(0.578)
Western Siberia	-0.598	-0.663	-0.480	-0.492	-0.490
	(0.501)	(0.494)	(0.600)	(0.507)	(0.604)
Eastern Siberia & Far Eastern	-0.902**	-0.729	-0.465	-0.880*	-0.560
	(0.457)	(0.462)	(0.566)	(0.457)	(0.559)
Year	0.051*	0.059**	0.072**	0.051*	0.057*
	(0.027)	(0.027)	(0.031)	(0.027)	(0.030)
Constant	4.201**	-1.630	0.635	4.270**	1.014
	(1.956)	(1.870)	(1.669)	(1.876)	(1.727)
Constant	2.000***	2.001***	1.998***	2.000***	2.001***
	(0.012)	(0.012)	(0.013)	(0.012)	(0.013)
Observations	16,804	16,804	15,089	16,804	13,450
Degrees of freedom	30	30	30	30	30

Price measures (all in real terms and logged) : (1) the average the Rosstat prices for domestic and foreign cigarette brands, (2) Rosstat price for domestic cigarette brands, (3) RLMS low price for domestic cigarette brands, (4) Rosstat price for foreign cigarette brands, (5) RLMS low price for foreign cigarette brands
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated with interval regression and using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
margins: average marginal effect; margins_se: standard error of average marginal effect
*** p<0.01 ** p<0.05 * p<0.1

6-J Consumption with different price measures (females)

Consumption (females)	(1) Average Rosstat	(2) Domestic Rosstat	(3) Domestic low RLMS	(4) Foreign Rosstat	(5) Foreign low RLMS
Interval regression	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)
Price	-1.896**	0.838	0.173	-1.685***	0.342
	(0.740)	(0.751)	(0.282)	(0.596)	(0.218)
Age in years	0.101***	0.100***	0.123***	0.101***	0.121***
	(0.017)	(0.016)	(0.018)	(0.017)	(0.018)
Age in years # Age in years	***	***	***	***	***
Equivalised income per capita (real, logged)	0.224	0.225	0.137	0.225	0.221
	(0.143)	(0.143)	(0.162)	(0.143)	(0.170)
University education	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Technical, medical, pedagogical, art college	0.234	0.223	0.572	0.235	0.419
	(0.503)	(0.506)	(0.539)	(0.502)	(0.552)
Complete secondary education	0.830	0.812	1.189**	0.839	1.043*
	(0.525)	(0.531)	(0.567)	(0.525)	(0.569)
Incomplete secondary education	1.309**	1.347**	1.382**	1.316**	1.365**
	(0.565)	(0.570)	(0.586)	(0.563)	(0.600)
Managerial & professional occupation	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Non-manual occupation	1.050***	1.018***	1.181***	1.057***	1.253***
	(0.384)	(0.385)	(0.431)	(0.384)	(0.425)
Manual occupation	0.923*	0.924*	1.307**	0.925*	1.411**
	(0.544)	(0.547)	(0.597)	(0.543)	(0.611)
Unskilled occupation	1.705***	1.684***	1.582**	1.708***	1.681***
	(0.579)	(0.582)	(0.645)	(0.579)	(0.643)
No occupation	1.425***	1.415***	1.354***	1.426***	1.467***
	(0.439)	(0.441)	(0.489)	(0.438)	(0.499)
0 other smokers in household	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
1 other smoker in household	0.774**	0.766**	0.602	0.769**	0.528
	(0.357)	(0.359)	(0.381)	(0.357)	(0.389)
2 other smokers in household	1.697***	1.726***	1.452***	1.693***	1.275**
	(0.468)	(0.471)	(0.514)	(0.467)	(0.515)

Consumption (females)	(1) Average Rosstat	(2) Domestic Rosstat	(3) Domestic low RLMS	(4) Foreign Rosstat	(5) Foreign low RLMS
Interval regression	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)
3 other smokers in household	2.852***	2.905***	2.284***	2.849***	2.182***
	(0.742)	(0.737)	(0.683)	(0.743)	(0.704)
4-7 other smokers in household	2.488***	2.477***	3.056***	2.500***	3.161***
	(0.885)	(0.884)	(0.949)	(0.884)	(0.962)
Number of adults in household	-0.354**	-0.377***	-0.410***	-0.352**	-0.409**
	(0.141)	(0.141)	(0.157)	(0.141)	(0.159)
Number of children in household	-0.366**	-0.382**	-0.297	-0.372**	-0.297
	(0.170)	(0.171)	(0.191)	(0.170)	(0.197)
Single	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Married	0.598*	0.668*	0.261	0.605*	0.442
	(0.362)	(0.362)	(0.375)	(0.361)	(0.388)
Divorced	1.093**	1.116**	0.700	1.091**	0.776*
	(0.450)	(0.450)	(0.456)	(0.450)	(0.465)
Widowed	1.605**	1.583**	0.919	1.619**	1.108
	(0.792)	(0.792)	(0.862)	(0.790)	(0.869)
City > 500,000 inhabitants	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
City 50,000-500,000 inhabitants	-0.837**	-0.862**	-0.751*	-0.854**	-0.718*
	(0.418)	(0.417)	(0.416)	(0.418)	(0.430)
Town <50,000 inhabitants & rural settlements	-0.553	-0.438	-0.383	-0.603	-0.264
	(0.425)	(0.424)	(0.429)	(0.426)	(0.457)
Moscow & St. Petersburg	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
North & Northwestern	-1.029	-0.879	0.326	-0.924	0.243
	(0.702)	(0.704)	(0.817)	(0.704)	(0.824)
Central & Central Black Earth	-0.985	-0.876	0.429	-0.881	0.237
	(0.636)	(0.646)	(0.744)	(0.635)	(0.756)
Volga Basin & Volga Vaytski	-2.813***	-2.640***	-1.354*	-2.744***	-1.445**
	(0.621)	(0.629)	(0.755)	(0.619)	(0.733)
Caucasus	-1.244*	-1.394**	-0.154	-1.082*	-0.010
	(0.649)	(0.663)	(0.770)	(0.654)	(0.764)

Consumption (females)	(1) Average Rosstat	(2) Domestic Rosstat	(3) Domestic low RLMS	(4) Foreign Rosstat	(5) Foreign low RLMS
Interval regression	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)	margins (margins_se)
Ural	-1.871***	-1.471**	-0.282	-1.801***	-0.250
	(0.603)	(0.612)	(0.730)	(0.599)	(0.727)
Western Siberia	-0.285	-0.428	0.889	-0.182	0.823
	(0.772)	(0.768)	(0.829)	(0.778)	(0.831)
Eastern Siberia & Far Eastern	-1.226**	-1.163**	0.223	-1.175**	0.181
	(0.547)	(0.552)	(0.674)	(0.547)	(0.685)
Year	0.107***	0.132***	0.187***	0.105***	0.177***
	(0.040)	(0.038)	(0.045)	(0.040)	(0.044)
Constant	2.136	-4.510*	-4.872**	2.132	-6.166**
	(2.771)	(2.625)	(2.417)	(2.672)	(2.544)
Constant	1.825***	1.827***	1.808***	1.825***	1.801***
	(0.023)	(0.024)	(0.024)	(0.023)	(0.023)
Observations	5,470	5,470	4,504	5,470	4,127
Degrees of freedom	30	30	30	30	30

Price measures (all in real terms and logged) : (1) the average the Rosstat prices for domestic and foreign cigarette brands, (2) Rosstat price for domestic cigarette brands, (3) RLMS low price for domestic cigarette brands, (4) Rosstat price for foreign cigarette brands, (5) RLMS low price for foreign cigarette brands
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated with interval regression and using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
margins: average marginal effect; margins_se: standard error of average marginal effect
*** p<0.01 ** p<0.05 * p<0.1

6-K BASE MODEL PLUS ALCOHOL EXPENDITURE DUMMY (MALES)

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Males	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
Average of price for domestic & foreign cigarette brands (real, logged)	-0.031	-1.382***	-0.084***	-1.388***	-1.414***	-0.230***
	(0.022)	(0.475)	(0.029)	(0.459)	(0.470)	(0.067)
Equivalised income per capita (real, logged)	-0.026***	0.225*	0.016*	0.222*	0.221*	0.019
	(0.005)	(0.129)	(0.008)	(0.120)	(0.124)	(0.017)
Dummy for household that is in top quartile of alcohol expenditure	0.022***	0.586***	0.032***	0.553***	0.570***	0.082***
	(0.008)	(0.163)	(0.010)	(0.157)	(0.161)	(0.023)
Age in years	0.005***	0.139***	0.009***	0.133***	0.137***	0.089***
	(0.001)	(0.010)	(0.001)	(0.010)	(0.010)	(0.009)
Age in years # Age in years	***	***	***	***	***	-0.001***
						(0.000)
University education	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Males	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
Technical, medical, pedagogical, art college	0.096***	0.850**	0.051**	0.845**	0.870**	0.134**
	(0.018)	(0.397)	(0.024)	(0.386)	(0.395)	(0.056)
Complete secondary education	0.130***	1.288***	0.074***	1.221***	1.265***	0.184***
	(0.015)	(0.355)	(0.022)	(0.344)	(0.352)	(0.049)
Incomplete secondary education	0.129***	1.967***	0.114***	1.894***	1.948***	0.282***
	(0.018)	(0.387)	(0.024)	(0.376)	(0.384)	(0.054)
Managerial & professional occupation	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
Non-manual occupation	0.032	-0.045	-0.006	-0.063	-0.049	-0.022
	(0.022)	(0.512)	(0.033)	(0.492)	(0.504)	(0.070)
Manual occupation	0.052***	0.871***	0.050***	0.878***	0.886***	0.135***
	(0.015)	(0.321)	(0.020)	(0.306)	(0.315)	(0.045)
Unskilled occupation	0.072***	0.911**	0.053**	0.902**	0.900**	0.149***
	(0.019)	(0.386)	(0.023)	(0.370)	(0.379)	(0.055)
No occupation	0.018	-0.892**	-0.054**	-0.809**	-0.861**	-0.131***
	(0.015)	(0.349)	(0.022)	(0.332)	(0.342)	(0.049)
0 other smokers in household	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
1 other smoker in household	0.424***	0.451**	0.027**	0.482**	0.485**	0.066**

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Males	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
	(0.009)	(0.212)	(0.013)	(0.204)	(0.209)	(0.029)
2 other smokers in household	0.482***	1.288***	0.078***	1.276***	1.304***	0.196***
	(0.010)	(0.328)	(0.020)	(0.304)	(0.314)	(0.043)
3 other smokers in household	0.499***	1.707***	0.103***	1.718***	1.724***	0.273***
	(0.011)	(0.466)	(0.028)	(0.455)	(0.465)	(0.067)
4-7 other smokers in household	0.521***	2.085***	0.127***	2.207***	2.196***	0.384***
	(0.010)	(0.676)	(0.041)	(0.653)	(0.672)	(0.102)
Number of adults in household	-0.068***	-0.225**	-0.015**	-0.266***	-0.256***	-0.039***
	(0.004)	(0.103)	(0.007)	(0.095)	(0.099)	(0.013)
Number of children in household	-0.040***	-0.282***	-0.016**	-0.292***	-0.303***	-0.047***
	(0.005)	(0.108)	(0.007)	(0.104)	(0.107)	(0.015)
Single	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
Married	0.068***	0.891***	0.056***	0.933***	0.940***	0.142***
	(0.016)	(0.275)	(0.018)	(0.270)	(0.276)	(0.041)
Divorced	0.102***	1.428***	0.086***	1.394***	1.444***	0.185***
	(0.023)	(0.410)	(0.024)	(0.392)	(0.402)	(0.055)
Widowed	0.093*	1.143	0.060	0.896	0.948	0.089

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Males	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
	(0.049)	(1.278)	(0.069)	(1.166)	(1.210)	(0.147)
City > 500,000 inhabitants	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
City 50,000-500,000 inhabitants	0.010	-0.204	-0.011	-0.226	-0.224	-0.019
	(0.015)	(0.312)	(0.019)	(0.303)	(0.309)	(0.044)
Town <50,000 inhabitants & rural settlements	0.022	0.167	0.013	0.121	0.139	0.003
	(0.014)	(0.296)	(0.018)	(0.287)	(0.294)	(0.040)
Moscow & St. Petersburg	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
North & Northwestern	0.023	0.056	0.003	-0.050	-0.040	-0.019
	(0.030)	(0.581)	(0.034)	(0.570)	(0.580)	(0.082)
Central & Central Black Earth	0.010	-0.245	-0.012	-0.322	-0.306	-0.048
	(0.023)	(0.437)	(0.025)	(0.424)	(0.433)	(0.061)
Volga Basin & Volga Vaytski	0.042*	-1.565***	-0.091***	-1.601***	-1.630***	-0.232***
	(0.022)	(0.420)	(0.025)	(0.408)	(0.417)	(0.060)
Caucasus	0.009	-0.804	-0.045	-0.830*	-0.855*	-0.158**
	(0.023)	(0.495)	(0.030)	(0.479)	(0.490)	(0.069)
Ural	0.016	-1.675***	-0.100***	-1.699***	-1.718***	-0.251***
	(0.024)	(0.479)	(0.029)	(0.464)	(0.474)	(0.068)

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Males	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
Western Siberia	0.027	-0.558	-0.027	-0.645	-0.634	-0.095
	(0.026)	(0.508)	(0.030)	(0.491)	(0.501)	(0.070)
Eastern Siberia & Far Eastern	0.035	-0.790*	-0.041	-0.943**	-0.933**	-0.143**
	(0.024)	(0.460)	(0.027)	(0.446)	(0.457)	(0.064)
Year	-0.003***	0.046*	0.003	0.051*	0.052*	0.010**
	(0.001)	(0.028)	(0.002)	(0.026)	(0.027)	(0.004)
Constant	-1.805***	4.213**	2.009***	4.752**	4.300**	
	(0.314)	(1.982)	(0.124)	(1.901)	(1.956)	
Constant					2.000***	
					(0.012)	
Cut1						0.413
						(0.279)
Cut2						1.276***
						(0.280)
Cut3						1.648***
						(0.280)
Cut4						3.116***
						(0.282)

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Males	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
Observations	27,528	16,804	16,804	16,804	16,804	16,804
Degrees of freedom	31	31	31	31	31	31

Estimators: (1) probit = probit regression for probability of being a current smoker; (2) reg y = OLS on the untransformed dependent variable (daily cigarette consumption); (3) GLM (%) = (%) generalised linear model with Gaussian distribution and log link on the untransformed dependent variable (exponentiated coefficients); (4) reg midp. = OLS on the midpoints of cigarette consumption; (5) intreg = interval regression; (6) oprobit = ordered probit regression on categorical indicator of cigarette consumption
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
b: Regression coefficient; b_se: Standard error of regression coefficient
margins: average marginal effect; margins_se: standard error of average marginal effect
*** p<0.01 ** p<0.05 * p<0.1

6-L Base model plus alcohol expenditure dummy (females)

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Females	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
Average of price for domestic & foreign cigarette brands (real, logged)	-0.030*	-1.769**	-0.161**	-1.370**	-1.923***	-0.269**
	(0.016)	(0.731)	(0.071)	(0.587)	(0.741)	(0.121)

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Females	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
Equivalised income per capita (real, logged)	-0.002	0.181	0.021	0.168	0.194	0.032
	(0.003)	(0.141)	(0.014)	(0.121)	(0.144)	(0.025)
Dummy for household that is in top quartile of alcohol expenditure	0.033***	0.398*	0.029	0.404**	0.399*	0.089**
	(0.005)	(0.222)	(0.021)	(0.188)	(0.224)	(0.038)
Age in years	-0.001***	0.104***	0.010***	0.084***	0.102***	0.078***
	(0.000)	(0.016)	(0.002)	(0.014)	(0.016)	(0.018)
Age in years # Age in years	***	***	***	***	***	-0.001***
						(0.000)
University education	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
Technical, medical, pedagogical, art college	0.029***	0.218	0.012	0.154	0.227	0.051
	(0.009)	(0.500)	(0.050)	(0.417)	(0.502)	(0.086)
Complete secondary education	0.036***	0.876*	0.078	0.589	0.826	0.141
	(0.009)	(0.519)	(0.051)	(0.424)	(0.525)	(0.087)
Incomplete secondary education	0.046***	1.407**	0.121**	1.067**	1.308**	0.243***
	(0.011)	(0.555)	(0.053)	(0.463)	(0.564)	(0.094)
Managerial & professional occupation	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Females	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
Non-manual occupation	0.041***	1.132***	0.101***	0.914***	1.060***	0.189***
	(0.008)	(0.382)	(0.037)	(0.322)	(0.384)	(0.066)
Manual occupation	0.019	1.042**	0.092*	0.905*	0.933*	0.196**
	(0.012)	(0.530)	(0.050)	(0.471)	(0.542)	(0.096)
Unskilled occupation	0.023*	1.710***	0.151***	1.490***	1.727***	0.299***
	(0.012)	(0.576)	(0.051)	(0.470)	(0.580)	(0.095)
No occupation	0.030***	1.470***	0.136***	1.117***	1.426***	0.225***
	(0.009)	(0.434)	(0.041)	(0.347)	(0.440)	(0.071)
0 other smokers in household	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
1 other smoker in household	0.439***	0.754**	0.071**	0.564**	0.730**	0.124**
	(0.010)	(0.355)	(0.035)	(0.284)	(0.358)	(0.060)
2 other smokers in household	0.681***	1.718***	0.160***	1.315***	1.656***	0.277***
	(0.015)	(0.459)	(0.044)	(0.374)	(0.468)	(0.078)
3 other smokers in household	0.832***	2.861***	0.260***	2.086***	2.783***	0.444***
	(0.015)	(0.729)	(0.068)	(0.538)	(0.745)	(0.110)
4-7 other smokers in household	0.902***	2.524***	0.231***	1.975**	2.390***	0.436***
	(0.010)	(0.854)	(0.077)	(0.768)	(0.883)	(0.158)
Number of adults in household	-0.082***	-0.361***	-0.032**	-0.285**	-0.352**	-0.061**

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Females	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
	(0.003)	(0.138)	(0.013)	(0.119)	(0.142)	(0.025)
Number of children in household	-0.028***	-0.346**	-0.033**	-0.220	-0.364**	-0.047
	(0.004)	(0.169)	(0.017)	(0.144)	(0.171)	(0.029)
Single	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
Married	-0.036***	0.478	0.053	0.428	0.546	0.103
	(0.010)	(0.356)	(0.035)	(0.314)	(0.362)	(0.067)
Divorced	0.046***	1.109**	0.104**	0.867**	1.069**	0.200**
	(0.013)	(0.440)	(0.041)	(0.383)	(0.450)	(0.080)
Widowed	0.046**	1.600**	0.147**	1.066*	1.583**	0.228*
	(0.019)	(0.775)	(0.065)	(0.635)	(0.791)	(0.129)
City > 500,000 inhabitants	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
City 50,000-500,000 inhabitants	-0.033***	-0.670	-0.063	-0.617*	-0.805*	-0.122
	(0.010)	(0.414)	(0.039)	(0.358)	(0.417)	(0.076)
Town <50,000 inhabitants & rural settlements	-0.072***	-0.407	-0.034	-0.380	-0.517	-0.061
	(0.009)	(0.418)	(0.039)	(0.364)	(0.424)	(0.076)
Moscow & St. Petersburg	0.000	0.000	0.000	0.000	0.000	0.000

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Females	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
North & Northwestern	0.025	-1.172*	-0.090	-0.930	-1.079	-0.199*
	(0.019)	(0.690)	(0.063)	(0.569)	(0.699)	(0.116)
Central & Central Black Earth	-0.020	-1.124*	-0.086	-0.875*	-1.008	-0.209*
	(0.015)	(0.628)	(0.055)	(0.528)	(0.637)	(0.110)
Volga Basin & Volga Vaytski	-0.089***	-2.858***	-0.244***	-2.383***	-2.831***	-0.517***
	(0.014)	(0.614)	(0.063)	(0.539)	(0.617)	(0.114)
Caucasus	-0.066***	-1.426**	-0.119**	-1.035*	-1.279**	-0.231**
	(0.015)	(0.638)	(0.059)	(0.554)	(0.646)	(0.113)
Ural	-0.044***	-1.978***	-0.172***	-1.558***	-1.930***	-0.312***
	(0.016)	(0.595)	(0.053)	(0.512)	(0.600)	(0.106)
Western Siberia	-0.026	-0.369	-0.010	-0.568	-0.327	-0.130
	(0.017)	(0.761)	(0.072)	(0.588)	(0.772)	(0.120)
Eastern Siberia & Far Eastern	-0.028*	-1.373**	-0.103**	-1.059**	-1.249**	-0.219**
	(0.014)	(0.543)	(0.048)	(0.444)	(0.546)	(0.090)
Year	0.001	0.116***	0.009**	0.108***	0.108***	0.025***
	(0.001)	(0.039)	(0.004)	(0.034)	(0.040)	(0.007)
Constant	-2.867***	1.871	1.485***	3.638	2.359	
	(0.410)	(2.748)	(0.265)	(2.278)	(2.784)	

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Females	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
Constant					1.825***	
					(0.023)	
Cut1						1.119**
						(0.470)
Cut2						2.087***
						(0.470)
Cut3						2.463***
						(0.470)
Observations	29,182	54,70	5,470	5,470	5,470	5,470
Degrees of freedom	31	31	31	31	31	31

Estimators: (1) probit = probit regression for probability of being a current smoker; (2) reg y = OLS on the untransformed dependent variable (daily cigarette consumption); (3) GLM (%) = (%) generalised linear model with Gaussian distribution and log link on the untransformed dependent variable (exponentiated coefficients); (4) reg midp. = OLS on the midpoints of cigarette consumption; (5) intreg = interval regression; (6) oprobit = ordered probit regression on categorical indicator of cigarette consumption
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
b: Regression coefficient; b_se: Standard error of regression coefficient
margins: average marginal effect; margins_se: standard error of average marginal effect
*** p<0.01 ** p<0.05 * p<0.1

6-M BASE MODEL PLUS POWER RANK (MALES)

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Males	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
Average of price for domestic & foreign cigarette brands (real, logged)	-0.029	-1.378***	-0.084***	-1.382***	-1.406***	-0.225***
	(0.022)	(0.480)	(0.029)	(0.463)	(0.474)	(0.067)
Equivalised income per capita (real, logged)	-0.023***	0.287**	0.020**	0.281**	0.281**	0.028
	(0.005)	(0.131)	(0.008)	(0.122)	(0.126)	(0.017)
Power rank (1 lowest – 9 highest)	-0.010***	-0.227***	-0.014***	-0.230***	-0.233***	-0.037***
	(0.002)	(0.052)	(0.003)	(0.049)	(0.050)	(0.007)
Age in years	0.004***	0.131***	0.008***	0.125***	0.129***	0.085***
	(0.001)	(0.010)	(0.001)	(0.010)	(0.010)	(0.009)
Age in years # Age in years	***	***	***	***	***	-0.001***
						(0.000)
University education	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
Technical, medical, pedagogical, art college	0.092***	0.778**	0.047*	0.773**	0.797**	0.125**
	(0.018)	(0.396)	(0.024)	(0.385)	(0.394)	(0.056)
Complete secondary education	0.126***	1.220***	0.070***	1.154***	1.196***	0.175***
	(0.016)	(0.356)	(0.022)	(0.345)	(0.353)	(0.049)

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Males	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
Incomplete secondary education	0.124***	1.857***	0.107***	1.782***	1.836***	0.266***
	(0.018)	(0.389)	(0.024)	(0.378)	(0.386)	(0.054)
Managerial & professional occupation	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
Non-manual occupation	0.037*	-0.050	-0.007	-0.068	-0.054	-0.024
	(0.022)	(0.512)	(0.033)	(0.492)	(0.504)	(0.070)
Manual occupation	0.050***	0.784**	0.045**	0.792***	0.799**	0.120***
	(0.015)	(0.319)	(0.019)	(0.305)	(0.313)	(0.045)
Unskilled occupation	0.067***	0.796**	0.046**	0.787**	0.783**	0.129**
	(0.019)	(0.383)	(0.023)	(0.368)	(0.377)	(0.054)
No occupation	0.016	-1.033***	-0.063***	-0.952***	-1.006***	-0.154***
	(0.015)	(0.349)	(0.022)	(0.332)	(0.342)	(0.049)
0 other smokers in household	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
1 other smoker in household	0.423***	0.505**	0.030**	0.534***	0.538**	0.073**
	(0.009)	(0.214)	(0.013)	(0.205)	(0.210)	(0.029)
2 other smokers in household	0.481***	1.348***	0.081***	1.333***	1.362***	0.203***
	(0.010)	(0.331)	(0.020)	(0.307)	(0.317)	(0.043)

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Males	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
3 other smokers in household	0.498***	1.747***	0.105***	1.754***	1.764***	0.280***
	(0.011)	(0.465)	(0.028)	(0.454)	(0.463)	(0.066)
4-7 other smokers in household	0.520***	2.273***	0.139***	2.390***	2.384***	0.410***
	(0.010)	(0.677)	(0.040)	(0.654)	(0.673)	(0.102)
Number of adults in household	-0.067***	-0.222**	-0.015**	-0.264***	-0.253**	-0.038***
	(0.005)	(0.104)	(0.007)	(0.096)	(0.100)	(0.014)
Number of children in household	-0.039***	-0.262**	-0.014**	-0.273**	-0.285***	-0.044***
	(0.005)	(0.110)	(0.007)	(0.107)	(0.109)	(0.016)
Single	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
Married	0.070***	1.001***	0.062***	1.041***	1.050***	0.156***
	(0.016)	(0.277)	(0.018)	(0.272)	(0.278)	(0.041)
Divorced	0.101***	1.525***	0.092***	1.486***	1.537***	0.195***
	(0.023)	(0.413)	(0.025)	(0.395)	(0.406)	(0.055)
Widowed	0.086*	1.061	0.056	0.799	0.853	0.076
	(0.050)	(1.217)	(0.066)	(1.105)	(1.148)	(0.143)
City > 500,000 inhabitants	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
City 50,000-500,000 inhabitants	0.009	-0.261	-0.013	-0.279	-0.278	-0.028

	Participation	**Consumption**				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Males	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
	(0.015)	(0.313)	(0.019)	(0.304)	(0.311)	(0.044)
Town <50,000 inhabitants & rural settlements	0.018	0.084	0.010	0.043	0.059	-0.009
	(0.014)	(0.300)	(0.018)	(0.291)	(0.298)	(0.041)
Moscow & St. Petersburg	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
North & Northwestern	0.023	0.157	0.007	0.041	0.053	-0.004
	(0.030)	(0.587)	(0.034)	(0.575)	(0.585)	(0.082)
Central & Central Black Earth	0.006	-0.298	-0.015	-0.380	-0.364	-0.056
	(0.023)	(0.439)	(0.025)	(0.425)	(0.434)	(0.061)
Volga Basin & Volga Vaytski	0.036	-1.558***	-0.091***	-1.599***	-1.629***	-0.232***
	(0.022)	(0.424)	(0.025)	(0.412)	(0.420)	(0.061)
Caucasus	0.013	-0.739	-0.041	-0.769	-0.792	-0.146**
	(0.023)	(0.497)	(0.030)	(0.480)	(0.491)	(0.070)
Ural	0.018	-1.561***	-0.092***	-1.593***	-1.608***	-0.235***
	(0.024)	(0.481)	(0.029)	(0.465)	(0.475)	(0.068)
Western Siberia	0.025	-0.563	-0.029	-0.657	-0.645	-0.098
	(0.026)	(0.511)	(0.031)	(0.493)	(0.503)	(0.070)
Eastern Siberia & Far Eastern	0.033	-0.798*	-0.043	-0.955**	-0.946**	-0.144**

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Males	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
	(0.024)	(0.462)	(0.028)	(0.448)	(0.459)	(0.065)
Year	-0.003***	0.050*	0.003	0.054**	0.055**	0.011***
	(0.001)	(0.029)	(0.002)	(0.027)	(0.028)	(0.004)
Constant	-1.704***	5.316***	2.074***	5.893***	5.454***	
	(0.319)	(2.017)	(0.126)	(1.929)	(1.986)	
Constant					2.001***	
					(0.012)	
Cut1						0.248
						(0.283)
Cut2						1.106***
						(0.283)
Cut3						1.478***
						(0.283)
Cut4						2.947***
						(0.285)
Observations	26,805	16,422	16,422	16,422	16,422	16,422
Degrees of freedom	31	31	31	31	31	31

Estimators: (1) probit = probit regression for probability of being a current smoker; (2) reg y = OLS on the untransformed dependent variable (daily cigarette consumption); (3) GLM (%) = (%) generalised linear model with Gaussian distribution and log link on the untransformed dependent variable (exponentiated coefficients); (4) reg midp. = OLS on the midpoints of cigarette consumption; (5) intreg = interval regression; (6) oprobit = ordered probit regression on categorical indicator of cigarette consumption

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Males	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)

Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
b: Regression coefficient; b_se: Standard error of regression coefficient
margins: average marginal effect; margins_se: standard error of average marginal effect
*** p<0.01 ** p<0.05 * p<0.1

6-N Base model plus power rank (females)

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Females	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
Average of price for domestic & foreign cigarette brands (real, logged)	-0.031*	-1.689**	-0.155**	-1.288**	-1.847**	-0.251**
	(0.016)	(0.738)	(0.072)	(0.587)	(0.748)	(0.120)
Equivalised income per capita (real, logged)	0.001	0.226	0.024*	0.218*	0.243*	0.043*
	(0.003)	(0.142)	(0.014)	(0.123)	(0.145)	(0.025)
Power rank (1 lowest – 9 highest)	-0.002	-0.121*	-0.010	-0.134**	-0.140*	-0.029**

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Females	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
	(0.001)	(0.072)	(0.007)	(0.060)	(0.073)	(0.012)
Age in years	-0.001***	0.097***	0.009***	0.077***	0.095***	0.074***
	(0.000)	(0.017)	(0.002)	(0.014)	(0.017)	(0.018)
Age in years # Age in years	***	***	***	***	***	-0.001***
						(0.000)
University education	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
Technical, medical, pedagogical, art college	0.029***	0.181	0.009	0.112	0.181	0.042
	(0.009)	(0.501)	(0.051)	(0.418)	(0.503)	(0.086)
Complete secondary education	0.037***	0.836	0.074	0.548	0.782	0.131
	(0.010)	(0.522)	(0.052)	(0.424)	(0.528)	(0.087)
Incomplete secondary education	0.047***	1.311**	0.112**	0.961**	1.196**	0.221**
	(0.011)	(0.560)	(0.054)	(0.465)	(0.568)	(0.095)
Managerial & professional occupation	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
Non-manual occupation	0.041***	1.099***	0.101***	0.872***	1.018***	0.180***
	(0.008)	(0.382)	(0.037)	(0.321)	(0.384)	(0.066)
Manual occupation	0.019	1.052**	0.094*	0.894*	0.922*	0.192**
	(0.013)	(0.536)	(0.050)	(0.477)	(0.549)	(0.097)

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Females	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
Unskilled occupation	0.021*	1.742***	0.155***	1.502***	1.742***	0.298***
	(0.012)	(0.585)	(0.051)	(0.476)	(0.590)	(0.096)
No occupation	0.031***	1.436***	0.135***	1.069***	1.381***	0.215***
	(0.009)	(0.431)	(0.041)	(0.347)	(0.437)	(0.071)
0 other smokers in household	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
1 other smoker in household	0.448***	0.804**	0.074**	0.619**	0.784**	0.134**
	(0.010)	(0.357)	(0.035)	(0.285)	(0.361)	(0.060)
2 other smokers in household	0.686***	1.755***	0.163***	1.353***	1.698***	0.283***
	(0.015)	(0.463)	(0.044)	(0.376)	(0.472)	(0.079)
3 other smokers in household	0.837***	2.981***	0.269***	2.188***	2.890***	0.465***
	(0.014)	(0.735)	(0.069)	(0.543)	(0.751)	(0.111)
4-7 other smokers in household	0.904***	2.663***	0.242***	2.148***	2.563***	0.473***
	(0.010)	(0.872)	(0.078)	(0.778)	(0.899)	(0.159)
Number of adults in household	-0.083***	-0.361***	-0.032**	-0.284**	-0.351**	-0.061**
	(0.003)	(0.139)	(0.013)	(0.120)	(0.143)	(0.025)
Number of children in household	-0.029***	-0.346**	-0.033*	-0.219	-0.368**	-0.046
	(0.004)	(0.171)	(0.017)	(0.145)	(0.173)	(0.030)

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Females	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
Single	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
Married	-0.032***	0.575	0.063*	0.529*	0.653*	0.124*
	(0.010)	(0.361)	(0.035)	(0.317)	(0.367)	(0.068)
Divorced	0.047***	1.171***	0.111***	0.936**	1.145**	0.216***
	(0.014)	(0.444)	(0.041)	(0.387)	(0.454)	(0.081)
Widowed	0.047**	1.651**	0.153**	1.118*	1.646**	0.240*
	(0.019)	(0.780)	(0.066)	(0.634)	(0.794)	(0.129)
City > 500,000 inhabitants	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
City 50,000-500,000 inhabitants	-0.035***	-0.714*	-0.066*	-0.667*	-0.853**	-0.133*
	(0.010)	(0.415)	(0.039)	(0.359)	(0.418)	(0.076)
Town <50,000 inhabitants & rural settlements	-0.075***	-0.431	-0.035	-0.407	-0.542	-0.067
	(0.009)	(0.425)	(0.039)	(0.368)	(0.430)	(0.077)
Moscow & St. Petersburg	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
North & Northwestern	0.025	-1.186*	-0.093	-0.939	-1.095	-0.201*
	(0.019)	(0.700)	(0.064)	(0.573)	(0.709)	(0.117)
Central & Central Black Earth	-0.024	-1.189*	-0.091*	-0.937*	-1.077*	-0.221**

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Females	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
	(0.016)	(0.628)	(0.055)	(0.526)	(0.637)	(0.109)
Volga Basin & Volga Vaytski	-0.092***	-2.855***	-0.244***	-2.374***	-2.830***	-0.516***
	(0.014)	(0.629)	(0.065)	(0.552)	(0.632)	(0.117)
Caucasus	-0.067***	-1.473**	-0.125**	-1.069*	-1.322**	-0.238**
	(0.015)	(0.645)	(0.060)	(0.559)	(0.653)	(0.114)
Ural	-0.043***	-1.946***	-0.171***	-1.512***	-1.898***	-0.302***
	(0.016)	(0.602)	(0.054)	(0.512)	(0.607)	(0.107)
Western Siberia	-0.027	-0.350	-0.009	-0.545	-0.310	-0.125
	(0.017)	(0.767)	(0.073)	(0.590)	(0.778)	(0.120)
Eastern Siberia & Far Eastern	-0.030**	-1.385**	-0.105**	-1.070**	-1.268**	-0.222**
	(0.015)	(0.551)	(0.049)	(0.448)	(0.555)	(0.091)
Year	0.001	0.120***	0.010**	0.114***	0.113***	0.026***
	(0.001)	(0.039)	(0.004)	(0.034)	(0.040)	(0.007)
Constant	-2.898***	2.177	1.508***	3.964*	2.720	
	(0.417)	(2.747)	(0.265)	(2.272)	(2.781)	
Constant					1.828***	
					(0.024)	
Cut1						1.047**

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Females	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
						(0.469)
Cut2						2.009***
						(0.468)
Cut3						2.385***
						(0.469)
Observations	28,425	5,368	5,368	5,368	5,368	5,368
Degrees of freedom	31	31	31	31	31	31

Estimators: (1) probit = probit regression for probability of being a current smoker; (2) reg y = OLS on the untransformed dependent variable (daily cigarette consumption); (3) GLM (%) = (%) generalised linear model with Gaussian distribution and log link on the untransformed dependent variable (exponentiated coefficients); (4) reg midp. = OLS on the midpoints of cigarette consumption; (5) intreg = interval regression; (6) oprobit = ordered probit regression on categorical indicator of cigarette consumption
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
b: Regression coefficient; b_se: Standard error of regression coefficient
margins: average marginal effect; margins_se: standard error of average marginal effect
*** p<0.01 ** p<0.05 * p<0.1

6-O BASE MODEL PLUS SMOKING LENGTH (MALES)

	Participation	**Consumption**				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Males	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
Average of price for domestic & foreign cigarette brands (real, logged)	-0.031	-1.375***	-0.083***	-1.454***	-1.463***	-0.247***
	(0.022)	(0.480)	(0.029)	(0.467)	(0.477)	(0.068)
Equivalised income per capita (real, logged)	-0.024***	0.209	0.015*	0.202*	0.202	0.018
	(0.005)	(0.129)	(0.008)	(0.122)	(0.126)	(0.017)
Dummy for smoking length (1 if smokes 10 years or more)		2.137***	0.154***	2.051***	2.108***	0.329***
		(0.316)	(0.021)	(0.307)	(0.315)	(0.047)
Age in years	0.005***	0.090***	0.005***	0.086***	0.088***	0.049***
	(0.001)	(0.013)	(0.001)	(0.012)	(0.013)	(0.011)
Age in years # Age in years	***	***	***	***	***	-0.000***
						(0.000)
University education	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
Technical, medical, pedagogical, art college	0.095***	0.798**	0.047*	0.775**	0.799**	0.124**
	(0.018)	(0.399)	(0.024)	(0.388)	(0.397)	(0.057)
Complete secondary education	0.130***	1.194***	0.068***	1.120***	1.159***	0.170***
	(0.015)	(0.354)	(0.022)	(0.345)	(0.353)	(0.050)

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Males	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
Incomplete secondary education	0.129***	1.799***	0.104***	1.718***	1.769***	0.258***
	(0.018)	(0.388)	(0.023)	(0.378)	(0.387)	(0.054)
Managerial & professional occupation	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
Non-manual occupation	0.033	-0.131	-0.014	-0.151	-0.134	-0.034
	(0.022)	(0.517)	(0.033)	(0.499)	(0.510)	(0.071)
Manual occupation	0.052***	0.813**	0.047**	0.810***	0.824***	0.124***
	(0.015)	(0.316)	(0.019)	(0.304)	(0.311)	(0.045)
Unskilled occupation	0.072***	0.851**	0.049**	0.823**	0.828**	0.135**
	(0.019)	(0.384)	(0.023)	(0.370)	(0.379)	(0.055)
No occupation	0.017	-0.960***	-0.058***	-0.881***	-0.928***	-0.144***
	(0.015)	(0.346)	(0.022)	(0.333)	(0.341)	(0.049)
0 other smokers in household	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
1 other smoker in household	0.425***	0.530**	0.032**	0.532***	0.542***	0.073**
	(0.009)	(0.208)	(0.013)	(0.202)	(0.206)	(0.029)
2 other smokers in household	0.483***	1.497***	0.091***	1.451***	1.488***	0.220***
	(0.010)	(0.325)	(0.020)	(0.308)	(0.316)	(0.044)
3 other smokers in household	0.501***	1.718***	0.102***	1.689***	1.707***	0.274***

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Males	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
	(0.011)	(0.454)	(0.027)	(0.448)	(0.456)	(0.067)
4-7 other smokers in household	0.522***	2.481***	0.150***	2.550***	2.557***	0.434***
	(0.010)	(0.657)	(0.039)	(0.644)	(0.660)	(0.101)
Number of adults in household	-0.068***	-0.264***	-0.018***	-0.293***	-0.287***	-0.042***
	(0.004)	(0.099)	(0.006)	(0.095)	(0.097)	(0.014)
Number of children in household	-0.040***	-0.316***	-0.017**	-0.327***	-0.339***	-0.053***
	(0.005)	(0.110)	(0.007)	(0.106)	(0.109)	(0.016)
Single	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
Married	0.070***	0.816***	0.047***	0.874***	0.880***	0.134***
	(0.016)	(0.278)	(0.018)	(0.273)	(0.279)	(0.042)
Divorced	0.103***	1.337***	0.076***	1.311***	1.357***	0.173***
	(0.023)	(0.413)	(0.024)	(0.395)	(0.406)	(0.056)
Widowed	0.095*	1.416	0.071	1.152	1.214	0.126
	(0.050)	(1.309)	(0.069)	(1.190)	(1.236)	(0.150)
City > 500,000 inhabitants	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
City 50,000-500,000 inhabitants	0.009	-0.192	-0.010	-0.232	-0.227	-0.022

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Males	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
	(0.015)	(0.312)	(0.019)	(0.303)	(0.310)	(0.045)
Town <50,000 inhabitants & rural settlements	0.019	0.049	0.008	0.010	0.022	-0.017
	(0.014)	(0.295)	(0.018)	(0.287)	(0.293)	(0.041)
Moscow & St. Petersburg	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(.)
North & Northwestern	0.024	0.021	0.001	-0.054	-0.049	-0.018
	(0.030)	(0.583)	(0.034)	(0.572)	(0.582)	(0.082)
Central & Central Black Earth	0.009	-0.250	-0.012	-0.331	-0.313	-0.049
	(0.023)	(0.435)	(0.025)	(0.423)	(0.431)	(0.061)
Volga Basin & Volga Vaytski	0.041*	-1.566***	-0.091***	-1.610***	-1.639***	-0.232***
	(0.022)	(0.418)	(0.025)	(0.407)	(0.415)	(0.060)
Caucasus	0.009	-0.887*	-0.051*	-0.859*	-0.895*	-0.161**
	(0.023)	(0.494)	(0.030)	(0.480)	(0.490)	(0.070)
Ural	0.018	-1.521***	-0.091***	-1.554***	-1.567***	-0.228***
	(0.024)	(0.477)	(0.029)	(0.462)	(0.472)	(0.068)
Western Siberia	0.028	-0.626	-0.033	-0.688	-0.683	-0.095
	(0.026)	(0.495)	(0.030)	(0.482)	(0.491)	(0.070)
Eastern Siberia & Far Eastern	0.035	-0.887*	-0.049*	-1.027**	-1.022**	-0.151**
	(0.024)	(0.459)	(0.027)	(0.446)	(0.456)	(0.065)

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Males	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
Year	-0.004***	0.058**	0.003*	0.060**	0.062**	0.011***
	(0.001)	(0.028)	(0.002)	(0.027)	(0.028)	(0.004)
Constant	-1.813***	8.355***	2.280***	8.997***	8.602***	
	(0.314)	(2.079)	(0.129)	(2.009)	(2.063)	
Constant					1.995***	
					(0.012)	
Cut1						-0.279
						(0.298)
Cut2						0.584**
						(0.298)
Cut3						0.958***
						(0.298)
Cut4						2.433***
						(0.300)
Observations	27,528	15,743	15,743	15,743	15,743	15,743
Degrees of freedom	30	31	31	31	31	31

Estimators: (1) probit = probit regression for probability of being a current smoker; (2) reg y = OLS on the untransformed dependent variable (daily cigarette consumption); (3) GLM (%) = (%) generalised linear model with Gaussian distribution and log link on the untransformed dependent variable (exponentiated coefficients); (4) reg midp. = OLS on the midpoints of cigarette consumption; (5) intreg = interval regression; (6) oprobit = ordered probit regression on categorical indicator of cigarette consumption

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Males	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)

Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
b: Regression coefficient; b_se: Standard error of regression coefficient
margins: average marginal effect; margins_se: standard error of average marginal effect
*** p<0.01 ** p<0.05 * p<0.1

6-P BASE MODEL PLUS SMOKING LENGTH (FEMALES)

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Females	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
Average of price for domestic & foreign cigarette brands (real, logged)	-0.029*	-1.750**	-0.163**	-1.380**	-1.932**	-0.271**
	(0.016)	(0.740)	(0.071)	(0.591)	(0.750)	(0.122)
Equivalised income per capita (real, logged)	0.000	0.189	0.020	0.187	0.205	0.036
	(0.003)	(0.139)	(0.013)	(0.120)	(0.142)	(0.025)
Dummy for smoking length (1 if smokes 10 years or more)		2.129***	0.198***	1.862***	2.151***	0.420***
		(0.316)	(0.030)	(0.283)	(0.323)	(0.063)

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Females	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
Age in years	0.029*	0.003*	0.019	0.027*	0.018	0.029*
	(0.020)	(0.002)	(0.018)	(0.020)	(0.020)	(0.020)
Age in years # Age in years	*	*		*	-0.000	*
					(0.000)	
University education	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(.)	(0.000)
Technical, medical, pedagogical, art college	0.162	0.005	0.105	0.172	0.041	0.162
	(0.508)	(0.051)	(0.421)	(0.509)	(0.087)	(0.508)
Complete secondary education	0.688	0.060	0.439	0.624	0.108	0.688
	(0.521)	(0.051)	(0.425)	(0.527)	(0.088)	(0.521)
Incomplete secondary education	1.143**	0.096*	0.836*	1.038*	0.192**	1.143**
	(0.562)	(0.054)	(0.468)	(0.569)	(0.096)	(0.562)
Managerial & professional occupation	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(.)	(0.000)
Non-manual occupation	1.189***	0.106***	0.994***	1.127***	0.208***	1.189***
	(0.383)	(0.037)	(0.325)	(0.385)	(0.068)	(0.383)
Manual occupation	1.068**	0.095*	0.944**	0.977*	0.204**	1.068**
	(0.534)	(0.050)	(0.472)	(0.545)	(0.097)	(0.534)

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Females	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
Unskilled occupation	1.664***	0.153***	1.460***	1.662***	0.292***	1.664***
	(0.575)	(0.051)	(0.468)	(0.580)	(0.095)	(0.575)
No occupation	1.348***	0.127***	1.021***	1.306***	0.206***	1.348***
	(0.434)	(0.042)	(0.348)	(0.440)	(0.072)	(0.434)
0 other smokers in household	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(.)	(0.000)
1 other smoker in household	0.697*	0.065*	0.531*	0.686*	0.118*	0.697*
	(0.357)	(0.035)	(0.287)	(0.361)	(0.061)	(0.357)
2 other smokers in household	1.867***	0.171***	1.480***	1.833***	0.315***	1.867***
	(0.461)	(0.043)	(0.376)	(0.470)	(0.079)	(0.461)
3 other smokers in household	2.579***	0.234***	2.024***	2.537***	0.437***	2.579***
	(0.685)	(0.063)	(0.553)	(0.700)	(0.114)	(0.685)
4-7 other smokers in household	2.429***	0.219***	2.035***	2.367***	0.460***	2.429***
	(0.860)	(0.077)	(0.789)	(0.886)	(0.163)	(0.860)
Number of adults in household	-0.315**	-0.027**	-0.264**	-0.316**	-0.057**	-0.315**
	(0.139)	(0.013)	(0.121)	(0.143)	(0.026)	(0.139)
Number of children in household	-0.316*	-0.029*	-0.193	-0.332*	-0.044	-0.316*
	(0.169)	(0.017)	(0.145)	(0.171)	(0.030)	(0.169)
Single	0.000	0.000	0.000	0.000	0.000	0.000

	Participation	**Consumption**				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Females	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
	(0.000)	(0.000)	(0.000)	(0.000)	(.)	(0.000)
Married	0.528	0.054	0.489	0.589	0.115*	0.528
	(0.359)	(0.035)	(0.316)	(0.365)	(0.068)	(0.359)
Divorced	1.150***	0.105**	0.898**	1.102**	0.208**	1.150***
	(0.444)	(0.041)	(0.386)	(0.455)	(0.081)	(0.444)
Widowed	1.750**	0.153**	1.266**	1.713**	0.269**	1.750**
	(0.754)	(0.062)	(0.643)	(0.767)	(0.131)	(0.754)
City > 500,000 inhabitants	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(.)	(0.000)
City 50,000-500,000 inhabitants	-0.634	-0.060	-0.565	-0.771*	-0.109	-0.634
	(0.417)	(0.039)	(0.362)	(0.422)	(0.077)	(0.417)
Town <50,000 inhabitants & rural settlements	-0.272	-0.023	-0.261	-0.379	-0.032	-0.272
	(0.419)	(0.038)	(0.364)	(0.425)	(0.077)	(0.419)
Moscow & St. Petersburg	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(.)	(0.000)
North & Northwestern	-1.235*	-0.093	-1.025*	-1.152	-0.223*	-1.235*
	(0.699)	(0.064)	(0.574)	(0.708)	(0.118)	(0.699)
Central & Central Black Earth	-1.210*	-0.088	-0.982*	-1.085*	-0.236**	-1.210*

	Participation	Consumption				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Females	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
	(0.622)	(0.055)	(0.522)	(0.633)	(0.110)	(0.622)
Volga Basin & Volga Vaytski	-2.657***	-0.219***	-2.199***	-2.598***	-0.481***	-2.657***
	(0.622)	(0.064)	(0.548)	(0.624)	(0.117)	(0.622)
Caucasus	-1.424**	-0.118*	-1.077*	-1.281*	-0.244**	-1.424**
	(0.650)	(0.061)	(0.566)	(0.658)	(0.117)	(0.650)
Ural	-1.966***	-0.166***	-1.521***	-1.885***	-0.310***	-1.966***
	(0.601)	(0.054)	(0.514)	(0.603)	(0.107)	(0.601)
Western Siberia	-0.504	-0.019	-0.687	-0.475	-0.157	-0.504
	(0.727)	(0.067)	(0.579)	(0.740)	(0.120)	(0.727)
Eastern Siberia & Far Eastern	-1.399**	-0.104**	-1.094**	-1.261**	-0.228**	-1.399**
	(0.549)	(0.049)	(0.449)	(0.553)	(0.092)	(0.549)
Year	0.096**	0.007*	0.091***	0.086**	0.021***	0.096**
	(0.039)	(0.004)	(0.035)	(0.040)	(0.007)	(0.039)
Constant	-2.950***	6.988**	1.976***	8.042***	7.550***	
	(0.411)	(2.859)	(0.273)	(2.377)	(2.898)	
Constant					1.818***	
					(0.023)	
Cut1						0.115
						(0.499)

	Participation	**Consumption**				
	(1) probit	(2) reg y	(3) glm (%)	(4) reg midp.	(5) intreg	(6) oprobit
Females	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)
Cut2						1.089**
						(0.499)
Cut3						1.465***
						(0.499)
Observations	29,182	5,173	5,173	5,173	5,173	5,173
Degrees of freedom	30	31	31	31	31	31

Estimators: (1) probit = probit regression for probability of being a current smoker; (2) reg y = OLS on the untransformed dependent variable (daily cigarette consumption); (3) GLM (%) = (%) generalised linear model with Gaussian distribution and log link on the untransformed dependent variable (exponentiated coefficients); (4) reg midp. = OLS on the midpoints of cigarette consumption; (5) intreg = interval regression; (6) oprobit = ordered probit regression on categorical indicator of cigarette consumption
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
b: Regression coefficient; b_se: Standard error of regression coefficient
margins: average marginal effect; margins_se: standard error of average marginal effect
*** p<0.01 ** p<0.05 * p<0.1

6-Q CONSUMPTION MODEL ESTIMATED WITH LINEAR AND COUNT DATA ESTIMATORS (MALES)

Males	(1) reg y margins/ (margins_se)	(2) glm (unit) margins/ (margins_se)	(3) reg midp. margins/ (margins_se)	(4) intreg margins/ (margins_se)	(5) poisson margins/ (margins_se)	(6) neg. binomial margins/ (margins_se)
Average of price for domestic & foreign cigarette brands (real, logged)	-1.377***	-1.422***	-1.384***	-1.409***	-1.349***	-1.296***
	(0.475)	(0.487)	(0.459)	(0.470)	(0.477)	(0.476)
Equivalised income per capita (real, logged)	0.263**	0.310**	0.258**	0.258**	0.251*	0.209*
	(0.129)	(0.140)	(0.120)	(0.124)	(0.130)	(0.125)
Age in years	0.138***	0.126***	0.132***	0.136***	0.127***	0.127***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Age in years # Age in years	***	***	***	***	***	***
University education	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Technical, medical, pedagogical, art college	0.825**	0.787**	0.822**	0.846**	0.805**	0.822**
	(0.397)	(0.390)	(0.385)	(0.394)	(0.384)	(0.382)
Complete secondary education	1.266***	1.180***	1.200***	1.243***	1.215***	1.251***
	(0.355)	(0.351)	(0.344)	(0.352)	(0.344)	(0.342)
Incomplete secondary education	1.944***	1.870***	1.873***	1.927***	1.894***	1.915***
	(0.386)	(0.383)	(0.375)	(0.384)	(0.378)	(0.377)
Managerial & professional occupation	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Males	(1) reg y margins/ (margins_se)	(2) glm (unit) margins/ (margins_se)	(3) reg midp. margins/ (margins_se)	(4) intreg margins/ (margins_se)	(5) poisson margins/ (margins_se)	(6) neg. binomial margins/ (margins_se)
Non-manual occupation	-0.044	-0.097	-0.062	-0.048	-0.041	-0.009
	(0.512)	(0.542)	(0.492)	(0.504)	(0.526)	(0.520)
Manual occupation	0.862***	0.855**	0.870***	0.877***	0.822**	0.795**
	(0.321)	(0.328)	(0.307)	(0.315)	(0.321)	(0.320)
Unskilled occupation	0.900**	0.895**	0.891**	0.890**	0.900**	0.897**
	(0.386)	(0.396)	(0.370)	(0.380)	(0.386)	(0.381)
No occupation	-0.905***	-0.890**	-0.822**	-0.874**	-0.953***	-1.010***
	(0.349)	(0.360)	(0.332)	(0.342)	(0.349)	(0.343)
0 other smokers in household	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
1 other smoker in household	0.497**	0.498**	0.525***	0.530**	0.464**	0.441**
	(0.211)	(0.215)	(0.203)	(0.208)	(0.210)	(0.209)
2 other smokers in household	1.362***	1.414***	1.346***	1.376***	1.364***	1.335***
	(0.327)	(0.353)	(0.304)	(0.313)	(0.340)	(0.334)
3 other smokers in household	1.832***	1.921***	1.836***	1.846***	1.918***	1.929***
	(0.463)	(0.498)	(0.453)	(0.463)	(0.496)	(0.504)
4-7 other smokers in household	2.285***	2.450***	2.395***	2.390***	2.446***	2.447***
	(0.666)	(0.746)	(0.644)	(0.663)	(0.747)	(0.755)
Number of adults in household	-0.236**	-0.264**	-0.276***	-0.267***	-0.232**	-0.208**

Males	(1) reg y margins/ (margins_se)	(2) glm (unit) margins/ (margins_se)	(3) reg midp. margins/ (margins_se)	(4) intreg margins/ (margins_se)	(5) poisson margins/ (margins_se)	(6) neg. binomial margins/ (margins_se)
	(0.103)	(0.111)	(0.095)	(0.098)	(0.106)	(0.104)
Number of children in household	-0.294***	-0.270**	-0.303***	-0.315***	-0.329***	-0.375***
	(0.107)	(0.116)	(0.104)	(0.107)	(0.112)	(0.110)
Single	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Married	0.926***	0.950***	0.965***	0.974***	1.014***	1.055***
	(0.275)	(0.293)	(0.270)	(0.276)	(0.282)	(0.277)
Divorced	1.467***	1.478***	1.431***	1.482***	1.503***	1.510***
	(0.410)	(0.415)	(0.392)	(0.402)	(0.401)	(0.394)
Widowed	1.209	1.058	0.958	1.013	1.262	1.408
	(1.269)	(1.166)	(1.157)	(1.201)	(1.174)	(1.182)
City > 500,000 inhabitants	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
City 50,000-500,000 inhabitants	-0.262	-0.230	-0.281	-0.280	-0.253	-0.271
	(0.312)	(0.321)	(0.303)	(0.309)	(0.313)	(0.310)
Town <50,000 inhabitants & rural settlements	0.075	0.150	0.033	0.048	0.076	0.024
	(0.297)	(0.309)	(0.288)	(0.295)	(0.300)	(0.297)
Moscow & St. Petersburg	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
North & Northwestern	0.124	0.109	0.014	0.025	0.120	0.132

Males	(1) reg y margins/ (margins_se)	(2) glm (unit) margins/ (margins_se)	(3) reg midp. margins/ (margins_se)	(4) intreg margins/ (margins_se)	(5) poisson margins/ (margins_se)	(6) neg. binomial margins/ (margins_se)
	(0.583)	(0.594)	(0.571)	(0.581)	(0.587)	(0.588)
Central & Central Black Earth	-0.236	-0.198	-0.313	-0.297	-0.239	-0.263
	(0.437)	(0.441)	(0.424)	(0.433)	(0.439)	(0.441)
Volga Basin & Volga Vaytski	-1.576***	-1.540***	-1.612***	-1.641***	-1.566***	-1.581***
	(0.420)	(0.426)	(0.409)	(0.417)	(0.423)	(0.425)
Caucasus	-0.771	-0.751	-0.799*	-0.824*	-0.764	-0.771
	(0.496)	(0.510)	(0.479)	(0.490)	(0.505)	(0.505)
Ural	-1.593***	-1.598***	-1.622***	-1.638***	-1.560***	-1.523***
	(0.479)	(0.490)	(0.463)	(0.473)	(0.480)	(0.476)
Western Siberia	-0.520	-0.443	-0.610	-0.598	-0.512	-0.562
	(0.509)	(0.529)	(0.491)	(0.501)	(0.518)	(0.513)
Eastern Siberia & Far Eastern	-0.757	-0.687	-0.912**	-0.902**	-0.741	-0.775*
	(0.461)	(0.473)	(0.446)	(0.457)	(0.463)	(0.460)
Year	0.046	0.043	0.050*	0.051*	0.051*	0.058**
	(0.028)	(0.030)	(0.026)	(0.027)	(0.028)	(0.028)
Constant	4.111**	2.004***	4.657**	4.201**	1.963***	1.930***
	(1.982)	(0.124)	(1.901)	(1.956)	(0.121)	(0.120)
Constant				2.000***		
				(0.012)		

Males	(1) reg y margins/ (margins_se)	(2) glm (unit) margins/ (margins_se)	(3) reg midp. margins/ (margins_se)	(4) intreg margins/ (margins_se)	(5) poisson margins/ (margins_se)	(6) neg. binomial margins/ (margins_se)
lnalpha						-1.921***
						(0.030)
Observations	16,804	16,804	16,804	16,804	16,804	16,804
Degrees of freedom	30	30	30	30	30	30

Estimators: (1) reg y = OLS on the untransformed dependent variable; (2)) glm(unit) = generalised linear model with Gaussian distribution and log link on the untransformed dependent variable; (3) reg midp. = OLS on the midpoints of cigarette consumption; (4) intreg = interval regression; (5) poisson = poisson regression on the untransformed dependent variable; (6) = negative binomial on the untransformed dependent variable
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
b: Regression coefficient; b_se: Standard error of regression coefficient
margins: average marginal effect; margins_se: standard error of average marginal effect
*** p<0.01 ** p<0.05 * p<0.1

6-R Consumption model estimated with linear and count data estimators (females)

Females	(1) reg y margins/ (margins_se)	(2) glm (unit) margins/ (margins_se)	(3) reg midp. margins/ (margins_se)	(4) intreg margins/ (margins_se)	(5) poisson margins/ (margins_se)	(6) neg. binomial margins/ (margins_se)
Average of price for domestic & foreign cigarette brands (real, logged)	-1.742**	-1.770**	-1.817**	-1.896**	-1.717**	-1.674**
	(0.730)	(0.794)	(0.710)	(0.740)	(0.724)	(0.696)
Equivalised income per capita (real, logged)	0.211	0.255*	0.216	0.224	0.211	0.182

Females	(1) reg y margins/ (margins_se)	(2) glm (unit) margins/ (margins_se)	(3) reg midp. margins/ (margins_se)	(4) intreg margins/ (margins_se)	(5) poisson margins/ (margins_se)	(6) neg. binomial margins/ (margins_se)
	(0.140)	(0.149)	(0.137)	(0.143)	(0.141)	(0.137)
Age in years	0.103***	0.093***	0.097***	0.101***	0.093***	0.093***
	(0.016)	(0.015)	(0.016)	(0.017)	(0.015)	(0.015)
Age in years # Age in years	***	***	***	***	***	***
University education	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Technical, medical, pedagogical, art college	0.225	0.130	0.201	0.234	0.209	0.274
	(0.500)	(0.529)	(0.480)	(0.503)	(0.490)	(0.475)
Complete secondary education	0.881*	0.853	0.767	0.830	0.837	0.843*
	(0.519)	(0.544)	(0.503)	(0.525)	(0.502)	(0.484)
Incomplete secondary education	1.408**	1.341**	1.214**	1.309**	1.387**	1.435***
	(0.556)	(0.576)	(0.541)	(0.565)	(0.542)	(0.528)
Managerial & professional occupation	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Non-manual occupation	1.121***	1.079***	0.987***	1.050***	1.101***	1.115***
	(0.382)	(0.392)	(0.367)	(0.384)	(0.372)	(0.365)
Manual occupation	1.032*	0.957*	0.853*	0.923*	1.010**	1.048**
	(0.531)	(0.534)	(0.518)	(0.544)	(0.518)	(0.513)

Females	(1) reg y margins/ (margins_se)	(2) glm (unit) margins/ (margins_se)	(3) reg midp. margins/ (margins_se)	(4) intreg margins/ (margins_se)	(5) poisson margins/ (margins_se)	(6) neg. binomial margins/ (margins_se)
Unskilled occupation	1.688***	1.640***	1.627***	1.705***	1.642***	1.640***
	(0.575)	(0.567)	(0.557)	(0.579)	(0.550)	(0.548)
No occupation	1.469***	1.486***	1.355***	1.425***	1.439***	1.400***
	(0.433)	(0.441)	(0.421)	(0.439)	(0.424)	(0.415)
0 other smokers in household	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
1 other smoker in household	0.798**	0.783**	0.726**	0.774**	0.774**	0.771**
	(0.353)	(0.363)	(0.341)	(0.357)	(0.344)	(0.338)
2 other smokers in household	1.758***	1.804***	1.608***	1.697***	1.736***	1.691***
	(0.459)	(0.486)	(0.447)	(0.468)	(0.461)	(0.452)
3 other smokers in household	2.929***	3.095***	2.688***	2.852***	2.996***	2.940***
	(0.726)	(0.855)	(0.718)	(0.742)	(0.760)	(0.726)
4-7 other smokers in household	2.621***	2.736***	2.318***	2.488***	2.706***	2.681***
	(0.857)	(0.961)	(0.847)	(0.885)	(0.929)	(0.925)
Number of adults in household	-0.363***	-0.360**	-0.331**	-0.354**	-0.365**	-0.369***
	(0.138)	(0.147)	(0.134)	(0.141)	(0.142)	(0.141)
Number of children in household	-0.348**	-0.366**	-0.352**	-0.366**	-0.336**	-0.318*
	(0.168)	(0.185)	(0.163)	(0.170)	(0.171)	(0.164)
Single	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Females	(1) reg y margins/ (margins_se)	(2) glm (unit) margins/ (margins_se)	(3) reg midp. margins/ (margins_se)	(4) intreg margins/ (margins_se)	(5) poisson margins/ (margins_se)	(6) neg. binomial margins/ (margins_se)
Married	0.530	0.617	0.548	0.598*	0.571	0.537
	(0.356)	(0.371)	(0.341)	(0.362)	(0.360)	(0.358)
Divorced	1.133**	1.172***	1.011**	1.093**	1.159***	1.154***
	(0.440)	(0.454)	(0.428)	(0.450)	(0.440)	(0.437)
Widowed	1.622**	1.674**	1.513**	1.605**	1.603**	1.580**
	(0.776)	(0.768)	(0.760)	(0.792)	(0.744)	(0.753)
City > 500,000 inhabitants	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
City 50,000-500,000 inhabitants	-0.702*	-0.719*	-0.802**	-0.837**	-0.706*	-0.700*
	(0.415)	(0.434)	(0.396)	(0.418)	(0.422)	(0.423)
Town <50,000 inhabitants & rural settlements	-0.443	-0.410	-0.546	-0.553	-0.438	-0.459
	(0.419)	(0.436)	(0.404)	(0.425)	(0.426)	(0.425)
Moscow & St. Petersburg	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
North & Northwestern	-1.122	-1.006	-0.959	-1.029	-1.106	-1.187*
	(0.693)	(0.722)	(0.673)	(0.702)	(0.694)	(0.690)
Central & Central Black Earth	-1.101*	-0.976	-0.889	-0.985	-1.079*	-1.172*
	(0.626)	(0.638)	(0.606)	(0.636)	(0.635)	(0.644)
Volga Basin & Volga Vaytski	-2.840***	-2.609***	-2.638***	-2.813***	-2.795***	-2.939***

Females	(1) reg y margins/ (margins_se)	(2) glm (unit) margins/ (margins_se)	(3) reg midp. margins/ (margins_se)	(4) intreg margins/ (margins_se)	(5) poisson margins/ (margins_se)	(6) neg. binomial margins/ (margins_se)
	(0.617)	(0.653)	(0.590)	(0.621)	(0.621)	(0.607)
Caucasus	-1.392**	-1.327*	-1.152*	-1.244*	-1.370**	-1.434**
	(0.641)	(0.675)	(0.620)	(0.649)	(0.648)	(0.643)
Ural	-1.919***	-1.860***	-1.778***	-1.871***	-1.901***	-1.947***
	(0.598)	(0.599)	(0.573)	(0.603)	(0.597)	(0.605)
Western Siberia	-0.327	-0.080	-0.239	-0.285	-0.281	-0.424
	(0.761)	(0.869)	(0.743)	(0.772)	(0.780)	(0.746)
Eastern Siberia & Far Eastern	-1.350**	-1.162**	-1.157**	-1.226**	-1.307**	-1.428***
	(0.543)	(0.556)	(0.525)	(0.547)	(0.541)	(0.541)
Year	0.115***	0.103**	0.097**	0.107***	0.118***	0.128***
	(0.039)	(0.042)	(0.038)	(0.040)	(0.039)	(0.039)
Constant	1.648	1.465***	2.898	2.136	1.493***	1.504***
	(2.736)	(0.264)	(2.652)	(2.771)	(0.246)	(0.241)
Constant				1.825***		
				(0.023)		
lnalpha						-1.511***
						(0.039)
Observations	16,804	16,804	16,804	16,804	16,804	16,804
Degrees of freedom	30	30	30	30	30	30

	(1) reg y	(2) glm (unit)	(3) reg midp.	(4) intreg	(5) poisson	(6) neg. binomial
Females	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)	margins/ (margins_se)

Estimators: (1) reg y = OLS on the untransformed dependent variable; (2)) glm(unit) = generalised linear model with Gaussian distribution and log link on the untransformed dependent variable; (3) reg midp. = OLS on the midpoints of cigarette consumption; (4) intreg = interval regression; (5) poisson = poisson regression on the untransformed dependent variable; (6) = negative binomial on the untransformed dependent variable
Based on the pooled representative sample for 2001-2010, restricted to working-age individuals (males 15-59/ females 15-54) and estimated separately by gender.
Estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
b: Regression coefficient; b_se: Standard error of regression coefficient
margins: average marginal effect; margins_se: standard error of average marginal effect
*** p<0.01 ** p<0.05 * p<0.1

7 The dynamics of cigarette consumption

7.1 INTRODUCTION

In the previous chapter, within the context of a static demand model, we addressed the microeconometric challenges stemming from the count and individual recall nature of the dependent variable in our data. In addressing these complexities, we deliberately put to one side the opportunity that the RLMS data offers us to exploit the longitudinal nature of the data. In presenting our static demand specification we therefore made two strong assumptions: first, we assumed away the possibility of unobserved longitudinal effects and second, we assumed that an individual's cigarette consumption, in this period, is independent of their cigarette consumption in the previous period. While these assumptions represented necessary simplifications as we focussed our attention on the peculiarities of our data, neither one of the claims stands up to either conceptual or empirical scrutiny. Relaxing these assumptions is therefore the task we set ourselves in this chapter.

In the case of the first assumption, the benefits of panel data in controlling for the bias inducing, individual unobserved characteristics which are potentially important determinants of smoking behaviour are well-rehearsed. The second assumption is less frequently addressed – as it is methodologically more complex to resolve – but it is no less important. Indeed, in the case of cigarette consumption, empirically we know that there is a statistical correlation within individuals and between periods, meaning that individuals who smoked one packet of cigarettes per day in the previous period are statistically likely to smoke a similar amount in the current period.

However, far from being a statistical nuisance, this is something that makes conceptual sense to us. In part, because consumption habits over any good are a reflection of enduring individual tastes and preferences and in part because we know that cigarettes are addictive, and therefore my smoking them this period, increases my likelihood of smoking them next period, independent of my tastes and preferences. We therefore find ourselves returned to the chapter 5 discussion of the 'addiction' and 'habit formation' literature and drawn into the notoriously tricky challenge of dealing with persistence in the dependent variable.

To set this out more concretely, smoking choices (whether to and how much) are a product of individual choices and exposures which evolve over time reflective of individual tastes and preferences, laws and regulations concerning cigarette availability, public perceptions of smoking, community level promotion of healthy behaviours, individual relationships, social networks, individual health shocks (including those experienced by friends, colleagues and relatives) and exposure to health care and health advice. This being the case, individual smoking consumption behaviour is what we refer to as ‘state-dependent’ and so the static analysis of chapter 6 is likely to be misspecified. Indeed, it could be the case that some of the unobserved persistent effects referred to above are erroneously captured by other observed variables in the static analysis.

This being so, the presence of serial correlation in the pooled cross-sectional error terms, far from being a statistical artefact, is actually a property of the underlying data generating process that requires modelling. Once we accept this logic, then we have a natural and necessary link with the literature on smoking addiction since, whether implicitly or explicitly, the bulk of that literature assumes an underlying persistence in the way the data is generated. So, whether developed within the frame of habit formation more generally or as a certain form of addiction, accounting for the persistence of consumption, naturally moves us from a static to a dynamic modelling framework. While of interest in and of itself, accounting for dynamics in cigarette consumption also has important policy implications since it is possible that the effects of price on demand are biased in static model results. At the very least then, dynamic estimates serve as a robustness check for the main claims of the static approach.

The rest of the chapter proceeds as follows: Section 2 discusses the additional econometric challenges as we move to a dynamic framework. In section 3 we outline our empirical approach. Section 4 presents the results and is followed by a more detailed discussion in section 5.

7.2 ECONOMETRIC APPROACH

FROM A STATIC TO A DYNAMIC DEMAND MODEL

To begin, we adapt our empirical model from the previous chapter by including a subscript t alongside the subscript i to reflect the reality that we have repeated observations at the individual level:

$$Y_{it} = \beta_o + \beta_1 P_{it} + \beta_2 X_{it} + v_{it} \qquad t = 1,2,\ldots,T \qquad (1)$$

$$v_{it} = u_i + \varepsilon_{it} \qquad (2)$$

where $\beta_1 P_{it}$ are the current period prices of cigarettes, $\beta_2 X_{it}$ is our $K \times 1$ vector of observable variables that can contain variables that (1) change across t but not i, (2) change across i but not t (e.g. the regional indicators), and (3) variables that change across t and i (e.g. income), and ε_{it} is a composite error consisting of time-invariant, unobserved individual effects (u_i) and serially uncorrelated, idiosyncratic errors (ε_{it}). In the following we refer to u_i as individual effects, and ε_{it} as disturbances or errors. Whereas the distinction into time-varying versus time-constant variables, and permanent individual effects versus idiosyncratic error is not very important in the static model (since we treat the data as a pooled cross-section), it becomes crucial when we move towards panel data models that take into account the time dimension, i.e. the fact that we have observations for the same individual at different periods of time and that we want to model the type of persistence we referred to in the introduction.

EFFECTS MODELS

While the pooled OLS approach fails to take account of time and individual variation in behaviour by exploiting the time dimension, the use of panel analysis enables richer hierarchical structures to be used, more complicated models to be formed, and observable and unobservable individual heterogeneity to be controlled for. The different parameter values for each individual and the fixed effects that panel data allows for is likely to be important in the examination of cigarette consumption because individual characteristics and behaviour differences might well be ‘fixed effects’ which influence variations in cigarette consumption for individual smokers. By being able to net these effects out, we may therefore get a more precise estimation of e.g. the role of price or income. As our descriptive statistics in chapter 4 have shown, there is sufficient variation across i and t for the benefits of panel analysis to be exploited.

The two main approaches to the fitting of models using panel data, fixed effects and random effects, differ in their treatment of u_i. In particular, if we believe that the unobservable individual-level effects are correlated with the explanatory variables, omitted variable bias will render OLS approaches biased and inconsistent. Fixed effects regression (FE) treats u_i as a time-invariant "fixed effect" which in the context of cigarette consumption (at least over short panels) may refer to the social attitudes towards smoking, the policies of the transnational tobacco companies, fashions, tastes, geography, regional history etc. These are all factors which could simultaneously affect both smoking habits and the explanatory variables. Furthermore, fixed effects regression relaxes the assumption that the regression function is constant over time and space and permits each cross-sectional unit to have its own constant term. It does so by removing the u_i from the estimation using the within-transformation, effectively removing panel-level averages from each side of equation (1), at the practical cost of dropping any characteristic which does not vary over each individual and hence has no 'within' variation. If the constant term is equal across individuals (which can be tested with an F-test) then the FE model is efficient and pooled OLS will produce inconsistent estimates.

By comparison, random effects (RE) estimates assume that the u_i are uncorrelated with the explanatory variables and the overall disturbance term, such that the individual level effects are simply parameterized as additional random disturbances so that equation (1) contains a composite error term as shown in equation (2). As a result the RE model allows for identification of the time-invariant variables since the 'de-meaning' is only partial. The RE model is estimated using generalised least squares (GLS) which, like OLS, is a matrix weighted average of the within and between estimators. The Hausman test, the null hypothesis of which is that the orthogonality conditions imposed by the RE model are valid, is used to access whether the RE model is appropriate.

While these effects models offer a route into exploiting the panel dimension of the data in order to control more thoroughly for observed and unobserved heterogeneity, as explained in the introduction, we have a sound conceptual, empirical and theoretical basis to believe that there is persistence in the behaviour of the dependent variable, in the sense that it is a function of its own past levels. We therefore need to go further.

MODELLING PERSISTENCE

If our prior about persistence in the dependent variable is correct we need a robust estimator for the dynamic equation (3) below.

$$Y_{it} = \beta_o + \alpha Y_{it-1} + \beta_1 P_{it} + \beta_2 X_{it} + \nu_{it} \qquad t = 1,2,\dots,T \qquad (3)$$

Equation (3) is the basic setup of a so-called first-order autoregressive model (AR(1)) in which the dependent variable depends linearly on its once-lagged past values. When we add the lagged dependent variable to the right-hand side of equation (3), i.e. to our set of regressors, the strict exogeneity of the regressors (no correlation between the regressors and the error term in *each* time period) is no longer plausible. This introduces a number of problems when applying OLS to dynamic models.[64] First, by construction the lags of the dependent variable Y_{it-1} will be correlated with the constant individual effects u_i in the error term. In the static setting, as explained above, we could address the resulting bias by using a fixed effects approach. However, while this removes the correlation between the error term and the regressors by eliminating u_i, in the dynamic case the demeaning process creates a further correlation between the regressor and the disturbances ε_{it}, giving rise to so-called 'dynamic panel bias' (Nickell, 1981). The mean of the lagged dependent variable contains observations 0 through $(T-1)$ on Y, and the mean error contains contemporaneous values of ε_{it} for $t = 1,\dots,T$. The resulting correlation creates a bias in the estimate of the coefficient on the lagged dependent variable which is not mitigated by increasing the number of individual units N. Thus, even when applying the within-estimator to purge the individual effects, the estimates remain biased in dynamic models, with the bias implying underestimation of the coefficient for lagged consumption (Nickell, 1981). The same problem is present in the random effects (RE) approach since the u_i error component enters every value of Y_{it} by assumption (since it is constant over time), so that Y_{it-1} cannot be independent of the composite error process (Baum, 2006).

In addition to this dynamic panel bias (i.e. correlation between elements of the observed regressors and the idiosyncratic error term), the inclusion of the lagged dependent variable may give rise to serial correlation (i.e. correlation between the disturbances over time),

[64] The problems outlined in the following apply equally to models using forward lags, such as the demand models based on the Rational Addiction framework.

which will make the bias still more severe. In general, while the fixed effects approach will underestimate the effect of Y_{it-1} (Roodman, 2009), applying OLS to equation (3) will have the opposite effect in that it will inflate the coefficient on Y_{it-1} since it attributes some predictive power from the unobserved effect u_i to Y_{it-1}.

Another way to look at the above is that, whether or not we are assuming correlation between individual effects and the regressors, dynamic models face an endogeneity problem in the sense of standard reverse causality due to the correlation between the lagged dependent variable and the idiosyncratic component of the error. One potential solution to this problem is to use first differences to estimate equation (1) in an attempt to remove the endogeneity. First difference models only require weak (sequential) exogeneity, in that the differenced error term should be uncorrelated with the differenced explanatory variable terms. This is a much weaker requirement than the FE or RE models have because it allows future values of the regressors to be correlated with the error term. However, this does not solve our problem because the lagged dependent variable is a function itself of the remaining lagged explanatory variables. That is, in our case, lagged cigarette consumption would capture the dynamics of all of the explanatory variables, based on the erroneous assumption that those dynamics are identical.

This leaves us in need of some form of instrumental variable (IV) strategy, independently of or in conjunction with (i) methods to address unobserved heterogeneity and (ii) methods to correct for serial correlation, if we are to obtain consistent estimates in a dynamic framework. In the following section we discuss different approaches, building up from cross-sectional IV estimators to panel data IV estimators which implement both IV and unobserved effects methods.

ENDOGENEITY IN PANEL DATA MODELS

As mentioned above, a key implication of adding lagged dependent variables to the right-hand side of equation (1) is that the strict exogeneity assumption of the covariates necessarily breaks down. While in static models, we distinguish between endogenous regressors (correlated with the current period disturbances) and strictly exogenous variables (uncorrelated with the disturbances in all periods), in the dynamic context this becomes more complex because we additionally have so-called predetermined or sequentially exogenous covariates which, while independent of current disturbances, are not strictly exogenous since they may be correlated with past disturbances. The lagged dependent variable is an example of such a predetermined regressor – it was determined in $t - 1$ and thus is a function of past covariates and the past disturbance. The distinction into strictly exogenous and predetermined becomes useful when we move to dynamic panel models that try to address both the correlation between the regressors and the disturbances (reverse causality) as well as the potential correlation between regressors and the individual effects, since predetermined variables can serve as their own instruments. For example, Y_{it-2} is likely to be correlated with Y_{it-1} but not with the disturbance in time t. This fact is used by dynamic panel data estimators in justifying the use of lags from within the model as instruments, rather than having to search from outside of the model for exogenous instruments. While the classification into endogenous, predetermined and exogenous covariates is a matter of judgement, Table 7.1 below provides some examples for each of the categories. The respondent's age can safely be considered as strictly exogenous, whereas lagged cigarette consumption and lagged prices are predetermined, if not contemporaneously endogenous.

Table 7.1 Classification of covariates for instrumental variable estimation

Contemporaneously endogenous	**Sequentially exogenous (predetermined)**	**Strictly exogenous**
Correlated with current (and possibly past) disturbances	Independent of current errors, but potentially correlated with past disturbances	Uncorrelated with disturbances in all time periods
Lagged cigarette consumption	Lagged cigarette consumption	Age
Cigarette prices	Lagged cigarette prices	Gender

If we were to estimate equation (3) using pooled OLS we would ignore the endogeneity of lagged consumption and control for unobserved heterogeneity only through the inclusion of our set of demographic characteristics – so this can be seen as the most naïve approach in that it ignores all of the problems outlined above. While we can address potential omitted variable bias due to unobserved heterogeneity by using a FE and RE estimator, this still leaves us with the endogeneity problem, so a natural first step to improve the model is to find an instrumental variable for the lagged dependent variable Y_{it-1}, which we can use in the FE and RE framework. Consider our model from equation

(3) where, for simplification, we supress the subscript $_{it}$ and subsume all observable regressors under the $K \times 1$ vector X

$$Y = \beta_o + \beta X + \theta Z + \nu \tag{4}$$

In general, a suitable $r \times 1$ vector of instruments z for an endogenous variable x_k , with $r \geq K$, is a variable that is (1) uncorrelated with the error term, (2) correlated with x_k conditional on the other exogenous variables, and (3) strongly correlated with x_k rather than weakly correlated. Conditions (1) and (2) are required for consistency, whereas the third condition ensures good finite sample performance of the IV estimator (Cameron and Trivedi, 2005). If the first condition fails, z is an invalid instrument. If the second condition fails the instrument is irrelevant, which may lead to the model not being identified if there are too few relevant instruments. While the second condition can be tested, the first one has to be argued since it involves judgements about the unobservable regression error (Wooldridge, 2010). If the third condition fails the instrument is weak and the model therefore only weakly identified. Thus, in the context of equation (3) a suitable instrument z_{it} for endogenous lagged consumption Y_{it-1} is a variable that is sufficiently correlated with Y_{it-1}, but does not directly affect (is uncorrelated with) current period consumption Y_{it}. In the empirical literature on cigarette demand, lags of cigarette prices (and leads in the Rational Addiction specification) are commonly used as instruments, following the approach taken in Becker et al. (1994). The idea behind this is that when modelling lagged endogenous behaviour (i.e. lagged consumption), previous exogenous covariates (predetermined covariates) serve as implicit instrumental variables for the lagged endogenous variables since they directly influence past, but not current period behaviour.

In a multiple regression model, some components of X and z may be shared. That is, X may contain both strictly exogenous regressors that are uncorrelated with ε_{it} and therefore qualify as potential instruments, and endogenous regressors correlated with ε_{it}. If we partition X into $X = [X'_1 X'_2]'$, where X_1 contains endogenous regressors, and X_2 contains exogenous regressors, then a valid instrument is Z= $[Z'_1 X'_2]'$, where X_2 can instrument for itself, but we need to find at least as many instruments Z_1 as there are endogenous variables in X_1. When the number of instrumental variables equals the number of endogenous regressors, the model is referred to as ‘just-identified’, while if the number of instruments exceeds the number of endogenous variables, the model is ‘over-identified’. For a just-identified model, the IV estimator is given by:

$$\hat{\beta}_{IV} = (\boldsymbol{Z}'\boldsymbol{X})^{-1}\boldsymbol{Z}'\boldsymbol{y} \tag{5}$$

$\hat{\beta}_{IV}$ requires that the number of instruments equals the number of endogenous regressors. If we have more than one instrumental variable for the endogenous variable x_k, for example, lagged cigarette prices and lagged income, or two lags of cigarette prices, then we could have as many IV estimators as instruments, or many more since any linear combination of the instruments is uncorrelated with ε_{it}. In this case the two-stage least squares (2SLS) estimator which, out of all possible linear combinations of Z that can be used as an instrument for x_k, chooses the combination that is most highly correlated with x_k (i.e. the strongest instrument), is considered the most efficient estimator (Wooldridge, 2010). To obtain consistent estimates of β, the 2SLS estimator performs two consecutive OLS regressions (thus the name two-stage least squares). In the first stage, the endogenous variable x_k is regressed on the instruments Z and X in order to obtain the fitted values, $\hat{x}_{k.}$ The second stage then involves OLS of the dependent variable on X, where x_k is replaced by $\hat{x}_k$ to obtain $\hat{\beta}_{2SLS}$. This approach allows for overidentification since the first-stage regression essentially ‘whittles down’ the available number of instruments to the number of endogenous variables. 2SLS is the predominant estimator employed in cross-sectional IV applications and implemented in standard software packages.

Dynamic panel data estimators (DPD estimators)

Given that a key advantage of panel data is the ability to control for permanent unobserved effects due to the repeated observations for the same unit of observation (individual, household, firm, country) over multiple time periods, a number of IV applications in the panel data context have been developed that can deal both with correlation between the lagged dependent (and other endogenous variables) and the idiosyncratic error, and correlation between the unobserved effect u_i and the regressors. This family of so-called dynamic panel data estimators (DPD) exploit the time structure of the data to create instruments from within the data, rather than searching for strictly exogenous instrumental variables from elsewhere, as is the case in the standard IV applications. The first DPD estimator goes back to Anderson and Hsiao (1982) who suggested a first-differenced 2SLS estimator.

Consider again our model from equation (3), reproduced as (6) below. First differencing it yields equation (7), but a correlation between the differenced lagged dependent variable $\triangle Y_{it-1}$ and the idiosyncratic error $\triangle \varepsilon_{it}$ remains.

$$Y_{it} = \beta_o + \alpha Y_{it-1} + \beta_1 P_{it} + \beta_2 X_{it} + u_i + \varepsilon_{it} \tag{6}$$

$$\triangle Y_{it} = \alpha \triangle Y_{it-1} + \beta_1 \triangle P_{it} + \beta_2 \triangle X_{it} + \triangle \varepsilon_{it} \tag{7}$$

That is, the $\triangle Y_{it-1}$ contains Y_{it-1} and $\triangle \varepsilon_{it}$ contains ε_{it-1}, also referred to as the first-order moving average process, or MA(1). However, in contrast to the demeaning transformation within the effects framework, in which the correlation is present in *all* time periods t, we can now construct instruments from the second and third lags of Y_{it} (in either differences or in lagged levels) since these will be necessarily uncorrelated with $\triangle \varepsilon_{it}$, if ε_{it} is distributed i.i.d. In other words, the deeper lags or differences (e.g. $(\Delta)Y_{it-2}$ and $(\Delta)Y_{it-3}$ etc) will not be serially correlated with $\triangle \varepsilon_{it}$ but will be highly correlated with, and thus a valid instrument for, ΔY_{it}. Instrumenting with levels is often preferable to preserve sample size, particularly in unbalanced panels where differenced lags magnify gaps in the time series.

Arellano and Bond (1991) argued that the Anderson-Hsiao estimator (AH) is not efficient when $T > 3$ since it does not exploit all the available information in the sample, i.e. not all the available instruments in the form of using lags beyond $t - 3$. However, in the standard 2SLS framework using longer lags runs into problems since observations for which lagged observations are unavailable are dropped in the first-stage regression, so that increasing the number of lags typically comes at the cost of a smaller sample (Roodman, 2009). Arellano and Bond therefore proposed an extension of the AH-estimator within a General Methods of Moment (GMM) framework, building on earlier work by Holtz-Eakin et al. (1988).

In contrast to 2SLS where missing values of the lags force the deletion of that row from the dataset, Holtz-Eakin et al. build a set of instruments, starting from the second lag as in the AH-estimator, and with one instrument per time period, but substitute zeroes for the missing values, yielding the so-called ‘GMM-style’ instruments. While this might seem like arbitrary imputation for the missing values, it is based on the expectation that

$E(y_{it-2}v_{it}^{*}) = 0$, that is, the twice lagged and deeper lagged values of the dependent variable are uncorrelated with the transformed errors and thus valid instruments. Equations (8) and (9) show the implications of the 2SLS and GMM approach for the resulting instrument matrix:

2SLS $$Z_i = \begin{pmatrix} \cdot \\ y_{i1} \\ \vdots \\ y_{iT-2} \end{pmatrix} \tag{8}$$

GMM $$\begin{pmatrix} 0 & 0 & \dots & 0 \\ y_{i1} & 0 & \dots & 0 \\ 0 & y_{i2} & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & & \dots & y_{iT-2} \end{pmatrix} \tag{9}$$

While both approaches only use the second lag of y_{it} as an instrument in each period,[65] the GMM approach will not delete any rows from the instrument matrix. This feature of GMM thus eliminates the trade-off between lag length and sample length in the 2SLS framework and thus enables using longer lags of the endogenous variables as instruments, as proposed by Arellano and Bond (1991), without losing additional degrees of freedom.

Before turning to the Arellano-Bond estimator, we briefly come back to the notion of predetermined variables, since an important feature that distinguishes DPD estimators from standard IV estimators is that they allow for both endogenous (contemporaneously correlated) and predetermined (previously correlated) regressors. To recap, under strict exogeneity we assume that the disturbances and regressors are uncorrelated in each time period, so that ε_{it} cannot affect X_{is} for any s or t. This requires that ε_{it} is unrelated to, for example, $prices_{is}$ or $income_{is}$, which means that a negative shock in prices or income cannot cause a decrease in cigarette consumption in the next period. This is clearly a very strong assumption, which is relaxed when we conceive of these variables as predetermined. For predetermined variables, ε_{it} has to be orthogonal to X_{is} for $s \leq t$ but can be correlated with X_{is} for $s > t$. The GMM-type moment conditions make use of the assumption of predeterminedness to generate additional instruments. That is, they assume that particular levels of the dependent variable are orthogonal to the differenced

[65] That is, the first row of the matrix corresponds to time $t = 2$, where in this example we have a gap, leading to deletion of this row under 2SLS and substitution with 0 in GMM. In the second row, corresponding to $t = 3$, y_{i1} is a valid instrument (constituting the second lag of y_{it} in period 3).

disturbances. This differs from the standard IV moment conditions which are formed using strictly exogenous covariates only.

DIFFERENCE GMM

As mentioned above, Arellano and Bond (1991) argued that the efficiency of the AH-estimator can be improved by using further lags as instruments in cases where $\mathrm{T} > 3$. The estimator they suggested therefore uses all valid lags of the untransformed variables as instruments, i.e. entering in levels, which for an endogenous variable means lags 2 and beyond, and for predetermined variables the first lag and beyond. For example, for the lagged dependent variable y_{it-1}, which is predetermined, we can use observations y_{it-2} and earlier. This approach can easily generate a large number of instruments, since by period T all lags prior to $T-2$ might be individually considered as instruments, which is best illustrated with an example: Going back to equation (6), current cigarette consumption can be modelled as a function of previous cigarette consumption, the price of cigarettes, and a vector of k strictly exogenous socioeconomic, demographic and regional variables:

$$Y_{it} = \beta_o + \alpha Y_{it-1} + \beta_1 P_{it} + \beta_2 X_{it} + u_i + \varepsilon_{it} \qquad t = 1, \ldots, 10 \qquad (10)$$

For simplicity, we assume that the only endogenous regressor is lagged cigarette consumption Y_{it-1} . In this case, the exogenous variables k each contribute one instrument. The remaining instruments come from the $T-2$ instruments available in periods $T = 3,\ 4,\ 5,\ 6,\ 7,\ 8,\ 9,\ 10$. For example:

In period 3: y_{i1} is a valid instrument for Δy_{i3}

In period 4: y_{i1} and y_{i2} are valid instruments for Δy_{i4}

In period 5: y_{i1}, y_{i2} and y_{i3} are valid instruments for Δy_{i5}

In period 6: y_{i1}, y_{i2}, y_{i3} and y_{i4} are valid instruments for Δy_{i6}

and so on.

So in a model with one lag of the dependent variable, k strictly exogenous variables and $T = T-2$ periods from which we can form moment equations, there are $k + T \times (T + 1)/2$ moment conditions (Wooldridge, 2010). This illustrates how the GMM framework can easily accumulate instruments, since by period T all lags prior to $T-2$ might be individually considered as instruments. Expressed in matrix form:

$$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & \cdots \\ y_{i1} & 0 & 0 & 0 & 0 & 0 & \cdots \\ 0 & y_{i2} & y_{i1} & 0 & 0 & 0 & \cdots \\ 0 & 0 & 0 & y_{i3} & y_{i2} & y_{i1} & \cdots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \ddots \end{pmatrix} \quad (11)$$

or collapsed into a single column

$$\begin{pmatrix} 0 & 0 & 0 & \cdots \\ y_{i1} & 0 & 0 & \cdots \\ y_{i2} & y_{i1} & 0 & \cdots \\ y_{i3} & y_{i2} & y_{i1} & \cdots \\ \vdots & \vdots & \vdots & \ddots \end{pmatrix} \quad (12)$$

Collapsing the instrument matrix into a single column still conveys the same expectation (as in number of lags used) but carries less information since it only produces a single moment condition (column), instead of one condition for each time period and lag available in that time period (Baum, 2006). Entering the instruments in collapsed form is a means of reducing the instrument count without restricting the lag ranges used.

The Arellano-Bond estimator is commonly referred to as 'difference GMM' since it was originally proposed using the first-difference transformation to remove the individual effects u_i . However, as mentioned before, one weakness of the first-difference transformation is that this approach magnifies gaps in unbalanced panels (Roodman, 2009). For example, if cigarette consumption y_{it} is missing for some individuals, then both Δy_{it} and Δy_{it+1} will be missing for those individuals. The same applies to any missing values of the other regressors. To prevent large losses in sample size, Arellano and Bover (1995) therefore proposed a transformation called 'forward orthogonal deviations'. Whereas the first difference approach transforms the data by subtracting the previous observation from the current one ($\Delta \mathrm{y}_{it} = y_{it} - y_{it-1}$) , the orthogonal deviations transformation subtracts the average of *all* future available observations, irrespective of gaps in the data, meaning that except for the last observation for each individual, the transformed values are computable no matter how many gaps there are. Furthermore, since the transformation does not use lagged observations of the variables, the first lags remain valid instruments (in contrast to the first-difference transformation where only lags beyond $T - 2$ are available as instruments). The formula for this transformation is given by:

$$w_{it+1}^{\perp} \equiv c_{it}\left(w_{it} - \frac{1}{T_{it}}\sum_{s>t} w_{is}\right) \tag{9}$$

where w is a particular variable, T_{it} are the available future observations, and c_{it} is a scale factor that equalises the variances using $\sqrt{T_{it}/(T_{it}+1)}$. An additional advantage of this procedure is that the disturbances remain homoscedastic after the transformation, whereas the first-difference transformation tends to make successive errors correlated since the differenced variables in two subsequent periods share common terms, e.g. ε_{it-1} appears in both $\Delta\varepsilon_{it}$ and $\Delta\varepsilon_{it-1}$. However, as we will see below, the assumption of homoscedastic errors is rarely used with DPD estimators, so that the data preserving property is the major aim for using orthogonal deviations (Roodman, 2009).

The challenge in estimating our model using the difference GMM estimator is that while all the instruments are theoretically uncorrelated with the error term, $E(z\varepsilon) = 0$, trying to force the corresponding vector of empirical moments to zero creates a system with more equations than variables, that is, similar to the 2SLS context, the model is overidentified. Since it is not possible to satisfy all moment conditions at the same time, the GMM estimator tries to minimize the magnitude of the vector of the instruments and disturbances. A detailed derivation of the GMM estimator is beyond the scope of this chapter, so instead, in Table 7.2 below we offer a brief summary of the properties of the GMM estimator:[66]

Table 7.2 Properties of the GMM estimator

Consistency:	The GMM estimator is consistent, meaning that under appropriate conditions it converges in probability to β as sample size goes to infinity. But as with 2SLS, it is in general biased since in finite samples, the instruments are almost always at least slightly correlated with the endogenous components of the instrumented regressors.
Efficiency:	GMM estimators weight the vector of sample-average moment conditions by the inverse of a positive definite matrix. When that matrix is the covariance matrix of moment conditions, we have an efficient GMM estimator.
Feasibility:	So far we have assumed that the errors (ε_{it}) are distributed i.i.d. so that there is no serial correlation. When we expect more complex variance patterns, such as heteroskedasticity or serially correlated errors, the following options are available: Heteroskedasticity: Estimate robust 'sandwich' errors similar to adjustments for heteroskedasticity in standard OLS (or use orthogonal deviations).

[66] For an excellent and detailed exposition of GMM estimation see Roodman (2009).

Autocorrelation: Use a two-step GMM estimator. The two-step procedure performs an initial GMM regression using an arbitrary approximation of the covariance matrix, e.g. under the assumption of homoskedasticity. In the second step it then uses the first-stage residuals to estimate the covariance matrix. Although the large-sample robust variance-covariance matrix of the two-step estimator is already robust in theory, Windmeijer (2005) found that it typically yields standard errors that are downward biased. He therefore suggested a small-sample correction for the two-step standard errors. In sum, two-step estimation with corrected errors seems modestly superior to cluster-robust one-step estimation (Roodman, 2009).

SYSTEM GMM

A few years after the proposition of the difference GMM estimator, Arellano and Bover (1995) and Blundell and Bond (1998) argued that this estimator performs poorly if the autoregressive process is close to a random walk (i.e. too persistent). In this case, the lagged levels convey little information about future changes and are therefore weak instruments for the differenced endogenous variables. They propose an estimator, commonly known as 'system GMM', which instead of transforming the regressors by first differencing, transforms the instruments with a view to making them exogenous to the individual effects u_i. The approach relies on the assumption that changes in any of the instrumenting variables w are uncorrelated with the individual effects, that is, $E(\Delta w_{it}\, u_i) = 0$ for for all i and t, which is to say that the relationship between w_{it} and u_i is constant over time. Under this assumption, the lagged first-differences Δw_{it-1} can be used to instrument for the endogenous (predetermined) variables in levels. The intuition behind the system GMM approach is that for variables that are random-walk, past changes (i.e. differences) may be a better predictor of the current levels, thus instrumenting variables in levels with differences, instead of the opposite way around.

Similar to the difference GMM, the errors are assumed to be i.i.d. and a violation of this assumption can be adjusted for by means of two-step estimation and the Windmeijer correction for the standard errors. The available instruments are also similar, with Δw_{it-1} and beyond available as an instrument for endogenous variables, and Δw_{it} and beyond for predetermined variables. Furthermore, given that system GMM transforms the instruments and not the variables, it is possible to include time-invariant variables which would disappear in difference GMM.

SUMMARY

In summary, in order to control for persistence and the endogeneity of the lagged variable (and other explanatory variables), a commonly adopted solution is the 2SLS IV estimator, based on the selection of exogenous instruments which are uncorrelated with the error term but highly correlated with the relevant explanatory variable (e.g. the lagged dependent variable in the dynamic model). While intuitively appealing and easy to implement in modern software packages, it is often undermined by the absence of suitable instruments. Indeed, as Rodrik (2004) states "an instrument does not a theory make". Furthermore, in the presence of heteroskedasticity, the IV estimates are rendered inconsistent, as too are the diagnostic tests for endogeneity and the appropriateness of the identification restrictions. For both of these reasons, an increasingly favoured approach involves the use of dynamic GMM techniques, drawing on multiple instruments from within the model and exploiting the orthogonality conditions to enable efficient estimation.

Arellano and Bond (1991) developed the 'difference' GMM estimator to tackle endogeneity by using first-differences to remove the u_i (and the associated omitted variable bias) and using lagged values of the endogenous variables, in difference form, as instruments. Several post-estimation tests, such as the Sargan or Hansen J statistic, can be used to determine if the instruments used are exogenous. However, in later work, it was found that lagged levels are often poor instruments for the first differenced variables, especially when the variables are highly persistent, as we expect to be the case with smoking. Blundell and Bond (1998) modified the "difference" estimator to include lagged levels as well as lagged first differences as instruments to create the "system" GMM estimator. The system GMM estimator performs better than the difference GMM estimator because the instruments in the levels model remain good predictors for the endogenous variables in this model even with high levels of persistence (Windmeijer 2005), and as system GMM is the more efficient estimator in this instance. Therefore, given our intuitive and empirical understanding of smoking behaviour, we *a priori* expect that the system GMM estimator will be the preferred choice. In implementation we use the Sargan/Hansen post-estimation tests and the Arellano-Bond test for autocorrelation in first differences, in order to determine the correct lag structure of the instruments and thus to ensure there is no autocorrelation in the disturbance term.

7.3 EMPIRICAL APPROACH

SAMPLE SPECIFICATION

In the previous chapter we discussed different specifications of the double-hurdle model (DHM) as a framework for addressing the limited dependent variable nature of cigarette consumption. In essence, these models address the zero problem by separating observed consumption into a participation decision (whether to smoke) and a consumption decision (how much to smoke) and have been widely applied in microeconometric analyses of cigarette demand in the context of cross-section data. However, while the full DHM proposed by Jones (1989) is a theoretically appealing specification since it allows for (1) different types of zero observations (abstentions and corner solutions), and (2) the decisions of whether to smoke and how much to smoke to be linked via unobservable factors, it leads to a complex and computationally demanding expression of the likelihood function that cannot be resolved by standard procedures available in econometric software packages. In practice, most applications have therefore imposed some restrictions on the model, either by assuming independence between the error terms in the two parts or by assuming away the possibility of corner solution zeros or, as in our chapter 6 case, both. These restrictions are arguably acceptable in a static pooled cross-sectional approach, where the goal is primarily to address the complexities of the modelling procedure.[67]

In our case however, the data has a longitudinal element which allows us to relax some other restrictive assumptions made in the static approach. In so doing, the implementation and interpretation of a restricted DHM becomes more difficult, since our modelling strategy is now predicated on the fact that we have multiple periods of observation for each individual, which allows for the possibility that people might transition between smoking and not smoking over the time they are observed. Put differently, in the static model, an individual that was observed for 10 years was implicitly treated as 10 different individuals rather than one person with enduring and evolving tastes and preferences.[68] However, relaxing the restrictive assumptions to facilitate a dynamic approach comes at

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[67] For example García and Labeaga (1996) showed that imposing independence is not restrictive provided for some adjustments in the second part of the model

[68] While we adjusted the standard errors for clustering at the individual-level, we did not model the smoking trajectory over time.

a cost, as there are a host of econometric challenges *independent of* the limited-dependent variable problems addressed in chapter 6. Solving both sets of issues at the same time results in a very complex model and not one that the data can always necessarily support. Therefore, in practice, most studies that model dynamics in cigarette consumption, e.g. the literature that tests the Rational Addiction (RA) model, have not been carried out within the double-hurdle framework of chapter 6. Instead, they have restricted the sample based on different assumptions about the zero observations in cigarette consumption.[69]

In our sample we have a maximum of ten years of observations on smoking status and consumption for each individual, and over the time each individual is observed he/she has a non-zero probability of starting, continuing and quitting smoking. Since we are not seeking to estimate a dynamic full DHM we face a number of options. One option would be to dichotomise cigarette consumption into a zero versus positive consumption indicator and thus look at transitions in smoking status only, i.e. the dynamics of initiation and quitting. However, without accounting for consumption intensity this does not seem a valid approach since the probability of quitting will surely depend on previous consumption levels, i.e. the strength of habit formation or addiction. The opposite approach would be to discard the zero observations and look at positive consumption levels only. This approach is common in the literature. For example, Chaloupka (1991) estimates a RA model on US data, Baltagi and Geishecker (2006) test for rational addiction in alcohol demand in Russia drawing on the RLMS data from the period 1994-2003. Given the inclusion of both lagged and lead consumption in the RA specification they need to exclude everyone who has less than three consecutive rounds of positive cigarette consumption. One drawback of this approach and of the dynamic approach in general, is that it might introduce sample selection bias if the factors that influence the probability of always-smoking when observed (and having three consecutive observations) are correlated with observed or unobserved factors that influence consumption levels. For example, unobserved individual characteristics such as the propensity to be a heavy smoker (perhaps stemming from the individual's discount rate) might influence both whether and how much someone smokes over three consecutive periods. Jones and Labeaga (2003) estimate a RA model using Spanish household expenditure panel data and test for selection bias in various specifications of the sample

[69] Examples of studies which have adopted a dynamic double-hurdle model are Christelis and Sanz-de-Galdeano (2011), Gilleskie and Strumpf (2005) and Labeaga (1999).

with regard to zero observations in cigarette purchases. They find no evidence of selection bias when excluding households who never purchase tobacco (i.e. are ‘always zero’), but caution that in their dataset it is not appropriate to drop those households who report zero consumption on one or more occasions, but that still have at least one positive observation of cigarette consumption. This leads them to estimate various models on the sample of ‘participating’ households, i.e. households with positive consumption in at least one period, under different assumptions about the reasons for zero observations. For example, under the assumption of infrequency of purchase, the zeroes are treated like measurement error, which leads them to apply a linear approach (GMM), whereas under the assumption of corner solutions they estimate dynamic Tobit models. In their estimation of the dynamics of food, alcohol, and cigarette consumption in Russia using the years 1994-2005 of the RLMS, Herzfeld et al. (2013) adopt a similar approach to Jones and Labeaga (2003): they exclude individuals who always report zero consumption and then adopt a linear model for the sample containing respondents who are observed in at least three consecutive rounds. To account for sample selection they adopt a kernel-weighted GMM estimator, following an approach suggested by Kyriazidou (2001). While not making any explicit assumptions about the nature of the zeroes, their approach implicitly also treats them like measurement error. In addition, they estimate their consumption model on the full sample (i.e. including also the individuals who never consume) using a system GMM estimator, finding that the estimated coefficients from the estimation on the full sample are similar to the results from the subsample of smokers adjusted for sample selection.[70]

Building on the above discussion and interpretation regarding the zero observations in the previous chapter, we estimate our demand model on two sample specifications: First, we follow the approach taken in Chaloupka (1991) and Baltagi and Geishecker (2006) and restrict the sample to respondents who always smoke when they are observed, i.e. dropping all of the zero observations.[71] This approach, which in the following we refer to as the ‘always-smoking’ sample, is similar in spirit to our two-part specification in the previous chapter, where we excluded the possibility of corner solutions in cigarette consumption. The potential drawback of this approach is that, particularly in the dynamic setting, we might be introducing sample selection bias. That is, in the presence of

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[70] Selection bias may also arise in the longitudinal context due to health-related attrition (Gerry and Papadopoulos, 2015).

[71] In an unlikely extreme, this approach means dropping individuals who smoke in 9 out 10 rounds they are observed due to the presence of just one zero observation.

unobservable characteristics, such as the propensity to be a heavy smoker, which influence both whether someone is always-smoking (and therefore ends up in our sample), and how much he/she consumes, our approach will be excluding potentially important information. As a second specification, we therefore estimate our model on the sample that excludes individuals who never smoke when they are observed, but do smoke in at least one round, yielding a 'participating' sample mirroring that of Jones and Labeaga (2003) and Herzfeld et al. (2013). The two sample specifications can be seen as a trade-off between the zero-problem on the one hand and the potential sample selection bias problem on the other. The 'always-smoking' sample avoids the former problem at the potential risk of the latter, while the 'participating' sample is likely to be more representative of the 'smoking population' but will struggle with the zero observations, especially in the female sample. In both the 'always-smoking' and 'participating' samples we exclude individuals who have less than three consecutive observations.

Ideally, we would want to estimate our model on the representative, working-age sample that we also used in chapters 4 and 6. However, in the dynamic context it becomes tricky to apply the restrictions regarding zero observations and a minimum of three consecutive rounds while at the same time only including individuals who are part of the representative sampling frame, since individuals may transition both between smoking and not smoking *and* between the representative and follow up samples. Table 7.3 below illustrates this problem using the illustrative case of two actual individuals in the dataset. For example, according to the participating sample specification, the female smoker with ID 1 would be included for the 7 consecutive observations between 2001 and 2007. However, since she moved out of the representative sample in 2006, the last two years would be cut off if we restrict the sample to those who are in the representative sampling frame. Since our aim here is to model persistence in smoking, using the maximum possible run of consecutive observations is essential and outweighs the aim of using a representative sample, which in any case, will likely lose its representativeness since we have to drop individuals with less than three consecutive rounds of observations given the lag structure.

Table 7.3 Example to illustrate sample specification

ID	year	gender	age	mover	spell	smokes	cignum
1	2001	female	23	0	7	yes	10
1	2002	female	24	0	7	yes	5
1	2003	female	25	0	7	yes	10
1	2004	female	26	0	7	yes	5
1	2005	female	27	0	7	no	0
1	2006	female	28	1	7	yes	5
1	2007	female	29	1	7	yes	5
1	2009	female	31	1	2	yes	10
1	2010	female	32	1	2	yes	10
195	2001	male	53	0	10	yes	20
195	2002	male	54	0	10	yes	40
195	2003	male	55	0	10	yes	20
195	2004	male	56	0	10	yes	20
195	2005	male	57	0	10	yes	25
195	2006	male	58	0	10	yes	20
195	2007	male	59	0	10	yes	20
195	2008	male	60	0	10	yes	10
195	2009	male	61	0	10	yes	20
195	2010	male	62	0	10	yes	35

mover refers to individuals who have left the representative sample
spell refers to the number of consecutive rounds
cignum refers to the reported daily cigarette consumption

Similarly, the working-age restriction has to be slightly modified in order to prevent individuals who reach retirement age during a consecutive spell from dropping from the sample. For example, individual 195 in Table 7.3 is observed in all 10 years, but since he reaches retirement age in 2008, he would be dropped from the sample for the last 3 years. Therefore, to maximize sample size, we restrict the sample to respondents who are below retirement age in the first year they are observed, meaning that we drop men who are 60 and above in their first observation, and women who are 55 years and older. Similar to chapters 4 and 6, we focus our analysis on individuals who are at least 15 years old, which given that we include the lagged dependent variable among the regressors, means that we have to drop individuals who are younger than 16 in the first year.

Table 7.4 and Table 7.5 illustrate the implications of the different restriction criteria outlined above on the sample size and composition. Table 7.4 distinguishes between the three states (1) always-smoking, (2) transitioning between smoking and not smoking, and

(3) always not smoking, both in terms of individuals (columns 1 and 2) and person-years (columns 3 and 4). The upper rows of the table refer to the whole sample, only restricted according to the age range, and the lower rows show the effect of dropping individuals with less than three consecutive observations, which leads to a loss of about 20 and 14 percent of the sample size for males and females respectively. In the participating sample, we will lose the 13,440 male and 49,890 female observations from respondents who never smoke, illustrating how the much higher rate of consistent non-smoking among women cuts down the sample size for females. If we only keep those who are always-smoking, the maximum sample size falls to 16,639 and 4,476 observations for males and females respectively.

Table 7.4 Cigarette consumption patterns in the longitudinal sample

	Individuals		Person-Years	
	Males	Females	Males	Females
Whole sample				
(1) Individuals who smoke in all rounds	6,098	1,977	21,762 *21,532	6,228 *6,172
(2) Individuals who smoke in some rounds	1,495	1,098	10,425	7,260
(3) Individuals who do not smoke in all rounds	3,931	11,747	13,440	49,890
Total	11,524	14,822	45,537	63,378
≥ 3 consecutive observations				
(1) Individuals who smoke in all rounds	2,572	711	16,804 *16,639	4,509 *4,476
(2) Individuals who smoke in some rounds	1,248	895	9,580	6,681
(3) Individuals who do not smoke in all rounds	1,521	5,813	10,237	41,809
Total	5,341	7,419	36,621	52,999

*smoking & non-missing cigarette consumption

Table 7.5 shows the composition of the 'always-smoking' and 'participating' samples with regard to the length of consumption spells, which in the always-smoking sample means three and more consecutive rounds of positive consumption, and in the participating sample three or more consecutive rounds of which at least one round is with positive cigarette consumption. Under both sample specifications and for both males and females, more than three quarters of the sample size fall on individuals who have 5 or more consecutive observations, which should be helpful for our GMM estimation strategies since it provides a large set of potential instruments.

Table 7.5 Consumption spells in the always-smoking and participating sample specifications

	Person-Years			
	Males		Females	
	Frequency	Percent	Frequency	Percent
Always-smoking (Strictly positive consumption)				
Three consecutive rounds	1,903	11.44	562	12.56
Four consecutive rounds	1,837	11.04	573	12.80
Five consecutive rounds	2,438	14.65	754	16.85
Six consecutive rounds	1,236	7.43	293	6.55
Seven consecutive rounds.	1,312	7.89	356	7.95
Eight consecutive rounds	1,183	7.11	285	6.37
Nine consecutive rounds	993	5.97	242	5.41
Ten consecutive rounds	5,737	34.48	1,411	31.52
Total	16,639		4,476	
Participating sample (≥ 1 round smoking)				
Three consecutive rounds	2,571	9.74	1,062	9.49
Four consecutive rounds	2,572	9.75	1,168	10.44
Five consecutive rounds	3,455	13.10	1,515	13.54
Six consecutive rounds	1,866	7.07	768	6.86
Seven consecutive rounds.	2,037	7.72	819	7.32
Eight consecutive rounds	1,904	7.22	680	6.08
Nine consecutive rounds	1,729	6.55	738	6.60
Ten consecutive rounds	10,260	38.89	4,440	39.68
Total	26,384		11,190	

Always-smoking sample: Individuals who (1) are observed at least 3 consecutive rounds, (2) are of working-age in the first round they are observed (males age 15-59/ females age 15-54), (3) smoke in all rounds they are observed and report positive cigarette consumption
Participating sample: Individuals who (1) are observed at least 3 consecutive rounds, (2) are of working-age in the first round they are observed (males age 15-59/ females age 15-54), (3) report positive cigarette consumption in at least one round.

PERSISTENCE, HABIT, AND ADDICTION

Our main interest in this chapter is in modelling persistence in cigarette consumption, which can be seen as representing habit formation or addiction. We are *not* following the literature that formally tests for myopic versus rational addiction, since while we agree that addiction does not necessarily rule out forward-looking behaviour, we concur with

Gilleskie and Strumpf (2005), who argue that (to the extent that) people are forward-looking, they form their expectations based on past or current information (i.e. information they have). If this is the case, including future values of cigarette prices or consumption, as in the empirical formulation of the Rational Addiction model, is unlikely to be a good proxy for forward-looking behaviour (Gilleskie and Strumpf, 2005). This being the case, with the somewhat more prosaic (but less controversial) ambition of capturing habit formation, our dynamic model includes the first lag of cigarette consumption, alongside the regressors used in the static specification from the previous chapter.

DESCRIPTIVE DYNAMICS

As explained, a key focus of this chapter is on the nature, extent and source of persistence in observed smoking. Ultimately, persistence is an empirical question and so, in Table 7.6 to Table 7.9, we detail the strong degree of persistence in reported smoking behaviour among our male and female samples, for both the always-smoking and participating samples. In each case, the bold figures on the diagonal indicate an individual reporting the same category of smoking consumption in period *t* as in period *t-1*. In order to show whether people consistently report in a 'heaped' number, consumption values in multiples of 5 are singled out. For both men and women and in both sample specifications, the highest persistence rate is at one packet of cigarettes per day, followed by half a packet per day. Consistent with the aggregate descriptive statistics, the persistence rate for females is higher at lower levels of smoking, while for males it is higher at the upper end of the smoking distribution. In the sample that allows zero cigarette consumption, the persistence in non-smoking is similar for both genders (about 30 percent), albeit the share of zero observations is double in the female sample (29.74 versus 15.5). Whereas among females, 50 percent of transitions out of smoking (indicated by the first column in Table 7.9) take place from 1-5 cigarettes per day, among men, a substantive outflow also occurs from intensity levels above one packet per day. Similarly, transitions into smoking (indicated by the first row of Tables 7.8 and 7.9) are concentrated among levels below 10 cigarettes per day, while men also transition upward to 20 cigarettes per day. Aside from the possibility that these transitions represent measurement or recall error, they are likely to reflect relapses to some extent, with people dipping in and out of smoking, from and to their previous consumption levels.

SUMMARY

In this chapter we are relaxing the assumptions of the static demand models estimated in chapter 6 and in doing so we have to confront three key problems: (i) the correlation between time-invariant individual effects and the explanatory variables (which arises through the inclusion of the lagged dependent variable); (ii) the contemporaneous correlation between the regressors and the disturbances; and (iii) the problem of identifying robust samples on which to estimate the models implied by (i) and (ii).

In the following section we compare three sets of estimators for our dynamic model in order to assess the performance of the various estimators discussed earlier: (1) OLS, FE and RE, which ignore the correlation between the dynamic error process and the independent variables; (2) pooled IV (standard 2SLS) and IV with FE which address the correlation but require valid exogenous instruments; and (3) difference and system GMM estimators, which both generate instruments from within the data.

For all three sets of estimators we compare the results between the sample specification that only includes individuals who are always-smoking and individuals who are smoking (i.e. participating) in at least one round in which they are observed, with both specifications requiring an individual to be observed for at least 3 consecutive years. Given that we found the distinction into participation and consumption to be relevant in the previous chapter, we expect the results to differ between the ‘’always-smoking’ and the ‘participating’ sample specifications. Specifically, the inclusion of zeroes in the (particularly female) participating sample might cause problems for the estimator, since implicitly we are treating the zeroes like any other positive consumption value, and thus as measurement error rather than as a corner solution.

Table 7.6 Transition probabilities in the always-smoking sample (males)

Males	1-4cig	5cig	6-9cig	10cig	11-14cig	15cig	16-19	20cig	21-24	25cig	26-29	30cig	31-34	35cig	36-39	40cig	40plus
1-4cig $_{t-1}$	**23.08**	14.29	13.19	29	1.65	4.95	0.55	12.09	0	0.55	0	0	0	0	0	0.55	0
5cig $_{t-1}$	10	**18.62**	15.86	32.41	3.1	7.24	0.34	10.69	0	1.03	0	0.34	0	0	0	0.34	0
6-9cig $_{t-1}$	3.92	9.02	**25.49**	26.27	6.27	11.37	1.37	15.29	0	0.2	0	0.59	0	0	0	0	0.2
10cig $_{t-1}$	1.42	4.03	6.02	**39.86**	4.36	14.36	1.56	26.45	0.05	0.24	0	1	0.05	0.05	0	0.57	0
11-14cig $_{t-1}$	0.9	1.57	6.29	19.1	**13.48**	26.07	4.27	24.94	0	1.12	0	1.35	0	0	0	0.67	0.22
15cig $_{t-1}$	0.47	0.88	3.12	17.07	5.71	**27.6**	3.59	38.14	0.06	0.88	0	1.35	0	0	0	1.12	0
16-19cig $_{t-1}$	0.4	0.8	5.58	9.96	5.98	23.11	**6.77**	44.62	0	0.8	0	0.8	0	0	0	0.4	0.8
20cig $_{t-1}$	0.4	0.51	1	7.8	1.63	8.61	1.34	**68.52**	0.15	2.11	0.1	4.53	0.01	0.16	0	2.94	0.18
21-24cig $_{t-1}$	0	0	0	0	6.67	6.67	0	73.33	**0**	6.67	0	6.67	0	0	0	0	0
25cig $_{t-1}$	0	0.76	0.76	1.53	1.15	6.49	1.15	54.2	0	**12.98**	0.38	15.65	0	0	0	4.96	0
26-29cig $_{t-1}$	0	0	0	20	0	0	0	20	0	0	**0**	50	0	0	0	10	0
30cig $_{t-1}$	0.15	0.15	0.58	3.63	0.58	2.76	0.87	38.32	0.15	5.95	0.44	**29.32**	0.15	1.6	0.29	14.22	0.87
31-34cig $_{t-1}$	0	0	0	0	0	0	0	100	0	0	0	0	**0**	0	0	0	0
35cig $_{t-1}$	0	0	0	3.03	0	3.03	0	18.18	0	6.06	0	45.45	0	**6.06**	0	12.12	6.06
36-39cig $_{t-1}$	0	0	0	50	0	0	0	0	0	0	0	50	0	0	**0**	0	0
40cig $_{t-1}$	0	0.18	0.36	2.01	0.36	1.28	0.55	33.76	0	2.19	0	15.33	0.18	1.28	0	**39.78**	2.74
40plus $_{t-1}$	2.13	0	4.26	2.13	0	2.13	2.13	19.15	0	0	0	12.77	0	2.13	0	36.17	**17.02**
Total	1.18	1.97	3.61	15.13	3.1	12	1.75	49.13	0.09	1.91	0.08	5.18	0.03	0.24	0.01	4.24	0.34

Always-smoking sample: Individuals who (1) are observed at least 3 consecutive rounds, (2) are of working-age in the first round they are observed (males age 15-59), (3) smoke in all rounds they are observed and report positive cigarette consumption

Table 7.7 Transition probabilities in always-smoking sample (females)

Females	1-4cig	5cig	6-9cig	10cig	11-14cig	15cig	16-19	20cig	25cig	26-29	30cig	31-34	35cig	40cig
1-4cig $_{t-1}$	**44.31**	22.35	13.33	10.98	1.18	3.14	1.57	1.96	0	0	0.78	0	0	0.39
5cig $_{t-1}$	13.51	**28.45**	20.4	26.15	0.57	4.6	1.15	4.89	0	0	0	0	0	0.29
6-9cig $_{t-1}$	5.99	15.44	**30.65**	31.57	2.76	6.22	1.38	5.53	0	0.23	0.23	0	0	0
10cig $_{t-1}$	2.13	5.78	10.4	**49.51**	5.6	12.36	1.16	12.62	0	0	0.27	0.09	0	0.09
11-14cig $_{t-1}$	1.45	2.17	5.8	39.86	**13.04**	19.57	0.72	17.39	0	0	0	0	0	0
15cig $_{t-1}$	1.64	3.04	5.84	26.87	2.8	**27.1**	2.34	28.5	0.7	0	0.7	0	0	0.47
16-19cig $_{t-1}$	2.17	6.52	21.74	10.87	15.22	21.74	**2.17**	15.22	2.17	0	2.17	0	0	0
20cig $_{t-1}$	0.6	0.84	1.69	14.6	2.29	11.7	0.84	**63.21**	0.97	0.12	2.05	0	0.12	0.97
25cig $_{t-1}$	0	0	0	18.75	0	12.5	0	50	**6.25**	0	0	0	6.25	6.25
26-29cig $_{t-1}$	0	50	0	0	0	0	0	50	0	**0**	0	0	0	0
30cig $_{t-1}$	2.13	0	2.13	8.51	0	2.13	0	48.94	8.51	0	**14.89**	0	4.26	8.51
31-34cig $_{t-}$	100	0	0	0	0	0	0	0	0	0	0	**0**	0	0
35cig $_{t-1}$	25	0	0	0	0	0	0	0	0	0	0	0	**0**	75
40cig $_{t-1}$	0	0	0	3.57	3.57	7.14	3.57	17.86	0	0	28.57	0	0	**35.71**
Total	6.16	8.51	11.16	30.18	3.7	12.02	1.27	24.37	0.46	0.05	1.13	0.03	0.11	0.84

Always-smoking sample: Individuals who (1) are observed at least 3 consecutive rounds, (2) are of working-age in the first round they are observed (females age 15-54), (3) smoke in all rounds they are observed and report positive cigarette consumption

Table 7.8 Transition probabilities in participating sample (males)

Males	0cig	1-4cig	5cig	6-9cig	10cig	11-14cig	15cig	16-19	20cig	21-24	25cig	26-29	30cig	31-34	35cig	36-39	40cig	40plus
0cig $_{t-1}$	**65.31**	5.3	3.64	3	7.03	0.96	2.96	0.31	9.99	0	0.31	0.03	0.62	0	0	0	0.31	0.06
1-4cig $_{t-1}$	25.12	**26.73**	10.95	6.76	16.1	2.09	3.22	0.81	7.09	0.32	0.16	0	0.16	0.16	0	0	0.32	0
5cig $_{t-1}$	17.26	10.81	**15.32**	12.1	25.16	2.58	6.29	0.32	8.87	0.16	0.48	0	0.32	0	0.16	0	0.16	0
6-9cig $_{t-1}$	10.04	5.26	8.12	**21.74**	25.81	5.02	9.8	1.19	12.19	0	0.24	0	0.36	0.12	0	0	0	0.12
10cig $_{t-1}$	9.3	2.14	3.99	5.98	**35.92**	4.09	13.17	1.34	22.5	0.03	0.29	0	0.7	0.03	0.03	0	0.45	0.03
11-14cig $_{t-1}$	7.06	1.93	2.57	6.26	19.1	**13**	22.47	3.69	21.19	0	0.96	0	0.96	0	0	0	0.48	0.32
15cig $_{t-1}$	5.91	0.86	1.17	2.89	17.14	5.28	**25.12**	3.34	35	0.14	0.86	0	1.22	0	0	0	0.99	0.09
16-19cig $_{t-1}$	5.19	0.86	1.73	4.61	10.95	6.05	21.61	**7.78**	38.62	0	0.86	0	0.58	0	0	0	0.58	0.58
20cig $_{t-1}$	4.52	0.5	0.66	1.09	8.16	1.57	8.3	1.36	**64.54**	0.13	1.93	0.1	4.23	0.01	0.13	0	2.59	0.17
21-24cig $_{t-1}$	13.04	0	0	4.35	0	4.35	4.35	0	60.87	**4.35**	4.35	0	4.35	0	0	0	0	0
25cig $_{t-1}$	4.2	0	0.6	0.9	2.4	1.5	6.61	1.2	48.05	0	**13.81**	0.6	15.32	0	0	0	4.8	0
26-29cig $_{t-1}$	15.38	0	0	0	15.38	0	0	0	23.08	0	0	**0**	38.46	0	0	0	7.69	0
30cig $_{t-1}$	2.74	0.12	0.5	0.5	3.73	0.62	2.99	0.75	37.44	0.12	5.85	0.37	**28.61**	0.12	1.49	0.25	13.06	0.75
31-34cig $_{t-1}$	0	0	0	0	25	0	0	0	50	0	25	0	0	**0**	0	0	0	0
35cig $_{t-1}$	5.71	0	0	0	2.86	0	2.86	0	17.14	0	5.71	0	42.86	0	**5.71**	0	11.43	5.71
36-39cig $_{t-1}$	0	0	0	0	33.33	0	0	0	33.33	0	0	0	33.33	0	0	**0**	0	0
40cig $_{t-1}$	2.61	0	0.16	0.49	2.12	0.33	1.63	0.81	32.57	0	2.61	0	14.82	0.16	1.14	0	**38.11**	2.44
40plus $_{t-1}$	6.67	1.67	0	5	3.33	0	5	1.67	20	0	0	0	10	0	1.67	0	31.67	**13.33**
Total	15.5	2.72	2.67	3.72	14.18	2.71	9.94	1.47	38.19	0.09	1.5	0.06	3.82	0.03	0.16	0.01	2.97	0.25

Participating sample: Individuals who (1) are observed at least 3 consecutive rounds, (2) are of working-age in the first round they are observed (males age 15-59), (3) report positive cigarette consumption in at least one round.

Table 7.9 Transition probabilities in participating sample (females)

Females	0cig	1-4cig	5cig	6-9cig	10cig	11-14cig	15cig	16-19	20cig	25cig	26-29	30cig	31-34	35cig	40cig
0cig $_{t-1}$	**69.67**	8.98	5.1	3.85	8.23	0.96	1.5	0.18	1.43	0.04	0	0	0	0	0.07
1-4cig $_{t-1}$	29.96	**32.94**	15.34	8.68	8.8	0.95	1.66	0.59	0.71	0	0	0.24	0	0	0.12
5cig $_{t-1}$	19.4	11.19	**25**	17.29	19.53	0.62	2.61	1	3.11	0.12	0	0	0	0	0.12
6-9cig $_{t-1}$	13.4	6.05	14.59	**25.74**	27.64	2.49	4.86	1.42	3.56	0	0.12	0.12	0	0	0
10cig $_{t-1}$	9.38	3.01	6.68	10.21	**44.25**	4.56	10.67	0.93	10.05	0	0	0.16	0.05	0	0.05
11-14cig $_{t-1}$	9.5	4.07	4.52	6.79	31.22	**13.57**	15.38	1.36	13.57	0	0	0	0	0	0
15cig $_{t-1}$	6.21	1.91	3.5	6.21	26.43	3.03	**25.8**	1.75	23.73	0.48	0	0.64	0	0	0.32
16-19cig $_{t-1}$	6.76	2.7	5.41	18.92	17.57	10.81	18.92	**1.35**	14.86	1.35	0	1.35	0	0	0
20cig $_{t-1}$	3.85	1.06	1.35	1.83	14.9	2.31	12.02	1.06	**57.69**	0.96	0.1	1.83	0	0.1	0.96
21-24cig $_{t-1}$	0	0	0	100	0	0	0	0	0	**0**	0	0	0	0	0
25cig $_{t-1}$	0	0	5	5	15	0	10	0	45	5	**0**	0	0	10	5
26-29cig $_{t-1}$	0	0	50	0	0	0	0	0	50	0	0	**0**	0	0	0
30cig $_{t-1}$	3.64	1.82	0	1.82	7.27	0	3.64	0	49.09	7.27	0	14.55	**0**	3.64	7.27
31-34cig $_{t-1}$	0	100	0	0	0	0	0	0	0	0	0	0	0	**0**	0
35cig $_{t-1}$	0	20	0	0	0	0	0	0	0	0	0	20	0	0	**60**
40cig $_{t-1}$	6.45	0	0	0	3.23	3.23	6.45	3.23	16.13	0	0	25.81	0	0	**35.48**
Total	29.74	8.22	8.35	8.86	21.07	2.48	7.15	0.81	12.12	0.23	0.02	0.51	0.01	0.05	0.39

Participating sample: Individuals who (1) are observed at least 3 consecutive rounds, (2) are of working-age in the first round they are observed (females age 15-54), (3) report positive cigarette consumption in at least one round.

7.4 RESULTS

We begin by comparing the results from our first set of estimators, starting from a naïve OLS approach and unobserved effects estimators that address the potential correlation between the individual effects and the regressors. Table 7.10 and Table 7.11 present the results for the non-instrumental variable models (pooled OLS, FE and RE) for the key variables of interest for males and females respectively, estimated using our two sample frames: the always-smoking and the participating samples (for the full results see Appendix 7-C and 7-D).

For males, the coefficients on lagged consumption are with the expected (positive) signs and significant in all models except for the FE model estimated on the always-smoking sample, where the lagged consumption enters with a negative sign. As expected, the pooled OLS and RE estimators produce the largest coefficients, in the region of 0.6, which would seem to be in the range that we would expect. The fixed effects model gives odd results in this case, probably due to the absence of substantial variation in many of the explanatory variables, which serves to exacerbate the downward bias of the lagged coefficient.

Prices are significant and with the expected sign in the OLS and RE models, with the effects more than two times larger in the always-smoking sample. However, the effect is still small in absolute terms - a one percent increase in price is associated with a -1.6990*(ln(101/100) reduction in consumption, equating to 0.0169 cigarettes in the always-smoking sample. For income, by contrast, the effects are larger in the participating sample. These results are likely a reflection of the sample specification. In the participating sample, we are effectively treating everyone as a smoker in all periods and the zeroes as measurement error in the dependent variable, rather than as a corner solution. Since there might be two different data-generating processes at work in the participating sample (one for the zeroes and one for the positive consumption values), our single-equation estimators are likely to yield less reliable results in this sample compared to the always-smoking sample specification. Again, this highlights the trade-off, discussed in the previous section, between the zero-problem and potential sample selection bias.

Table 7.10 Results for non-instrumental variable models (males)

	Always-smoking sample			Participating sample		
Consumption (males)	reg	xtreg FE	xtreg RE	reg	xtreg FE	xtreg RE
	b/p	b/p	b/p	b/p	b/p	b/p
$Cigarette\ consumption_{t-1}$	0.5570***	-0.0463**	0.5570***	0.6017***	0.0227	0.6017***
	(0.013)	(0.016)	(0.013)	(0.010)	(0.013)	(0.010)
Price	-1.6339***	-0.6166	-1.6339***	-0.6079*	0.2527	-0.6079*
	(0.323)	(0.570)	(0.323)	(0.278)	(0.465)	(0.278)
Income	0.2819**	0.1355	0.2819**	0.0891	0.1572	0.0891
	(0.089)	(0.104)	(0.089)	(0.090)	(0.106)	(0.090)
Age in years	0.1360***	0.4435	0.1360***	0.1745***	0.6209***	0.1745***
	(0.027)	(0.229)	(0.027)	(0.024)	(0.151)	(0.024)
Age in years # Age in years	-0.0013***	-0.0046***	-0.0013***	-0.0017***	-0.0066***	-0.0017***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
1 other smoker in household	0.2167	-0.0664	0.2167	2.2706***	3.3271***	2.2706***
	(0.134)	(0.230)	(0.134)	(0.131)	(0.224)	(0.131)
2 other smokers in household	0.4666	0.0164	0.4666	3.3487***	5.2180***	3.3487***
	(0.246)	(0.373)	(0.246)	(0.225)	(0.401)	(0.225)
3 other smokers in household	0.8767*	0.3030	0.8767*	3.6722***	5.3016***	3.6722***
	(0.409)	(0.611)	(0.409)	(0.392)	(0.573)	(0.392)
4-7 other smokers in household	0.7907	-0.7929	0.7907	4.2633***	5.6704***	4.2633***
	(0.471)	(0.783)	(0.471)	(0.444)	(0.872)	(0.444)
Number of adults in household	-0.1736**	-0.0857	-0.1736**	-0.5787***	-0.8449***	-0.5787***
	(0.067)	(0.121)	(0.067)	(0.056)	(0.112)	(0.056)
Observations	13,248	13,248	13,248	20,959	20,959	20,959

Always-smoking sample: Individuals who (i) are observed at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (males age 15-59), (iii) smoke in all rounds they are observed and report positive cigarette consumption.
Participating sample: Individuals who (i) are observed for at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (males age 15-59), (iii) report positive cigarette consumption in at least one round.
reg = Pooled ordinary least-squares regression estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
xtreg FE = Fixed effects regression model
xtreg RE = Random effects regression model
Price = Average of price for domestic & foreign cigarette brands (real, logged)
Income = Equivalised income per capita (real, logged)
Reference categories: 0 other smokers in household
Controlling for education, occupation, number of children, marital status, settlement size, region and time trend.
b: Regression coefficient; b: Regression coefficient; p: p-value *** p<0.01 ** p<0.05 * p<0.1

For all estimators, the effects of other smokers in the household are 5-10 times smaller, and insignificant or only very marginally significant, in the always-smoking compared to the participating sample. In the participating sample, living in a household with other smokers has the strongest effect on cigarette consumption compared to all other variables in the model: living in a household with one smoker compared to a household without other smokers increases average daily consumption by 3.3 cigarettes, and by 4.3 cigarettes in a household with 4-7 compared to zero other smokers. The reason why the indicators for other smokers in the household turn insignificant in the always-smoking sample is likely driven by the fact that this sample consists of more intensive smokers (average daily consumption is 18.11 cigarettes, compared to 17.14 for those who smoke in the participating sample) who are less susceptible to the presence of other smokers and more driven by the impulse of habit/addiction. In other words, once we control for the habit formation nature of smoking, the longitudinal impact of peer effects becomes diluted. That is, the static model overstates the importance of peer effects for committed smokers by conflating the causes of tobacco use *per se* with the causes of starting or quitting smoking. If this is the case, we should see higher coefficients in the static estimates and in the dynamic estimates using the participating sample. This is just what we see.

We control separately for the number of adults in the household and find that this variable is negatively related to cigarette consumption, with one additional household member reducing the average quantity consumed by .17 cigarettes in the always-smoking sample, and .58 cigarettes in the participating sample.

Turning next to the results for females, presented in Table 7.11 below. In both sample specifications, the coefficients on lagged consumption are significant in all models and, in contrast to males, slightly higher in the always-smoking sample, except for the FE specification in which the lag enters again with a mis-estimated negative sign. Prices are significant and with the expected signs in the participating sample, but turn insignificant in the always-smoking sample. In both samples income is only significant in the FE specification. Similarly to the results for men, the effects of other household smokers are strongly significant and large in the participating sample, but much smaller and insignificant in the always-smoking specification. Again, this would lend support to the hypothesis that these effects largely impact on participation rather than consumption level decisions.

Table 7.11 Results for non-instrumental variable models (females)

	Always-smoking sample			Participating sample		
Consumption (females)	reg	xtreg FE	xtreg RE	reg	xtreg FE	xtreg RE
	b/p	b/p	b/p	b/p	b/p	b/p
$Cigarette\ consumption_{t-1}$	0.6234***	-0.0617*	0.5946***	0.6084***	0.0439**	0.5685***
	(0.021)	(0.026)	(0.022)	(0.014)	(0.017)	(0.014)
Price	-1.0358	-0.3743	-1.0889*	-1.1462***	-0.6963	-1.1942***
	(0.530)	(0.859)	(0.541)	(0.338)	(0.529)	(0.346)
Income	-0.0107	0.3779*	0.0003	0.0985	0.2471*	0.1067
	(0.127)	(0.170)	(0.129)	(0.083)	(0.099)	(0.083)
Age in years	0.1334**	-0.1034	0.1425**	0.1176***	-0.1636	0.1316***
	(0.047)	(0.322)	(0.049)	(0.027)	(0.263)	(0.028)
Age in years # Age in years	-0.0016**	-0.0013	-0.0017**	-0.0013***	-0.0044***	-0.0015***
	(0.001)	(0.002)	(0.001)	(0.000)	(0.001)	(0.000)
1 other smoker in household	0.2257	-0.0083	0.2335	3.5434***	4.1388***	3.7237***
	(0.256)	(0.367)	(0.261)	(0.168)	(0.206)	(0.168)
2 other smokers in household	0.2245	0.0832	0.2311	4.1453***	5.6343***	4.4357***
	(0.364)	(0.543)	(0.373)	(0.246)	(0.348)	(0.251)
3 other smokers in household	0.9648	-0.8540	0.9124	5.5089***	7.0311***	5.8438***
	(0.895)	(0.859)	(0.897)	(0.492)	(0.532)	(0.490)
4-7 other smokers in household	1.0519	0.1491	1.0705	7.8104***	9.5251***	8.2529***
	(0.702)	(1.006)	(0.721)	(0.471)	(0.844)	(0.485)
Number of adults in household	-0.0448	0.0353	-0.0374	-0.7957***	-1.0490***	-0.8441***
	(0.125)	(0.188)	(0.129)	(0.072)	(0.122)	(0.074)
Observations	3,294	3,294	3,294	8,488	8,488	8,488

Always-smoking sample: Individuals who (i) are observed at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (females age 15-54), (iii) smoke in all rounds they are observed and report positive cigarette consumption.
Participating sample: Individuals who (i) are observed for at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (females age 15-54), (iii) report positive cigarette consumption in at least one round.
reg = Pooled ordinary least-squares regression estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
xtreg FE = Fixed effects regression model
xtreg RE = Random effects regression model
Price = Average of price for domestic & foreign cigarette brands (real, logged)
Income = Equivalised income per capita (real, logged)
Reference categories: 0 other smokers in household
Controlling for education, occupation, marital status, settlement size, region and time trend.
b: Regression coefficient; p: p-value *** p<0.01 ** p<0.05 * p<0.1

In interpreting these results, recall that the estimate of the lagged coefficient is not consistent within these frameworks, so we now move on to examine whether the above results still hold when we address the endogeneity of lagged consumption by means of an instrumental variable strategy. We present the results for a pooled IV estimator (standard 2SLS) and the IV estimator with fixed effects, comparing once again between the participating and the always-smoking samples. In both models we follow the approach taken by Baltagi and Geishecker (2006) who use lagged prices and lagged income as instruments in their dynamic alcohol consumption model based on the RLMS. For the full results see Tables 7-E and 7-F in the appendix.

For males, presented in Table 7.12, the pooled IV model yields positive and statistically significant results for lagged consumption in both the always-smoking and participating samples, whereas the IV with fixed effects does not produce any significant results, despite the instruments in the first stage being significant here as well. Contrary to what we would expect once we address the endogeneity, the coefficients are slightly larger than in the pooled OLS model. This might be related to problems with the instruments which are taken to be strictly exogenous in standard IV models, and which is unlikely to hold in our case. The coefficient on lagged consumption is larger in the always-smoking sample, which would be in line with the higher average consumption, and thus higher degree of habit formation/addiction, in this sample.

The fact that the IV with FE does not produce any significant results despite the instruments in the first stage being significant might be related to the fact that a) once differenced, there is little variation in some of our explanatory variables, particularly within the sub-sample of always-smoking individuals, and b) individual fixed effects might not play a large role anyway once we focus on the subset of individuals who consistently smoke. In this context, we note also that the FE model in the participating sample does not yield plausible estimates, perhaps reflecting the structural differences between the zeros and the positive consumers. In other words, our separate modelling of participation and consumption decisions in the previous chapter seems to represent the correct approach.

In the female sample, presented in Table 7.13 below, none of the IV estimators produces significant effects for any of the variables. The fact that the IV estimates are insignificant indicates that treating lagged prices and lagged income as exogenous instruments is clearly wrong, which is what we would expect given our discussion in the second section.

Table 7.12 Results for instrumental variable models (males)

	Always-smoking sample				Participating sample			
Consumption (males)	Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)		Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)	
	First stage	Second stage	First stage	Second stage	First stage	Second stage	First stage	Second stage
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
Instrumented variable:								
$Cigarette\ consumption_{t-1}$		0.7885***		0.4354		0.6126**		0.4871
		(0.1583)		(0.3924)		(0.2792)		(0.3119)
Instruments:								
$Price_{t-1}$	-3.2334***		-2.0178**		-1.4765*		-1.8801***	
	(0.9430)		(0.8738)		(0.7810)		(0.6843)	
$Income_{t-1}$	0.5219***		0.1650		0.2874**		0.2192**	
	(0.1133)		(0.1010)		(0.1172)		(0.1014)	
$Price_t$	-0.0650	-0.8330	1.0582	-0.2748	-0.5813	-0.5582	0.9354	0.4760
	(0.8858)	(0.5827)	(0.8344)	(0.5489)	(0.7447)	(0.6165)	(0.6646)	(0.4243)
$Income_t$	0.2515**	0.1842	0.0079	0.1108	0.0833	0.0978	0.1092	0.1171
	(0.1209)	(0.1213)	(0.0955)	(0.1153)	(0.1244)	(0.1161)	(0.1071)	(0.1330)
Age in years	0.4646***	0.0342	0.3554	0.2336	0.6310***	0.1694	0.6407***	0.2897
	(0.0524)	(0.0755)	(0.2418)	(0.2905)	(0.0495)	(0.1775)	(0.1584)	(0.2560)
Age in years # Age in years	-0.0044***	-0.0003	-0.0054***	-0.0018	-0.0062***	-0.0017	-0.0077***	-0.0030

Consumption (males)	Always-smoking sample				Participating sample			
	Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)		Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)	
	First stage	Second stage	First stage	Second stage	First stage	Second stage	First stage	Second stage
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
	(0.0006)	(0.0007)	(0.0011)	(0.0023)	(0.0005)	(0.0018)	(0.0010)	(0.0025)
1 other smoker in household	0.2985	0.1607	-0.2910	0.0343	2.6467***	2.2421***	0.3222*	3.2127***
	(0.2446)	(0.1180)	(0.2043)	(0.2526)	(0.2223)	(0.7431)	(0.1954)	(0.2504)
2 other smokers in household	1.0775**	0.2186	0.0510	-0.1718	4.6295***	3.2568**	0.7377*	4.8483***
	(0.4545)	(0.2665)	(0.3736)	(0.3763)	(0.4201)	(1.3093)	(0.3869)	(0.4736)
3 other smokers in household	1.0661*	0.6798*	-0.0769	0.0951	5.5836***	3.6677**	0.3726	5.1204***
	(0.6379)	(0.4058)	(0.6234)	(0.6292)	(0.6065)	(1.5737)	(0.6795)	(0.6583)
4-7 other smokers in household	1.5680*	0.4658	0.0236	-1.0727	6.6186***	4.1860**	0.5203	5.2069***
	(0.8761)	(0.4347)	(0.7452)	(0.7336)	(0.9386)	(1.8717)	(0.9343)	(0.8958)
Number of adults in household	-0.2938**	-0.1074	0.0444	-0.0702	-0.9732***	-0.5638**	-0.2127*	-0.7497***
	(0.1311)	(0.0681)	(0.1199)	(0.1207)	(0.1168)	(0.2746)	(0.1157)	(0.1347)
Hansen J statistic		0.096		0.461		1.517		0.968
p-value of Hansen J statistic		0.757		0.497		0.218		0.325
Observations	12,970	12,970	12,885	12,885	20,519	20,519	20,403	20,403

Always-smoking sample: Individuals who (i) are observed at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (males age 15-59), (iii) smoke in all rounds they are observed and report positive cigarette consumption.
Participating sample: Individuals who (i) are observed for at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (males age 15-59), (iii) report positive cigarette consumption in at least one round.
Price = Average of price for domestic & foreign cigarette brands (real, logged); Income = Equivalised income per capita (real, logged)
Reference category: 0 other smokers in household. Controlling for education, occupation, number of children, marital status, settlement size, region and time trend.
b: Regression coefficient; se: Standard error of regression coefficient, *** p<0.01 ** p<0.05 * p<0.1

Table 7.13 Results for instrumental variable models (females)

	Always-smoking sample				Participating sample			
Consumption (females)	Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)		Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)	
	First stage	Second stage	First stage	Second stage	First stage	Second stage	First stage	Second stage
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
Instrumented variable:								
$Cigarette\ consumption_{t-1}$								
		0.9160		0.5107		0.7137		0.1294
Instruments:		(1.1321)		(0.5258)		(0.7368)		(0.6464)
$Price_{t-1}$								
	-1.4250		-0.4328		-1.1210		-0.6520	
$Income_{t-1}$	(2.0149)		(1.4246)		(1.1666)		(0.8337)	
	-0.0004		0.2849*		-0.0257		0.1364	
$Price_t$	(0.1669)		(0.1678)		(0.1133)		(0.1056)	
	-0.1766	-0.5261	1.7995	-0.9725	-0.8208	-0.9602	0.9377	-0.5171
$Income_t$	(2.0481)	(1.8641)	(1.7025)	(1.1191)	(1.1618)	(1.4227)	(0.9365)	(0.5880)
	0.2506	-0.0935	0.5475***	0.0937	0.3775***	0.0339	0.3045***	0.2214
Age in years	(0.1956)	(0.3032)	(0.1697)	(0.3857)	(0.1252)	(0.2781)	(0.1016)	(0.2086)
	0.4499***	0.0031	-0.1337	-0.0731	0.4705***	0.0650	0.1813	-0.2154
Age in years # Age in years	(0.1070)	(0.5111)	(0.3605)	(0.3214)	(0.0571)	(0.3473)	(0.2577)	(0.2767)
	-0.0049***	-0.0001	-0.0031	0.0009	-0.0050***	-0.0008	-0.0078***	-0.0038

	Always-smoking sample				Participating sample			
Consumption (females)	Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)		Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)	
	First stage	Second stage	First stage	Second stage	First stage	Second stage	First stage	Second stage
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
1 other smoker in household	0.5706	0.0431	0.1066	-0.0816	3.8648***	3.0924	0.3443*	4.1318***
	(0.5311)	(0.6787)	(0.3743)	(0.4019)	(0.2447)	(2.8616)	(0.1765)	(0.3078)
2 other smokers in household	0.6274	-0.0102	0.6562	-0.2149	5.3187***	3.5211	1.1791***	5.5787***
	(0.7110)	(0.7820)	(0.6401)	(0.7027)	(0.4026)	(3.9320)	(0.3484)	(0.8411)
3 other smokers in household	1.9222	0.5361	0.3043	-0.8706	6.9130***	4.7299	0.6245	6.8804***
	(1.1781)	(2.4018)	(1.0413)	(1.1219)	(0.6921)	(5.1490)	(0.5854)	(0.6762)
4-7 other smokers in household	3.3662**	0.1908	1.1781	-0.3533	9.5476***	6.8217	0.6102	9.3627***
	(1.6206)	(3.9025)	(1.4079)	(1.6136)	(1.0355)	(7.0519)	(0.8452)	(0.9541)
Number of adults in household	-0.0765	-0.0162	-0.0905	0.0076	-0.9644***	-0.6722	-0.0969	-1.0197***
	(0.2352)	(0.1459)	(0.2753)	(0.2506)	(0.1265)	(0.7172)	(0.1286)	(0.1428)
Hansen J statistic		1.123		0.042		2.295		0.166
p-value of Hansen J statistic		0.289		0.837		0.130		0.684
Observations	3,138	3,138	3,093	3,093	8,129	8,129	8,042	8,042

Always-smoking sample: Individuals who (i) are observed at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (females age 15-54), (iii) smoke in all rounds they are observed and report positive cigarette consumption.
Participating sample: Individuals who (i) are observed for at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (females age 15-54), (iii) report positive cigarette consumption in at least one round.
Price = Average of price for domestic & foreign cigarette brands (real, logged); Income = Equivalised income per capita (real, logged)
Controlling for education, occupation, marital status, number of children in household, settlement size, region and year.
Reference category: 0 other smokers in household
b: Regression coefficient; se: Standard error of regression coefficient, *** p<0.01 ** p<0.05 * p<0.1

We now turn to the results for our third set of dynamic estimators – difference and system GMM. Recall, from section 7.2, that the difference and system GMM approach allows us to escape from the instrumenting conundrum by efficiently using information from within the model. Specifically, through instrumenting the differenced variables with their available lags in levels for the difference GMM estimates; and using the lagged differences/lagged levels as instruments in the level/difference system GMM equation we are able to tease out consistent estimates of the lagged consumption effect.

The IV estimation in this approach draws on lags from two or more periods ago on the (testable) assumption that the associated errors are serially uncorrelated and thus that the differenced errors are uncorrelated with the differenced dependent variable. As explained in section 7.2, we have *a priori* reason to believe that the system GMM will perform better, owing to its greater efficiency in the presence of endogeneity and persistence. However, we also know from the previous discussion, that the sampling frame we use will impact upon the appropriateness of the estimator too. In this case, we would anticipate that the simpler difference model would perform less well for the always smoking sample. In other words, we have further reason to believe that the system GMM approach will be our preferred dynamic estimator. System GMM has the additional benefit of allowing a more flexible approach to distinguishing between endogenous, exogenous and pre-determined variables.

In implementing these estimates, we use the two-step estimates, robust to both heteroskedasticity and arbitrary patterns of auto-correlation within individuals. We treat the lag of the dependent variable as endogenous, along with prices, income and the presence of other household smokers and we treat the remaining variables as exogenous instruments. Our default lag structure is to use lags two through eight, thus restricting the instrument count (Roodman, 2009) to instrument for the endogenous variables but in the participating sample we find it necessary to move to the third lag of the instruments as being the first available that are statistically not correlated with the error term or its lag. This is not unexpected for this sample. In the results, reported in Tables 7.14 – 7.17 below, we report the lag structure used, by referring to the appropriate auto-correlation test AR(2) or AR(3); we report the Hansen-J statistic testing the validity of the instruments and we also report the AR(1) test which we would expect to reject. The Hansen test, unlike the (also available) Sargan test, is robust to both heteroskedasticity and autocorrelation and confirms, in all cases, that our instruments are valid. We choose not to ‘collapse’ the instrument matrix, since there is no intuitive reason, given our sample size, not to use an instrument for each period, variable and lag distance. Moreover, in larger samples, collapsing the instrument matrix can reduce statistical efficiency.

A note of caution; while the Hansen test is preferred to the Sargan test, it has also been shown to be prone to weakness, particularly with regard to detecting invalid instruments as the instrument count increases (as is the case in system compared to difference GMM). We therefore also refer to the results for the AR(2) test for autocorrelation in the disturbances, which has been shown by Arellano and Bover (Arellano and Bover, 1995) to be more reliable in detecting lagged instruments being made invalid through autocorrelation.

Within the GMM approach, the possible (and potentially justifiable) combinations of lag structure, instrumenting strategy, error adjustment approach and matrix construction assumptions are numerous. The researcher must make decisions according to judgements based on the understanding they have of the data and they must be confident that small adjustments in the specification do not qualitatively alter the results. We are confident that this is the case in our estimations and to this end note also that the Difference-in-Hansen tests, indicate that the system-GMM instruments are exogenous in each case.

Finally, before turning to the results, a note on the size of the coefficient on lagged consumption. The OLS and FE models estimated above should provide the range into which the true parameter on lagged consumption falls, with both models ignoring the endogeneity of lagged consumption, which causes upward bias in OLS, and downward bias in the FE model, where the effects of lagged consumption get soaked up in the individual effects. Table 7.14 below presents the main significant results for our four GMM models for males (difference and system GMM each estimated for the participating and the always-smoking samples). The full results are in appendix 7-G. Table 7.15 then compares the results of the GMM models to the two other sets of estimators presented above (the non-IV and IV models) for key variables of interest.

From a cursory glance at Table 7.14 we see that lagged cigarette consumption is significant in both the difference and the system GMM estimates and under both sample specifications. As expected, the (less efficient) difference estimator yields lower coefficients, which are close to the coefficients given by the FE estimator (presented in Table 7.15), and thus close to the lower limit into which the true parameters should fall.

While the difference estimator yields similarly sized coefficients on lagged consumption in both samples, for system GMM the size of the coefficient on lagged consumption is more than double the size in the participating sample compared to the always-smoking sample (0.35 versus 0.62). This illustrates the interaction between the properties of the dynamic estimators and the sample specification, and highlights again the need to carefully consider a robust sample specification in the context of single-equation estimators. In all cases, the Hansen test of over-identifying restrictions is passed (i.e. we do not reject the null of joint validity of the instruments), as well as the AR(1) test for autocorrelation in first differences. As we can see in Table 7.14, the AR(2) test is rejected in the system GMM models, a point we will come back to later.

Table 7.14 Results for difference and system GMM models (males)

Males	Difference GMM		System GMM	
Sample specification	Always-smoking	Participating	Always-smoking	Participating
	b/p	b/p	b/p	b/p
$\boldsymbol{Cigarette\ consumption_{t-1}}$	0.0568**	0.0784***	0.3460***	0.6217***
	(0.028)	(0.000)	(0.000)	(0.000)
Price	-1.3840	-0.6018	-1.4055	-2.5892**
	(0.170)	(0.497)	(0.179)	(0.031)
Income	-0.6485	-0.1168	-0.0644	-2.7049**
	(0.314)	(0.831)	(0.894)	(0.022)
Complete secondary education	0.0093	0.3755	0.5646*	0.2072
	(0.988)	(0.514)	(0.075)	(0.464)
Incomplete secondary education	0.0656	0.4886	0.8603**	0.4289
	(0.917)	(0.421)	(0.021)	(0.293)
Manual occupation	0.5461*	0.3367	0.7014**	0.2010
	(0.094)	(0.297)	(0.030)	(0.479)
2 other smokers in household	1.5992	4.5226***	2.4152**	4.3645*
	(0.212)	(0.001)	(0.017)	(0.051)
Hansen J Statistic	232.9	270.0	228.7	58.53
Hansen degrees of freedom	231	231	231	42
Hansen p-value	0.453	0.040	0.530	0.047
AR(1)	-13.79	-17.11	-9.413	-9.798
AR(1) p-value	0.000	0.000	0.000	0.000
AR(2)	1.299	1.664	3.677	4.438
AR(2) p-value	0.194	0.096	0.000	0.000
AR(3)			-0.068	0.643

Males	Difference GMM		System GMM	
Sample specification	Always-smoking	Participating	Always-smoking	Participating
	b/p	b/p	b/p	b/p
AR(3) p-value			0.946	0.520
Observations	10,608	16,454	13,248	20,959

Always-smoking sample: Individuals who (i) are observed at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (males age 15-59), (iii) smoke in all rounds they are observed and report positive cigarette consumption.
Participating sample: Individuals who (i) are observed for at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (males age 15-59), (iii) report positive cigarette consumption in at least one round.
Price = Average of price for domestic & foreign cigarette brands (real, logged);
Income = Equivalised income per capita (real, logged)
Controlling for age, age-squared, occupation, marital status, number of adults in household, number of children in household, settlement size, region and time trend
Reference categories: University education, 0 other smokers in household
b: Regression coefficient; p: p-value *** p<0.01 ** p<0.05 * p<0.1

Hansen J Statistic: Sargan–Hansen test of overidentifying restrictions (used to determine the validity of the instruments), the null hypothesis is that J =0, meaning that the overidentification restrictions are valid
Hansen degrees of freedom: degrees-of-freedom adjustment for the number of instruments
AR(1): Arellano-Bond test of first-order serial correlation, null hypothesis = no serial correlation
AR(2): Arellano-Bond test of second-order serial correlation, used to detect autocorrelation in the underlying levels variables in first differences. The presence of significant AR(2) is a diagnostic test of the validity of the instruments, complementary to the standard Sargan–Hansen test of overidentifying restrictions, null hypothesis = no serial correlation
AR(3): Arellano-Bond test of third-order serial correlation, null hypothesis = no serial correlation

Table 7.15 Comparison of dynamic models (males)

Always-smoking sample	Observations	Consumption in t-1	Price	Income	2 other smokers in household	Incomplete secondary edu
OLS	13,248	0.5570***	-1.6339***	0.2819**	0.4666	0.7005**
FE	13,248	-0.0463**	-0.6166	0.1355	0.0164	0.3321
2SLS	12,970	0.7885***	-0.8330	0.1842	0.2186	0.3799
2SLS with FE	12,885	0.4354	-0.2748	0.1108	-0.1718	-0.6410
Difference GMM	10,608	0.0568**	-1.3840	-0.6485	1.5992	0.0656
System GMM	13,248	0.3460***	-1.4055	-0.0644	2.4152**	0.8603**

Participating sample	Observations	Consumption t-1	Price	Income	2 other smokers in household	Incomplete secondary edu
OLS	20,959	0.6017***	-0.6079*	0.0891	3.3487***	1.1440***
FE	20,959	0.0227	0.2527	0.1572	5.2180***	0.3101
2SLS	20,519	0.6126**	-0.5582	0.0978	3.2568**	1.1033
2SLS with FE	20,403	0.4871	0.4760	0.1171	4.8483***	0.1348
Difference GMM	16,454	0.0784***	-0.6018	-0.1168	4.5226***	0.4886
System GMM	20,959	0.6217***	-2.5892**	-2.7049**	4.3645*	0.4289

Both price and income enter with a negative sign in all four models but are only significant for the system GMM estimated on the participating sample. Here the price coefficient is now larger compared to the static model from chapter 6 (-1.3 in static consumption model versus -2.6 in dynamic model), and about 4 times higher than the OLS price coefficient for the dynamic model (-.61). We would expect the price coefficients in the GMM model to be larger than in OLS or FE as we are now taking into account the endogeneity of the lagged dependent variable. That is, in OLS/FE the effect of price will partly be soaked up by the endogenous lagged consumption. The large price effect for the participating sample, when estimated using system GMM, reflects the conflation of participation and consumption elasticities and suggests that the static models of chapter 6, using the average price, are not picking up the true price effects.

The fact that prices are insignificant for the difference GMM models indicates that for prices, past changes (i.e. differences in prices) may be a better predictor of (and thus instrument for) current consumption levels, than past price levels are of differences in consumption, i.e. the instruments in the system GMM perform better, particularly given the high degree of persistence.

This is further supported by the strong degree of autocorrelation present, as evidenced by the failure to pass the AR(2) test of autocorrelation in first differences for the system GMM. Looking at the test output at the bottom of Table 7.14 we see that, for the system GMM the rejection of the null hypothesis in the AR(2) test suggests correlation of order 1 in the disturbances v_{it}, which means that the second lags are invalid instruments. Given the presence of strong autocorrelation we therefore have to resort to lags 3 and beyond as valid instruments for the lagged dependent variable, the validity of which is then confirmed by the AR(3) test where we can now not reject the null of the validity of the instruments.

As with price elasticity, for income, the effects are negative and significant only in the system GMM. In view of the negative impact of income on participation shown in chapter 6, it seems likely that this result also reflects the strong participation effect within this sample

Among other results, worth highlighting, we note that in contrast to the static model, the educational gradient is absent in the GMM models, except for the system GMM estimated on the always-smoking sample, where men with basic education consume .86 cigarettes more per day compared to smokers with university education, and those with complete high school consume .56 cigarettes more. The fact that, unlike for many of the other covariates, the coefficients for education are larger and only significant in the always-smoking sample seems to suggest that, once we account for persistence, education matters more for consumption than for participation. Similarly, occupational characteristics such as working in a manual or unskilled occupation are significant in the always-smoking sample for both the difference and system GMM, but disappear when estimated on the participating sample.

Finally, the strong influence of peers as captured by the number of other smokers in the household also gets picked up in our GMM models, with the exception of the difference GMM in the always-smoking sample and, as expected, the coefficients are larger in magnitude in the participating sample. For example, living in a household with 2 other smokers increases daily consumption by about 2.4 cigarettes in the always-smoking sample, compared to 4.4 cigarettes in the participating sample. For both difference and system GMM, the effects increase strongly with the number of smokers, with the highest category of 4-7 other smokers increasing daily consumption by 6.4 and 10.9 cigarettes respectively in the participating sample. While the large coefficients for the participating sample will conflate participation and consumption elasticities, the system GMM for the always-smoking sample also yields sizeable effects of between 2.4 and 3.2 cigarettes more per day. This suggests that while playing a larger role for less ‘committed’ smokers who transition between smoking and not smoking, the immediate social environment also influences consumption among the more committed smokers in the always-smoking sample. However, as noted in the previous chapter, there is potential endogeneity in these observations since it is likely that smokers meet and form partnerships with other smokers, rather than non-smokers, which is more likely to be the case among the group of committed and intensive smokers.

Turning now to the results for the much smaller sample of female smokers. Analogous to the results for males, Table 7.16 provides the results for key significant variables as well as the test results for the four GMM models, and Table 7.17 compares these results to the other two sets of estimators (non-IV and IV estimators). Once again the full results are in appendix Table 7-H. Lagged cigarette consumption is significant only in the system GMM estimates and in contrast to males, the coefficients are much closer here for the two different sample specifications: 0.32 vs 0.45 for the always-smoking and participating samples respectively, compared to 0.35 vs. 0.62 for males. The likely explanation for the lower differentials in the lag effect between the two sample specifications lies in the very high level of persistence in the zeroes that are part of the participating sample for females. That is, there are many women who are just fulfilling the minimum criteria to qualify for the participating sample (i.e. they only smoke in one round of the minimum 3 for which they are observed). This is consistent with the large difference in mean consumption between the two samples. This again highlights the problem that our dynamic estimators have no way of distinguishing between persistence in not smoking versus smoking in the participating sample since the zeroes are treated like any other consumption value.

Table 7.16 Difference and system GMM results (females)

Females	Difference GMM		System GMM	
Sample specification	Always-smoking	Participating	Always-smoking	Participating
	b/p	b/p	b/p	b/p
$\boldsymbol{Cigarette\ consumption_{t-1}}$	0.0469	0.0503	0.3191***	0.4525***
	(0.350)	(0.149)	(0.008)	(0.000)
$Price_{\boldsymbol{t-1}}$	-1.7172	-2.0473*	1.2916	-0.3297
	(0.246)	(0.063)	(0.405)	(0.738)
Income	-0.3465	0.8004*	0.2980	0.9823*
	(0.691)	(0.081)	(0.674)	(0.063)
Complete secondary education	1.5737	0.9830*	1.2438*	0.9348***
	(0.130)	(0.071)	(0.066)	(0.009)
Incomplete secondary education	0.7439	0.8115	0.8854	1.0228**
	(0.504)	(0.175)	(0.237)	(0.021)
3 other smokers in household	-0.8013	5.0750***	5.4555**	7.9634***
	(0.527)	(0.007)	(0.012)	(0.000)
4-7 other smokers in household	-0.0878	6.9211***	4.1980*	11.0365***
	(0.966)	(0.000)	(0.052)	(0.000)
Number of adults in household	-0.2100	-0.6984***	-0.5873	-1.2039***
	(0.500)	(0.005)	(0.115)	(0.000)
Hansen J Statistic	123.5	274.8	186.5	226.3
Hansen degrees of freedom	97	234	185	191
Hansen p-value	0.036	0.035	0.455	0.041
AR(1)	-7.025	-9.702	-5.480	-10.25
AR(1) p-value	0.000	0.000	0.000	0.000
AR(2)	0.672	0.872	2.178	3.893
AR(2) p-value	0.502	0.383	0.029	0.000

Females	Difference GMM		System GMM	
Sample specification	Always-smoking	Participating	Always-smoking	Participating
	b/p	b/p	b/p	b/p
AR(3)			-1.167	-0.492
AR(3) p-value			0.243	0.623
Observations	2,355	6,288	3,138	8,129

Always-smoking sample: Individuals who (i) are observed at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (females age 15-54), (iii) smoke in all rounds they are observed and report positive cigarette consumption.
Participating sample: Individuals who (i) are observed for at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (females age 15-54), (iii) report positive cigarette consumption in at least one round.
Price = Average of price for domestic & foreign cigarette brands (real, logged);
Income = Equivalised income per capita (real, logged)
Controlling for age, age-squared, occupation, marital status, number of children in household, settlement size, region and time trend
Reference categories: University education, 0 other smokers in household
b: Regression coefficient; p: p-value *** p<0.01 ** p<0.05 * p<0.1

Hansen J Statistic: Sargan–Hansen test of overidentifying restrictions (used to determine the validity of the instruments), the null hypothesis is that J =0, meaning that the overidentification restrictions are valid
Hansen degrees of freedom: degrees-of-freedom adjustment for the number of instruments
AR(1): Arellano-Bond test of first-order serial correlation, null hypothesis = no serial correlation
AR(2): Arellano-Bond test of second-order serial correlation, used to detect autocorrelation in the underlying levels variables in first differences. The presence of significant AR(2) is a diagnostic test of the validity of the instruments, complementary to the standard Sargan–Hansen test of overidentifying restrictions, null hypothesis = no serial correlation
AR(3): Arellano-Bond test of third-order serial correlation, null hypothesis = no serial correlation

With respect to the post-estimation tests, all four GMM models pass the Hansen test (and Difference Hansen tests) of over-identifying restrictions, but, as for males, the AR(2) test in the system GMM indicates that there is autocorrelation in first differences, requiring us to move back to third lags and deeper to ensure exogeneity of the instruments. Doing so produces stable results.

Table 7.17 Comparison of dynamic models (females)

Always-smoking sample	Observations	Consumption t-1	Price	Income	3 other smokers in household	Incomplete secondary edu
OLS	3,294	0.6234***	-1.0358	-0.0107	0.9648	0.5368
FE	3,294	-0.0617*	-0.3743	0.3779*	-0.8540	0.3184
2SLS	3,138	0.9160	-0.5261	-0.0935	0.5361	-0.1772
2SLS with FE	3,093	0.5107	-0.9725	0.0937	-0.8706	0.6738
Difference GMM	2,355	0.0469	-1.7172	-0.3465	-0.8013	0.7439
System GMM	3,138	0.3191***	1.2916	0.2980	5.4555**	0.8854

Participating sample	Observations	Consumption t-1	Price	Income	3 other smokers in household	Incomplete secondary edu
OLS	8,488	0.6084***	-1.1462***	0.0985	5.5089***	0.5867**
FE	8,488	0.0439**	-0.6963	0.2471*	7.0311***	1.1568**
2SLS	8,129	0.7137	-0.9602	0.0339	4.7299	0.3807
2SLS with FE	8,042	0.1294	-0.5171	0.2214	6.8804***	1.1213**
Difference GMM	6,288	0.0503	-2.0473*	0.8004*	5.0750***	0.8115
System GMM	8,129	0.4525***	-0.3297	0.9823*	7.9634***	1.0228**

For females, prices are only weakly significant in the difference GMM for the participating sample. This is in contrast to the results from our static model in the previous chapter, as well as for the previous literature on cigarette demand in Russia, including the Herzfeld et al. (2013) study that used a dynamic model, which showed female consumption to be responsive to price, and even to a greater degree than males. While it is difficult to gauge the extent to which these results might be related to either the estimator or the sample specification, the sign change between the participating and always-smoking sample for the system GMM, with a large positive effect in the latter, suggests that the always-smoking specification might be problematic, as in, affected by sample selection bias. This might possibly explain why Herzfeld et al., who corrected their GMM estimator for sample selection bias, found females to be more price responsive also in the dynamic context. This is another important question for future research. For now, we simply note that the small size of our always-smoking sample and the high proportion of zeros in our participating sample cast a major doubt over the robustness of the results for the female samples.

In contrast to price, income is significant, entering with a positive sign and similar in size in the participating sample for both the difference and the system estimators (0.80 and .98). This is also in contrast to the static model, where income was not significant and also about 4 times smaller in magnitude. Intuitively, the results for prices and income make sense in that we know that females consume less than men on average, switch more frequently between lower smoking levels and not smoking (as shown in our transition tables in section 3) and tend to prefer the more expensive foreign cigarette brands. The latter is also consistent with the proposition that some females engage in smoking because of a positive image effect rather than because of a more deep-rooted addition or habit formation. Indeed, our socioeconomic profiles in chapter 4 showed that while male smokers had a lower income compared to their non-smoking counterparts, the opposite was true of women for whom cigarette consumption (and participation) increases as income increases.

As a more general pattern, the dynamic model for females, whether estimated with difference or system GMM, tend to yield significant effects only in the participating sample, indicating that we are picking up effects on both participation and consumption. It is worth noting that education appears to matter more for female consumption. In particular, women with complete secondary education consume about 1 cigarette more per day in both the always-smoking and participating samples. Similar to males, the effect of other smokers in the household, while large and strongly significant for all categories in the participating sample, also yields a significant and sizeable effect in the two higher categories (i.e. 3 and more smokers) in the system GMM for the always-smoking sample. The very large coefficients in the participating sample, e.g. for the 4-7 other smokers category the effect is as large as the average consumption in the sample (11 cigarettes), suggest that the participation effect is dominating. That is, it could be simply capturing the fact that, where females are in households with other smokers they themselves are much more likely to smoke.

7.5 Discussion

Our point of departure for this chapter was the observation that for all consumption goods, and particularly for those that are known to be strongly addictive, habit formation and persistence are important determining concepts that need to be incorporated into the models of cigarette demand that we estimate. As so often, achieving this is not straightforward and involves numerous statistical and conceptual challenges and trade-offs. OLS, unobserved effects models, and standard IV approaches, while providing useful markers for the impact of habit formation, are inconsistent estimators for dynamic panel models. In this chapter, we therefore propose using more efficient estimators, from the family of GMM estimators, which are able to control for unobserved individual heterogeneity, omitted variable bias, measurement error and endogeneity, while also modelling persistence.

We started by comparing a set of estimators that are inconsistent for dynamic panel models, moving from OLS and unobserved effects models, through to standard IV approaches that require strictly exogenous instruments, including pooled 2SLS and 2SLS with fixed effects. We then moved into the GMM framework, comparing both difference and system GMM.

Our three most important claims arising from this chapter are that: (i) persistence or habit formation (or addiction) clearly matter, both for males and females and therefore the dynamic framework is the correct framework for estimating cigarette consumption models; (ii) by comparing the results of the participating vs. always smoking samples, we garner strong support for the argument elaborated in chapter 6 in favour of estimating two-part models; and (iii) the longitudinal element of the RLMS data, while needing very careful handling, is strong enough to undertake dynamic panel analysis and is therefore an important source of information and evidence, both in terms of understanding Russian health behaviours and profiles, but also in terms of international comparisons with other major household surveys.

Aside from these major claims, our results are generally supportive of many of those of the static demand model estimated in the previous chapter and also of the other results found in the literature for Russia. In particular, for males (though not females, for whom we suspect sample selection bias in relation to the different underlying processes that give rise to zeros and positive observations for consumption) our dynamic specifications confirm the significance of the price effects and indicate that they are in fact larger once we model persistence in consumption. This is what we would expect, since not taking into account persistence in consumption will impart downward bias on the coefficients. If correct, this has obvious but important policy implications. With regard to two other important policy areas, we find persuasive evidence in this chapter that, for those that always smoke, social effects are likely to be less important, though the education gradient is stronger.

Finally, and just as importantly, our results in this chapter prompt a number of questions for future research including two of particular importance: first, are social and peer effects more important for transitional smokers, starters and quitters than they are for more permanent smokers?; and second, are prices significant for female smokers once we control for sample selection bias?

Chapter 7 Appendices

7-A Sample composition for different sample specifications (males)

Males (age 16-59 in first year)	Whole sample	Participating sample	Always-smoking sample
Year			
2001	8.63	8.71	8.65
2002	9.18	9.33	9.32
2003	9.92	10.13	10.25
2004	10.33	10.35	10.24
2005	9.59	9.65	9.5
2006	11.49	11.48	11.6
2007	11.29	11.17	11.3
2008	11.14	11.01	11.1
2009	9.79	9.67	9.64
2010	8.64	8.52	8.39
Region			
Moscow & St. Petersburg	10.38	9.49	10.03
Northern & North Western	5.45	5.87	7.05
Central & Central Black Earth	18.34	16.9	18.32
Volga-Vyatski & Volga Basin	17.91	17.49	18.88
North Caucasian	15.42	17.13	9.6
Ural	14.07	14.74	15.61
Western Siberian	9.27	9.23	10.58
Eastern Siberian & Far Eastern	9.17	9.15	9.93
Settlement type			
City >500,000	31	28.09	29.28
City 50,000-500,000	29.1	29.59	32.1
Rural & Town <50,000	40	42.32	38.63
Age			
15-17	1.2	1.08	0.41
18-24	10.53	10.72	8.17
25-34	20.52	22.75	22.41

Males (age 16-59 in first year)	Whole sample	Participating sample	Always-smoking sample
35-44	22	24.85	26.87
45-54	19.89	20.87	22.81
55-64	11.87	11.4	11.76
≥65	13.98	8.33	7.57
Number of household members			
1	4.67	3.96	4.41
2	24.63	21.82	24.47
3	27.13	27.88	29.47
4	23	23.37	22.53
5+	21	22.99	19.13
Number of other smokers			
0	73.05	64.88	59.55
1	19.40	25.28	28.57
2	5.37	7.07	8.58
3	1.26	1.66	2.07
4-7	0.77	1.04	1.24
missing	0.15	0.07	0
Real per capita income (deciles)			
1 (lowest)	8.83	10.39	10.34
2	9.13	10.07	9.94
3	9.5	9.77	9.87
4	9.52	9.34	9.54
5	9.76	9.56	9.54
6	9.93	9.67	9.67
7	9.9	9.49	9.62
8	10.13	9.69	10.01
9	10	9.96	9.73
10	10.08	9.47	9.06
missing	2.83	2.59	2.7
Marital status			
Single	18.90	19.27	15.81
Married	71.60	71.78	73.5
Divorced	6.09	6.84	8.38
Widowed	3	1.99	2.2

Males (age 16-59 in first year)	Whole sample	Participating sample	Always-smoking sample
missing	0.19	0.12	0.12
Education			
University	17.3	13.51	11.06
Tec & Med	15.75	15.19	15.64
High School (11 years)	40	45.11	44.98
Basic (8 years)	25.63	25.77	27.9
missing	0.88	0.42	0.41
Occupation			
Managerial & Professional	15.93	13.77	12.61
Non-manual	4	3.81	3.58
Manual	34	37.3	41.58
Unskilled	8	8.6	9.67
No Occupation	39	36.45	32.48
missing	0	0.07	0.07
Observations	26,210	18,605	11,412

7-B SAMPLE COMPOSITION FOR DIFFERENT SAMPLE SPECIFICATIONS (FEMALES)

Females (age 16-54 in first year)	Whole sample	Participating sample	Always-smoking sample
Year			
2001	8.76	8.56	7.9
2002	9.26	9.37	9.08
2003	9.72	9.61	9.47
2004	10.12	9.86	9.57
2005	9.49	9.36	8.8
2006	11.43	11.46	11.69
2007	11.26	11.52	11.96
2008	10.99	11.28	11.92
2009	9.82	9.93	10.25
2010	9.16	9.04	9.36
Region			
Moscow & St. Petersburg	11.07	19.29	25.38
Northern & North Western	6.37	10.21	12.5
Central & Central Black Earth	18.87	17.17	18.03
Volga-Vyatski & Volga Basin	17.3	11.06	6.36
North Caucasian	14.22	8.41	5.89
Ural	14.38	14.47	11.28
Western Siberian	9.46	9.45	9.95
Eastern Siberian & Far Eastern	8.32	9.94	10.61
Settlement type			
City >500,000	31.33	42.16	45.42
City 50,000-500,000	29.81	32.98	31.42
Rural & Town <50,000	38.86	24.86	23.16
Age			
15-17	0.91	1.59	0.52
18-24	9.41	16.58	9.86
25-34	16.54	31.24	28.51
35-44	18.55	27.19	31.56
45-54	17.7	15.16	19.48
Number of household members			

Females (age 16-54 in first year)	Whole sample	Participating sample	Always-smoking sample
1	14	7.45	9.25
2	25	19.36	23.9
3	24.16	30.61	27.18
4	19.26	22.16	21.02
5+	17.92	20.42	18.64
Number of other smokers			
0	80.34	46.51	33.5
1	14.21	35.35	43.26
2	3.82	12.31	16.19
3	0.91	3.42	3.99
4-7	1	2.27	3.06
missing	0.14	0.14	0
Real per capita income (deciles)			
1 (lowest)	8.50	10.58	10.53
2	9.53	9.75	8.97
3	9.95	8.26	7.67
4	9.9	7.8	7.7
5	10	7.79	7.12
6	9.76	8.78	7.27
7	9.55	8.47	8.09
8	9.39	9.45	9.88
9	9.47	10.8	11.46
10	9.03	11.33	11.98
missing	5.18	6.99	9.34
Marital status			
Single	14.24	21.08	15
Married	53.49	54.66	55.56
Divorced	11.46	16.9	21.16
Widowed	20.61	7.08	7.97
missing	0	0.28	0.3
Education			
University	20	17.31	16.01
Tec & Med	25	24.55	24.08

Females (age 16-54 in first year)	Whole sample	Participating sample	Always-smoking sample
High School (11 years)	29	39.15	39.42
Basic (8 years)	24.7	18.4	19.83
missing	1	0.59	0.66
Occupation			
Managerial & Professional	25.98	27.21	23.79
Non-manual	13.53	21.45	24.05
Manual	5.84	9.45	8.99
Unskilled	6.22	8.2	9.26
No Occupation	48.37	33.6	33.91
missing	0.05	0.09	0
Observations	52,999	11,190	4,476

7-C Estimators set I (males)

	Always-smoking sample			Participating sample		
Consumption (males)	reg	xtreg FE	xtreg RE	reg	xtreg FE	xtreg RE
	b/p	b/p	b/p	b/p	b/p	b/p
$\boldsymbol{Cigarette\ consumption_{t-1}}$	0.5570***	-0.0463**	0.5570***	0.6017***	0.0227	0.6017***
	(0.013)	(0.016)	(0.013)	(0.010)	(0.013)	(0.010)
Price	-1.6339***	-0.6166	-1.6339***	-0.6079*	0.2527	-0.6079*
	(0.323)	(0.570)	(0.323)	(0.278)	(0.465)	(0.278)
Income	0.2819**	0.1355	0.2819**	0.0891	0.1572	0.0891
	(0.089)	(0.104)	(0.089)	(0.090)	(0.106)	(0.090)
Age in years	0.1360***	0.4435	0.1360***	0.1745***	0.6209***	0.1745***
	(0.027)	(0.229)	(0.027)	(0.024)	(0.151)	(0.024)
Age in years # Age in years	-0.0013***	-0.0046***	-0.0013***	-0.0017***	-0.0066***	-0.0017***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
Technical, medical, pedagogical, art college	0.0229	0.0207	0.0229	0.3461	0.0241	0.3461
	(0.238)	(0.625)	(0.238)	(0.220)	(0.481)	(0.220)
Complete secondary education	0.4105	0.3651	0.4105	0.6507**	0.1699	0.6507**
	(0.219)	(0.597)	(0.219)	(0.199)	(0.478)	(0.199)
Incomplete secondary education	0.7005**	0.3321	0.7005**	1.1440***	0.3101	1.1440***
	(0.235)	(0.619)	(0.235)	(0.217)	(0.505)	(0.217)
Non-manual occupation	0.4820	0.6479	0.4820	0.4868	-0.0618	0.4868
	(0.326)	(0.482)	(0.326)	(0.291)	(0.401)	(0.291)
Manual occupation	0.6240**	0.5112	0.6240**	0.6685***	0.1752	0.6685***
	(0.215)	(0.323)	(0.215)	(0.197)	(0.286)	(0.197)
Unskilled occupation	0.5089	0.7256	0.5089	0.6616**	0.3705	0.6616**
	(0.268)	(0.383)	(0.268)	(0.250)	(0.342)	(0.250)
No occupation	-0.2672	-0.7859*	-0.2672	-0.3853	-1.0961***	-0.3853
	(0.235)	(0.344)	(0.235)	(0.210)	(0.295)	(0.210)
1 other smoker in household	0.2167	-0.0664	0.2167	2.2706***	3.3271***	2.2706***
	(0.134)	(0.230)	(0.134)	(0.131)	(0.224)	(0.131)
2 other smokers in household	0.4666	0.0164	0.4666	3.3487***	5.2180***	3.3487***
	(0.246)	(0.373)	(0.246)	(0.225)	(0.401)	(0.225)
3 other smokers in household	0.8767*	0.3030	0.8767*	3.6722***	5.3016***	3.6722***
	(0.409)	(0.611)	(0.409)	(0.392)	(0.573)	(0.392)
4-7 other smokers in household	0.7907	-0.7929	0.7907	4.2633***	5.6704***	4.2633***
	(0.471)	(0.783)	(0.471)	(0.444)	(0.872)	(0.444)
Number of adults in household	-0.1736**	-0.0857	-0.1736**	-0.5787***	-0.8449***	-0.5787***

	Always-smoking sample			Participating sample		
Consumption (males)	reg	xtreg FE	xtreg RE	reg	xtreg FE	xtreg RE
	b/p	b/p	b/p	b/p	b/p	b/p
	(0.067)	(0.121)	(0.067)	(0.056)	(0.112)	(0.056)
Number of children in household	0.0623	0.0158	0.0623	-0.1085	-0.2369	-0.1085
	(0.071)	(0.144)	(0.071)	(0.065)	(0.131)	(0.065)
Married	0.3456	0.0663	0.3456	0.3729*	0.3975	0.3729*
	(0.185)	(0.358)	(0.185)	(0.172)	(0.327)	(0.172)
Divorced	0.6522*	0.5119	0.6522*	0.9603***	1.0950*	0.9603***
	(0.258)	(0.447)	(0.258)	(0.259)	(0.452)	(0.259)
Widowed	-0.0885	0.0135	-0.0885	0.1782	-0.0027	0.1782
	(0.462)	(0.805)	(0.462)	(0.420)	(0.743)	(0.420)
City 50,000-500,000 inhabitants	-0.4094*	-1.2916**	-0.4094*	-0.0818	-0.9326*	-0.0818
	(0.188)	(0.494)	(0.188)	(0.177)	(0.457)	(0.177)
Town < 50,000 inhabitants & rural settlements	-0.2139	-0.8616	-0.2139	-0.0683	-0.7603	-0.0683
	(0.176)	(0.478)	(0.176)	(0.164)	(0.435)	(0.164)
North & Northwestern	0.3388		0.3388	0.2552		0.2552
	(0.335)		(0.335)	(0.329)		(0.329)
Central & Central Black Earth	0.1000		0.1000	0.2168		0.2168
	(0.259)		(0.259)	(0.250)		(0.250)
Volga Basin & Volga Vaytski	-0.3957		-0.3957	-0.0039		-0.0039
	(0.261)		(0.261)	(0.247)		(0.247)
North Caucasus	0.4780		0.4780	-0.3560		-0.3560
	(0.318)		(0.318)	(0.273)		(0.273)
Ural	-0.7277*		-0.7277*	-0.3157		-0.3157
	(0.291)		(0.291)	(0.275)		(0.275)
Western Siberia	0.3214		0.3214	0.4780		0.4780
	(0.302)		(0.302)	(0.293)		(0.293)
Eastern Siberia & Far Eastern	-0.2330		-0.2330	0.0487		0.0487
	(0.289)		(0.289)	(0.273)		(0.273)
Year	-0.0064	0.0763	-0.0064	-0.0574**	-0.1227	-0.0574**
	(0.020)	(0.218)	(0.020)	(0.019)	(0.140)	(0.019)
Constant	6.4024***	9.3148	6.4024***	3.2033**	2.6355	3.2033**
	(1.291)	(6.404)	(1.291)	(1.150)	(4.100)	(1.150)
sigma_mu		7.287	0.000		6.510	0.000
rho		0.592	0.000		0.611	0.000
Observations	20,959	20,959	20,959	13,248	13,248	13,248

Consumption (males)	Always-smoking sample reg	xtreg FE	xtreg RE	Participating sample reg	xtreg FE	xtreg RE
	b/p	b/p	b/p	b/p	b/p	b/p
Degrees of freedom	31	23	31	31	23	31

Always-smoking sample: Individuals who (i) are observed at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (males age 15-59), (iii) smoke in all rounds they are observed and report positive cigarette consumption.
Participating sample: Individuals who (i) are observed for at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (males age 15-59), (iii) report positive cigarette consumption in at least one round.

reg = ordinary least-squares regression estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
xtreg FE = ordinary least-squares regression with fixed effects
xtreg RE = ordinary least-squares regression with random effects

Reference categories: University education, Managerial and professional occupation, 0 other smokers in household, Single, City>500,000 inhabitants, Moscow & St. Petersburg,
Price = Average of price for domestic & foreign cigarette brands (real, logged)
Income = Equivalised income per capita (real, logged)
b: Regression coefficient; p: p-value *** p<0.01 ** p<0.05 * p<0.1

7-D Estimators set I (females)

Consumption (females)	Always-smoking sample reg	xtreg FE	xtreg RE	Participating sample reg	xtreg FE	xtreg RE
	b/p	b/p	b/p	b/p	b/p	b/p
$\boldsymbol{Cigarette\ consumption_{t-1}}$	0.6234***	-0.0617*	0.5946***	0.6084***	0.0439**	0.5685***
	(0.021)	(0.026)	(0.022)	(0.014)	(0.017)	(0.014)
Price	-1.0358	-0.3743	-1.0889*	-1.1462***	-0.6963	-1.1942***
	(0.530)	(0.859)	(0.541)	(0.338)	(0.529)	(0.346)
Income	-0.0107	0.3779*	0.0003	0.0985	0.2471*	0.1067
	(0.127)	(0.170)	(0.129)	(0.083)	(0.099)	(0.083)
Age in years	0.1334**	-0.1034	0.1425**	0.1176***	-0.1636	0.1316***
	(0.047)	(0.322)	(0.049)	(0.027)	(0.263)	(0.028)
Age in years # Age in years	-0.0016**	-0.0013	-0.0017**	-0.0013***	-0.0044***	-0.0015***
	(0.001)	(0.002)	(0.001)	(0.000)	(0.001)	(0.000)
Technical, medical, pedagogical, art college	0.3002	0.7957	0.3338	0.3411	1.1452**	0.3710
	(0.308)	(0.520)	(0.317)	(0.187)	(0.351)	(0.194)
Complete secondary education	1.0025**	1.2582	1.0564**	0.7088***	1.3462***	0.7704***
	(0.325)	(0.661)	(0.335)	(0.202)	(0.404)	(0.208)
Incomplete secondary education	0.5368	0.3184	0.5820	0.5867**	1.1568**	0.6679**
	(0.341)	(0.700)	(0.351)	(0.225)	(0.447)	(0.232)
Non-manual occupation	-0.0582	0.0637	-0.0470	0.1924	0.1189	0.2085

	Always-smoking sample			Participating sample		
Consumption (females)	reg	xtreg FE	xtreg RE	reg	xtreg FE	xtreg RE
	b/p	b/p	b/p	b/p	b/p	b/p
	(0.272)	(0.370)	(0.278)	(0.166)	(0.242)	(0.171)
Manual occupation	-0.0617	-0.5701	-0.0675	-0.1695	-0.5700	-0.1843
	(0.353)	(0.551)	(0.362)	(0.240)	(0.337)	(0.244)
Unskilled occupation	0.2324	-0.0777	0.2522	0.3695	0.0185	0.3807
	(0.388)	(0.511)	(0.394)	(0.244)	(0.335)	(0.250)
No occupation	0.1814	-0.1497	0.1813	0.2851	-0.1625	0.2699
	(0.287)	(0.393)	(0.292)	(0.176)	(0.233)	(0.178)
1 other smoker in household	0.2257	-0.0083	0.2335	3.5434***	4.1388***	3.7237***
	(0.256)	(0.367)	(0.261)	(0.168)	(0.206)	(0.168)
2 other smokers in household	0.2245	0.0832	0.2311	4.1453***	5.6343***	4.4357***
	(0.364)	(0.543)	(0.373)	(0.246)	(0.348)	(0.251)
3 other smokers in household	0.9648	-0.8540	0.9124	5.5089***	7.0311***	5.8438***
	(0.895)	(0.859)	(0.897)	(0.492)	(0.532)	(0.490)
4-7 other smokers in household	1.0519	0.1491	1.0705	7.8104***	9.5251***	8.2529***
	(0.702)	(1.006)	(0.721)	(0.471)	(0.844)	(0.485)
Number of adults in household	-0.0448	0.0353	-0.0374	-0.7957***	-1.0490***	-0.8441***
	(0.125)	(0.188)	(0.129)	(0.072)	(0.122)	(0.074)
Number of children in household	0.0567	0.1820	0.0659	-0.0296	-0.2308	-0.0377
	(0.120)	(0.247)	(0.123)	(0.084)	(0.182)	(0.087)
Married	0.3204	-0.3011	0.2914	-0.5069**	-0.5455	-0.5441**
	(0.311)	(0.537)	(0.319)	(0.168)	(0.310)	(0.175)
Divorced	0.5081	-0.3289	0.5007	0.5290*	0.3229	0.5557*
	(0.364)	(0.682)	(0.375)	(0.225)	(0.392)	(0.235)
Widowed	0.9851*	0.2930	0.9893	0.2265	-0.0889	0.2237
	(0.494)	(0.829)	(0.511)	(0.348)	(0.551)	(0.363)
City 50,000-500,000 inhabitants	-0.2096	0.3627	-0.2203	-0.1809	-0.1994	-0.1954
	(0.268)	(0.551)	(0.278)	(0.178)	(0.452)	(0.187)
Town < 50,000 inhabitants & rural settlements	-0.1217	-0.4392	-0.1367	-0.1878	-0.2920	-0.2032
	(0.286)	(0.738)	(0.298)	(0.174)	(0.406)	(0.182)
North & Northwestern	-0.0250		-0.0332	0.0056		-0.0228
	(0.449)		(0.469)	(0.307)		(0.328)
Central & Central Black Earth	-0.2460		-0.2706	-0.0698		-0.1257
	(0.366)		(0.383)	(0.241)		(0.257)

	Always-smoking sample			Participating sample		
Consumption (females)	reg	xtreg FE	xtreg RE	reg	xtreg FE	xtreg RE
	b/p	b/p	b/p	b/p	b/p	b/p
Volga Basin & Volga Vaytski	-0.6243		-0.6688	-0.8687***		-0.9907***
	(0.447)		(0.471)	(0.245)		(0.262)
North Caucasus	-0.0284		-0.0555	-0.3092		-0.3728
	(0.439)		(0.458)	(0.279)		(0.296)
Ural	-0.8287*		-0.9284*	-0.5431*		-0.6540*
	(0.389)		(0.403)	(0.265)		(0.279)
Western Siberia	0.1409		0.1113	0.1903		0.1315
	(0.435)		(0.461)	(0.310)		(0.330)
Eastern Siberia & Far Eastern	-0.6198		-0.6936	-0.2925		-0.3666
	(0.353)		(0.368)	(0.254)		(0.269)
Year	0.0331	0.3945	0.0361	-0.0054	0.6377*	-0.0010
	(0.029)	(0.296)	(0.030)	(0.020)	(0.248)	(0.020)
Constant	3.7173	10.7339	3.8724	2.7279*	9.3804	2.7766*
	(1.970)	(8.072)	(2.013)	(1.227)	(5.677)	(1.254)
sigma_mu		6.569	0.602		8.937	0.749
rho		0.729	0.0221		0.831	0.0334
Observations	3,294	3,294	3,294	8,488	8,488	8,488
Degrees of freedom	31	23	31	31	23	31

Always-smoking sample: Individuals who (i) are observed at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (females age 15-54), (iii) smoke in all rounds they are observed and report positive cigarette consumption.
Participating sample: Individuals who (i) are observed for at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (females age 15-54), (iii) report positive cigarette consumption in at least one round.

reg = ordinary least-squares regression estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.
xtreg FE = ordinary least-squares regression with fixed effects
xtreg RE = ordinary least-squares regression with random effects
reg = ordinary least-squares regression estimated using robust (Huber-White) standard errors that account for heteroskedasticity and repeated observations at the individual level.

Reference categories: University education, Managerial and professional occupation, 0 other smokers in household, Single, City>500,000 inhabitants, Moscow & St. Petersburg,
Price = Average of price for domestic & foreign cigarette brands (real, logged)
Income = Equivalised income per capita (real, logged)
b: Regression coefficient; p: p-value *** p<0.01 ** p<0.05 * p<0.1

7-E ESTIMATORS SET II – INSTRUMENTAL VARIABLE MODELS (MALES)

	Always-smoking sample				Participating sample			
Consumption (males)	Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)		Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)	
	First stage	Second stage	First stage	Second stage	First stage	Second stage	First stage	Second stage
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
Instrumented variable:								
$Cigarette\ consumption_{t-1}$		0.7885***		0.4354		0.6126**		0.4871
		(0.1583)		(0.3924)		(0.2792)		(0.3119)
Instruments:								
$Price_{t-1}$	-3.2334***		-2.0178**		-1.4765*		-1.8801***	
	(0.9430)		(0.8738)		(0.7810)		(0.6843)	
$Income_{t-1}$	0.5219***		0.1650		0.2874**		0.2192**	
	(0.1133)		(0.1010)		(0.1172)		(0.1014)	
$Price_t$	-0.0650	-0.8330	1.0582	-0.2748	-0.5813	-0.5582	0.9354	0.4760
	(0.8858)	(0.5827)	(0.8344)	(0.5489)	(0.7447)	(0.6165)	(0.6646)	(0.4243)
$Income_t$	0.2515**	0.1842	0.0079	0.1108	0.0833	0.0978	0.1092	0.1171
	(0.1209)	(0.1213)	(0.0955)	(0.1153)	(0.1244)	(0.1161)	(0.1071)	(0.1330)
Age in years	0.4646***	0.0342	0.3554	0.2336	0.6310***	0.1694	0.6407***	0.2897
	(0.0524)	(0.0755)	(0.2418)	(0.2905)	(0.0495)	(0.1775)	(0.1584)	(0.2560)
Age in years # Age in years	-0.0044***	-0.0003	-0.0054***	-0.0018	-0.0062***	-0.0017	-0.0077***	-0.0030
	(0.0006)	(0.0007)	(0.0011)	(0.0023)	(0.0005)	(0.0018)	(0.0010)	(0.0025)

Consumption (males)	Always-smoking sample				Participating sample			
	Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)		Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)	
	First stage	Second stage	First stage	Second stage	First stage	Second stage	First stage	Second stage
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
Technical, medical, pedagogical, art college	0.3751	-0.0959	1.2221*	-0.9604	1.0576**	0.3347	0.4683	-0.3775
	(0.4463)	(0.1894)	(0.6603)	(0.8097)	(0.4584)	(0.3669)	(0.5169)	(0.4857)
Complete secondary education	0.8887**	0.1922	0.7191	-0.5360	1.5953***	0.6367	-0.2549	0.1110
	(0.4216)	(0.2179)	(0.6722)	(0.6628)	(0.4054)	(0.4848)	(0.5165)	(0.4419)
Incomplete secondary education	1.3135***	0.3799	0.8090	-0.6410	2.7629***	1.1033	-0.1315	0.1348
	(0.4515)	(0.2747)	(0.6979)	(0.7098)	(0.4422)	(0.7970)	(0.5465)	(0.4743)
Non-manual occupation	0.9640*	0.3347	0.8704*	0.2099	1.3175**	0.5236	0.3343	-0.2303
	(0.5297)	(0.3050)	(0.4445)	(0.5958)	(0.5188)	(0.4651)	(0.3933)	(0.4026)
Manual occupation	1.1770***	0.4067*	0.2180	0.4192	1.5950***	0.6672	-0.0815	0.2083
	(0.3747)	(0.2408)	(0.3046)	(0.3214)	(0.3656)	(0.4805)	(0.2816)	(0.2782)
Unskilled occupation	0.7604*	0.3600	0.3896	0.4672	1.1425**	0.6205	0.0329	0.3218
	(0.4426)	(0.2499)	(0.3525)	(0.4077)	(0.4522)	(0.4040)	(0.3277)	(0.3441)
No occupation	0.2841	-0.2882	0.0207	-0.7910**	-0.2144	-0.3996*	-0.4454	-0.8786***
	(0.4019)	(0.1917)	(0.3230)	(0.3329)	(0.3883)	(0.2145)	(0.2956)	(0.3158)
1 other smoker in household	0.2985	0.1607	-0.2910	0.0343	2.6467***	2.2421***	0.3222*	3.2127***
	(0.2446)	(0.1180)	(0.2043)	(0.2526)	(0.2223)	(0.7431)	(0.1954)	(0.2504)
2 other smokers in household	1.0775**	0.2186	0.0510	-0.1718	4.6295***	3.2568**	0.7377*	4.8483***
	(0.4545)	(0.2665)	(0.3736)	(0.3763)	(0.4201)	(1.3093)	(0.3869)	(0.4736)

	Always-smoking sample				Participating sample			
Consumption (males)	Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)		Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)	
	First stage	Second stage	First stage	Second stage	First stage	Second stage	First stage	Second stage
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
3 other smokers in household	1.0661*	0.6798*	-0.0769	0.0951	5.5836***	3.6677**	0.3726	5.1204***
	(0.6379)	(0.4058)	(0.6234)	(0.6292)	(0.6065)	(1.5737)	(0.6795)	(0.6583)
4-7 other smokers in household	1.5680*	0.4658	0.0236	-1.0727	6.6186***	4.1860**	0.5203	5.2069***
	(0.8761)	(0.4347)	(0.7452)	(0.7336)	(0.9386)	(1.8717)	(0.9343)	(0.8958)
Number of adults in household	-0.2938**	-0.1074	0.0444	-0.0702	-0.9732***	-0.5638**	-0.2127*	-0.7497***
	(0.1311)	(0.0681)	(0.1199)	(0.1207)	(0.1168)	(0.2746)	(0.1157)	(0.1347)
Number of children in household	0.1357	0.0571	0.1456	-0.0337	-0.3422**	-0.0776	0.0861	-0.2430**
	(0.1341)	(0.0578)	(0.1384)	(0.1375)	(0.1352)	(0.1155)	(0.1286)	(0.1168)
Married	0.9359***	0.0749	0.2673	-0.0961	1.2805***	0.3237	0.3613	0.2178
	(0.3370)	(0.2126)	(0.3949)	(0.3652)	(0.3314)	(0.4006)	(0.3254)	(0.3418)
Divorced	0.9096**	0.4729*	0.1242	0.5014	2.0287***	0.9902	0.5702	0.8492*
	(0.4622)	(0.2497)	(0.4838)	(0.4477)	(0.4850)	(0.6280)	(0.4341)	(0.4946)
Widowed	0.1300	-0.1806	0.0243	0.0134	1.6749*	0.1158	0.3799	-0.2178
	(0.8635)	(0.3520)	(0.6690)	(0.7071)	(0.8736)	(0.6280)	(0.6775)	(0.7057)
City 50,000-500,000 inhabitants	-0.7422*	-0.2150	-1.4139***	-0.6351	-0.3191	-0.0789	-0.7762	-0.5727
	(0.3808)	(0.1800)	(0.5220)	(0.7281)	(0.3782)	(0.1997)	(0.4911)	(0.4927)
Town < 50,000 inhabitants & rural settlements	-0.2791	-0.1115	-1.0849**	-0.5128	-0.4873	-0.0597	-0.8723**	-0.4829
	(0.3594)	(0.1347)	(0.4910)	(0.6918)	(0.3453)	(0.2206)	(0.4356)	(0.5444)
North & Northwestern	0.4363	0.3013			0.6690	0.2969		

	Always-smoking sample				Participating sample			
Consumption (males)	Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)		Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)	
	First stage	Second stage	First stage	Second stage	First stage	Second stage	First stage	Second stage
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
	(0.6537)	(0.2526)			(0.6978)	(0.3881)		
Central & Central Black Earth	0.3438	0.0122			0.5762	0.2116		
	(0.5095)	(0.1984)			(0.5336)	(0.3024)		
Volga Basin & Volga Vaytski	-1.4282***	-0.0317			-0.8821*	0.0306		
	(0.5000)	(0.2818)			(0.5276)	(0.3434)		
North Caucasus	0.5365	0.3179			-1.8541***	-0.3298		
	(0.6014)	(0.2490)			(0.5866)	(0.5699)		
Ural	-1.7050***	-0.3218			-1.2494**	-0.2834		
	(0.5651)	(0.3280)			(0.5931)	(0.4345)		
Western Siberia	-0.3196	0.3724*			0.1366	0.4704		
	(0.5947)	(0.2114)			(0.6276)	(0.2888)		
Eastern Siberia & Far Eastern	-1.0622*	0.0521			-0.3728	0.0709		
	(0.5491)	(0.2545)			(0.5622)	(0.2864)		
Year	-0.0703*	-0.0115	0.2238	-0.0336	-0.1247***	-0.0547*	-0.0504	-0.0905
	(0.0394)	(0.0180)	(0.2327)	(0.2811)	(0.0368)	(0.0300)	(0.1482)	(0.1567)
Constant	149.2333*	26.6009			251.8562***	111.8717*		
	(78.2400)	(35.6853)			(72.9636)	(60.5142)		
Hansen J statistic		0.096		0.461		1.517	0.000	0.968

Consumption (males)	Always-smoking sample				Participating sample			
	Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)		Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)	
	First stage	Second stage	First stage	Second stage	First stage	Second stage	First stage	Second stage
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
p-value of Hansen J statistic		0.757		0.497		0.218		0.325
Degrees of freedom of Hansen J statistic		1.000		1.000		1.000		1.000
Observations	12,970	12,970	12,885	12,885	20,519	20,519	20,403	20,403
Degrees of freedom	32	31	25	24	32	31	25	24

Always-smoking sample: Individuals who (i) are observed at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (males age 15-59), (iii) smoke in all rounds they are observed and report positive cigarette consumption.
Participating sample: Individuals who (i) are observed for at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (males age 15-59), (iii) report positive cigarette consumption in at least one round.

Reference categories: University education, Managerial and professional occupation, 0 other smokers in household, Single, City>500,000 inhabitants, Moscow & St. Petersburg
Price = Average of price for domestic & foreign cigarette brands (real, logged); Income = Equivalised income per capita (real, logged)

b: Regression coefficient; se: Standard error of regression coefficient, *** p<0.01 ** p<0.05 * p<0.1

7-F Estimators set II – Instrumental variable models (females)

	Always-smoking sample				Participating sample			
Consumption (females)	Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)		Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)	
	First stage	Second stage	First stage	Second stage	First stage	Second stage	First stage	Second stage
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
Instrumented variable:								
$Cigarette\ consumption_{t-1}$		0.9160		0.5107		0.7137		0.1294
		(1.1321)		(0.5258)		(0.7368)		(0.6464)
Instruments:								
$Price_{t-1}$	-1.4250		-0.4328		-1.1210		-0.6520	
	(2.0149)		(1.4246)		(1.1666)		(0.8337)	
$Income_{t-1}$	-0.0004		0.2849*		-0.0257		0.1364	
	(0.1669)		(0.1678)		(0.1133)		(0.1056)	
$Price_t$	-0.1766	-0.5261	1.7995	-0.9725	-0.8208	-0.9602	0.9377	-0.5171
	(2.0481)	(1.8641)	(1.7025)	(1.1191)	(1.1618)	(1.4227)	(0.9365)	(0.5880)
$Income_t$	0.2506	-0.0935	0.5475***	0.0937	0.3775***	0.0339	0.3045***	0.2214
	(0.1956)	(0.3032)	(0.1697)	(0.3857)	(0.1252)	(0.2781)	(0.1016)	(0.2086)
Age in years	0.4499***	0.0031	-0.1337	-0.0731	0.4705***	0.0650	0.1813	-0.2154
	(0.1070)	(0.5111)	(0.3605)	(0.3214)	(0.0571)	(0.3473)	(0.2577)	(0.2767)
Age in years # Age in years	-0.0049***	-0.0001	-0.0031	0.0009	-0.0050***	-0.0008	-0.0078***	-0.0038
	(0.0013)	(0.0056)	(0.0021)	(0.0022)	(0.0007)	(0.0037)	(0.0013)	(0.0053)
Technical, medical, pedagogical, art college	0.9319	0.1005	-1.4311*	1.5879*	0.5629	0.3081	-0.2306	1.2537***

Consumption (females)	Always-smoking sample				Participating sample			
	Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)		Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)	
	First stage	Second stage	First stage	Second stage	First stage	Second stage	First stage	Second stage
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
	(0.7136)	(1.0721)	(0.8334)	(0.9617)	(0.4183)	(0.4318)	(0.5165)	(0.3711)
Complete secondary education	1.7481**	0.5562	-1.1438	1.7872*	1.3788***	0.5754	-0.1320	1.3631***
	(0.7467)	(1.9876)	(0.9144)	(0.9916)	(0.4372)	(1.0309)	(0.5537)	(0.3996)
Incomplete secondary education	2.3411***	-0.1772	-0.9981	0.6738	1.8795***	0.3807	-0.0895	1.1213**
	(0.7648)	(2.6649)	(0.9505)	(0.9733)	(0.4951)	(1.4007)	(0.5812)	(0.4397)
Non-manual occupation	0.3207	-0.1174	0.2087	-0.0314	1.0492***	0.1230	0.4041	0.1026
	(0.5679)	(0.4131)	(0.3734)	(0.4164)	(0.3503)	(0.7852)	(0.2689)	(0.3654)
Manual occupation	-0.2248	0.0051	-0.5055	-0.0139	-0.0378	-0.1759	-0.3726	-0.4007
	(0.7642)	(0.3692)	(0.5191)	(0.5593)	(0.5180)	(0.2112)	(0.3815)	(0.4017)
Unskilled occupation	-0.2006	0.3243	-0.6521	0.3842	0.2168	0.3870	-0.4179	0.0824
	(0.7872)	(0.3803)	(0.4716)	(0.6278)	(0.4684)	(0.2621)	(0.3528)	(0.3873)
No occupation	0.6845	0.0156	0.0456	-0.1180	1.0761***	0.1714	0.1923	-0.1392
	(0.6170)	(0.8136)	(0.3916)	(0.4271)	(0.3781)	(0.8077)	(0.2805)	(0.2604)
1 other smoker in household	0.5706	0.0431	0.1066	-0.0816	3.8648***	3.0924	0.3443*	4.1318***
	(0.5311)	(0.6787)	(0.3743)	(0.4019)	(0.2447)	(2.8616)	(0.1765)	(0.3078)
2 other smokers in household	0.6274	-0.0102	0.6562	-0.2149	5.3187***	3.5211	1.1791***	5.5787***
	(0.7110)	(0.7820)	(0.6401)	(0.7027)	(0.4026)	(3.9320)	(0.3484)	(0.8411)
3 other smokers in household	1.9222	0.5361	0.3043	-0.8706	6.9130***	4.7299	0.6245	6.8804***
	(1.1781)	(2.4018)	(1.0413)	(1.1219)	(0.6921)	(5.1490)	(0.5854)	(0.6762)

	Always-smoking sample				Participating sample			
Consumption (females)	Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)		Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)	
	First stage	Second stage	First stage	Second stage	First stage	Second stage	First stage	Second stage
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
4-7 other smokers in household	3.3662**	0.1908	1.1781	-0.3533	9.5476***	6.8217	0.6102	9.3627***
	(1.6206)	(3.9025)	(1.4079)	(1.6136)	(1.0355)	(7.0519)	(0.8452)	(0.9541)
Number of adults in household	-0.0765	-0.0162	-0.0905	0.0076	-0.9644***	-0.6722	-0.0969	-1.0197***
	(0.2352)	(0.1459)	(0.2753)	(0.2506)	(0.1265)	(0.7172)	(0.1286)	(0.1428)
Number of children in household	0.0401	0.0411	0.1306	0.1378	-0.2656*	0.0031	-0.4435***	-0.2110
	(0.2528)	(0.0941)	(0.2629)	(0.2165)	(0.1567)	(0.2059)	(0.1532)	(0.3636)
Married	-0.2507	0.4110	-0.2380	-0.1624	-0.6201*	-0.3502	-0.2081	-0.4827
	(0.6186)	(0.3600)	(0.5058)	(0.5903)	(0.3237)	(0.4826)	(0.3164)	(0.3449)
Divorced	0.8052	0.3350	0.2800	-0.4104	1.3509***	0.4928	0.4285	0.2744
	(0.6786)	(0.9819)	(0.5512)	(0.6809)	(0.4422)	(1.0314)	(0.3731)	(0.4492)
Widowed	0.8295	0.6749	0.9037	-0.2335	0.7095	0.2140	0.7122	-0.0571
	(0.9816)	(1.0434)	(0.7426)	(0.9121)	(0.6578)	(0.6152)	(0.5190)	(0.6805)
City 50,000-500,000 inhabitants	-0.5974	-0.1214	0.2483	0.0812	-0.5060	-0.1909	-0.2210	-0.2185
	(0.5826)	(0.7059)	(0.6019)	(0.6353)	(0.3725)	(0.4117)	(0.4663)	(0.4447)
Town < 50,000 inhabitants & rural settlements	-0.7889	0.0730	1.2501	-1.0557	-0.6580*	-0.1490	0.1233	-0.2593
	(0.5842)	(0.9113)	(0.8715)	(1.2475)	(0.3543)	(0.5128)	(0.4614)	(0.4186)
North & Northwestern	-1.0300	0.3208			-0.9630	0.1151		
	(0.9111)	(1.1986)			(0.6513)	(0.7415)		

	Always-smoking sample				Participating sample			
Consumption (females)	Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)		Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)	
	First stage	Second stage	First stage	Second stage	First stage	Second stage	First stage	Second stage
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
Central & Central Black Earth	-0.7513	-0.0789			-1.5088***	0.0304		
	(0.8349)	(0.8500)			(0.5463)	(1.1100)		
Volga Basin & Volga Vaytski	-1.6889*	-0.1027			-2.9394***	-0.5699		
	(1.0155)	(1.8747)			(0.5468)	(2.1302)		
North Caucasus	-1.2862	0.3251			-2.1292***	-0.0578		
	(0.9579)	(1.4918)			(0.6146)	(1.5823)		
Ural	-3.1820***	0.1146			-2.7159***	-0.2349		
	(0.8151)	(3.5837)			(0.5587)	(1.9772)		
Western Siberia	-0.3147	0.0635			-0.6099	0.2088		
	(1.0245)	(0.4197)			(0.6760)	(0.4957)		
Eastern Siberia & Far Eastern	-1.7858**	-0.1590			-1.7367***	-0.1550		
	(0.7633)	(2.0025)			(0.5765)	(1.2486)		
Year	0.0834	-0.0034	0.5184	0.0643	0.0530	-0.0188	0.5760**	0.6232
	(0.0768)	(0.1298)	(0.3277)	(0.4244)	(0.0449)	(0.0559)	(0.2439)	(0.4950)
Constant	-163.2356	9.7233			-106.3479	40.6216		
	(153.9435)	(255.6515)			(89.6601)	(112.1393)		
Hansen J statistic		1.123		0.042		2.295		0.166
p-value of Hansen J statistic		0.289		0.837		0.130		0.684
Degrees of freedom of Hansen J statistic		1.000		1.000		1.000		1.000

	Always-smoking sample				Participating sample			
Consumption (females)	Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)		Pooled IV regression (2SLS)		IV with fixed effects (2SLS with FE)	
	First stage	Second stage	First stage	Second stage	First stage	Second stage	First stage	Second stage
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
Observations	3,138	3,138	3,093	3,093	8,129	8,129	8,042	8,042
Degrees of freedom	32	31	25	24	32	31	25	24

Always-smoking sample: Individuals who (i) are observed at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (females age 15-54), (iii) smoke in all rounds they are observed and report positive cigarette consumption.
Participating sample: Individuals who (i) are observed for at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (females age 15-54), (iii) report positive cigarette consumption in at least one round.

Reference categories: University education, Managerial and professional occupation, 0 other smokers in household, Single, City>500,000 inhabitants, Moscow & St. Petersburg
Price = Average of price for domestic & foreign cigarette brands (real, logged); Income = Equivalised income per capita (real, logged)

b: Regression coefficient; se: Standard error of regression coefficient, *** p<0.01 ** p<0.05 * p<0.1

7-G ESTIMATORS SET III – GMM MODELS (MALES)

Males	Difference GMM		System GMM	
Sample specification	Always-smoking	Participating	Always-smoking	Participating
	b/p	b/p	b/p	b/p
Cigarette consumption$_{t-1}$	0.0568**	0.0784***	0.3460***	0.6217***
	(0.028)	(0.000)	(0.000)	(0.000)
Price	-1.3840	-0.6018	-1.4055	-2.5892**
	(0.170)	(0.497)	(0.179)	(0.031)
Income	-0.6485	-0.1168	-0.0644	-2.7049**
	(0.314)	(0.831)	(0.894)	(0.022)
Age in years	0.5250**	0.6745***	0.2327***	0.1144*
	(0.025)	(0.001)	(0.000)	(0.057)
Age in years # Age in years	-0.0040***	-0.0064***	-0.0021***	-0.0011*
	(0.000)	(0.000)	(0.000)	(0.067)
Technical, medical, pedagogical, art college	-0.1304	-0.1880	0.1366	0.0471
	(0.834)	(0.756)	(0.678)	(0.856)
Complete secondary education	0.0093	0.3755	0.5646*	0.2072
	(0.988)	(0.514)	(0.075)	(0.464)
Incomplete secondary education	0.0656	0.4886	0.8603**	0.4289
	(0.917)	(0.421)	(0.021)	(0.293)
Non-manual occupation	0.2974	-0.5747	0.8121*	0.1083
	(0.536)	(0.206)	(0.067)	(0.759)
Manual occupation	0.5461*	0.3367	0.7014**	0.2010
	(0.094)	(0.297)	(0.030)	(0.479)
Unskilled occupation	0.6535*	0.3723	0.5434	-0.2110
	(0.091)	(0.374)	(0.159)	(0.614)
No occupation	-0.9989**	-0.9025**	-0.5420	-1.8585***
	(0.012)	(0.022)	(0.212)	(0.005)
1 other smoker in household	-0.0823	1.9265**	0.7742	0.9950
	(0.907)	(0.019)	(0.263)	(0.433)
2 other smokers in household	1.5992	4.5226***	2.4152**	4.3645*
	(0.212)	(0.001)	(0.017)	(0.051)
3 other smokers in household	0.6094	5.2055**	2.2349*	3.6466
	(0.692)	(0.022)	(0.071)	(0.219)
4-7 other smokers in household	1.6415	6.3545**	3.3269**	10.8967**
	(0.403)	(0.013)	(0.049)	(0.019)
Number of adults in household	-0.2367	-0.6898***	-0.4521**	-0.6462**

Males	Difference GMM		System GMM	
Sample specification	Always-smoking	Participating	Always-smoking	Participating
	b/p	b/p	b/p	b/p
	(0.230)	(0.002)	(0.014)	(0.022)
Number of children in household	-0.0969	-0.5535***	-0.0478	-0.6197***
	(0.548)	(0.007)	(0.680)	(0.000)
Married	-0.1309	-0.4280	0.5518**	0.5477**
	(0.716)	(0.299)	(0.032)	(0.026)
Divorced	0.1154	-0.2301	0.8101**	0.6054*
	(0.784)	(0.676)	(0.020)	(0.081)
Widowed	-0.6158	-1.5885	-0.3754	-0.3133
	(0.507)	(0.130)	(0.567)	(0.546)
City 50,000-500,000 inhabitants	-0.8753*	-0.1806	-0.5288**	-0.5117**
	(0.084)	(0.741)	(0.017)	(0.044)
Town < 50,000 & rural settlements	-0.3937	-0.1183	-0.2704	-0.7570*
	(0.401)	(0.824)	(0.292)	(0.091)
Year	-0.0019	-0.1913	0.0250	0.2042*
	(0.993)	(0.339)	(0.616)	(0.079)
Constant			9.7282*	30.5697***
			(0.078)	(0.005)
Hansen J Statistic	232.9	270.0	228.7	58.53
Hansen degrees of freedom	231	231	231	42
Hansen p-value	0.453	0.040	0.530	0.047
AR(1)	-13.79	-17.11	-9.413	-9.798
AR(1) p-value	0.000	0.000	0.000	0.000
AR(2)	1.299	1.664	3.677	4.438
AR(2) p-value	0.194	0.096	0.000	0.000
AR(3)			-0.068	0.643
AR(3) p-value			0.946	0.520
Observations	10,608	16,454	13,248	20,959
Degrees of freedom	24	24	24	24

Always-smoking sample: Individuals who (i) are observed at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (males age 15-59), (iii) smoke in all rounds they are observed and report positive cigarette consumption.
Participating sample: Individuals who (i) are observed for at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (males age 15-59), (iii) report positive cigarette consumption in at least one round.

Reference categories: University education, Managerial and professional occupation, 0 other smokers in household, Single, City>500,000 inhabitants, Moscow & St. Petersburg

Price = Average of price for domestic & foreign cigarette brands (real terms, logged)
Income = Equivalised income per capita (real, logged)

b: Regression coefficient; p: p-value *** p<0.01 ** p<0.05 * p<0.1

Males	Difference GMM		System GMM	
Sample specification	Always-smoking	Participating	Always-smoking	Participating
	b/p	b/p	b/p	b/p

Hansen J Statistic: Sargan–Hansen test of overidentifying restrictions (used to determine the validity of the instruments), the null hypothesis is that J =0, meaning that the overidentification restrictions are valid
Hansen degrees of freedom: degrees-of-freedom adjustment for the number of instruments
AR(1): Arellano-Bond test of first-order serial correlation, null hypothesis = no serial correlation
AR(2): Arellano-Bond test of second-order serial correlation, used to detect autocorrelation in the underlying levels variables in first differences. The presence of significant AR(2) is a diagnostic test of the validity of the instruments, complementary to the standard Sargan–Hansen test of overidentifying restrictions, null hypothesis = no serial correlation
AR(3): Arellano-Bond test of third-order serial correlation, null hypothesis = no serial correlation

7-H ESTIMATORS SET III – GMM MODELS (FEMALES)

Females	Difference GMM		System GMM	
Sample specification	Always-smoking	Participating	Always-smoking	Participating
	b/p	b/p	b/p	b/p
$\boldsymbol{Cigarette\ consumption_{t-1}}$	0.0469	0.0503	0.3191***	0.4525***
	(0.350)	(0.149)	(0.008)	(0.000)
$Price_{t-1}$	-1.7172	-2.0473*	1.2916	-0.3297
	(0.246)	(0.063)	(0.405)	(0.738)
Income	-0.3465	0.8004*	0.2980	0.9823*
	(0.691)	(0.081)	(0.674)	(0.063)
Age in years	-0.0368	0.3027	0.1965**	0.1599***
	(0.937)	(0.390)	(0.025)	(0.000)
Age in years # Age in years	0.0019	-0.0043**	-0.0022**	-0.0018***
	(0.604)	(0.049)	(0.028)	(0.001)
Technical, medical, pedagogical, art college	1.1712	0.7141	0.4462	0.6435**
	(0.200)	(0.156)	(0.466)	(0.034)
Complete secondary education	1.5737	0.9830*	1.2438*	0.9348***
	(0.130)	(0.071)	(0.066)	(0.009)
Incomplete secondary education	0.7439	0.8115	0.8854	1.0228**
	(0.504)	(0.175)	(0.237)	(0.021)
Non-manual occupation	-0.3211	0.0402	-0.2116	0.4465*
	(0.476)	(0.882)	(0.682)	(0.090)
Manual occupation	0.3373	-0.2243	0.0498	0.1619
	(0.591)	(0.587)	(0.948)	(0.674)
Unskilled occupation	0.8348	0.5800*	0.6546	0.7520**
	(0.192)	(0.093)	(0.413)	(0.040)
No occupation	0.0845	-0.0428	0.5128	0.8908**

Females	Difference GMM		System GMM	
Sample specification	Always-smoking	Participating	Always-smoking	Participating
	b/p	b/p	b/p	b/p
	(0.876)	(0.880)	(0.475)	(0.013)
1 other smoker in household	-0.0434	3.1201***	-1.6350	4.4410***
	(0.936)	(0.000)	(0.215)	(0.000)
2 other smokers in household	-0.1173	3.0121***	0.5126	6.4708***
	(0.885)	(0.010)	(0.757)	(0.000)
3 other smokers in household	-0.8013	5.0750***	5.4555**	7.9634***
	(0.527)	(0.007)	(0.012)	(0.000)
4-7 other smokers in household	-0.0878	6.9211***	4.1980*	11.0365***
	(0.966)	(0.000)	(0.052)	(0.000)
Number of adults in household	-0.2100	-0.6984***	-0.5873	-1.2039***
	(0.500)	(0.005)	(0.115)	(0.000)
Number of children in household	0.0117	-0.0555	0.2491	0.0084
	(0.969)	(0.779)	(0.246)	(0.950)
Married	-1.0339	-0.8854*	1.0452	-0.6544**
	(0.144)	(0.051)	(0.177)	(0.023)
Divorced	-1.5331*	-0.4179	0.5879	0.7111**
	(0.054)	(0.409)	(0.364)	(0.026)
Widowed	-1.1073	-1.2273	0.9808	0.3485
	(0.317)	(0.108)	(0.219)	(0.500)
City 50,000-500,000 inhabitants	0.5899	-0.3388	-0.7638	-0.2457
	(0.347)	(0.500)	(0.111)	(0.246)
Town < 50,000 & rural settlements	0.5126	-0.2506	-0.3508	-0.1598
	(0.400)	(0.477)	(0.482)	(0.540)
Year	0.1511	0.1559	0.1270	-0.0315
	(0.647)	(0.572)	(0.105)	(0.530)
Constant			-2.9256	-6.6139
			(0.696)	(0.203)
Hansen J Statistic	123.5	274.8	186.5	226.3
Hansen degrees of freedom	97	234	185	191
Hansen p-value	0.036	0.035	0.455	0.041
AR(1)	-7.025	-9.702	-5.480	-10.25
AR(1) p-value	0.000	0.000	0.000	0.000
AR(2)	0.672	0.872	2.178	3.893
AR(2) p-value	0.502	0.383	0.029	0.000
AR(3)			-1.167	-0.492
AR(3) p-value			0.243	0.623

Females	Difference GMM		System GMM	
Sample specification	Always-smoking	Participating	Always-smoking	Participating
	b/p	b/p	b/p	b/p
Observations	2,355	6,288	3,138	8,129
Degrees of freedom	24	24	24	24

Always-smoking sample: Individuals who (i) are observed at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (females age 15-54), (iii) smoke in all rounds they are observed and report positive cigarette consumption.
Participating sample: Individuals who (i) are observed for at least 3 consecutive rounds, (ii) are of working-age in the first round they are observed (females age 15-54), (iii) report positive cigarette consumption in at least one round.

Reference categories: University education, Managerial and professional occupation, 0 other smokers in household, Single, City>500,000 inhabitants, Moscow & St. Petersburg

Price = Average of price for domestic & foreign cigarette brands (real terms, logged)
Income = Equivalised income per capita (real, logged)

b: Regression coefficient; p: p-value *** p<0.01 ** p<0.05 * p<0.1

Hansen J Statistic: Sargan–Hansen test of overidentifying restrictions (used to determine the validity of the instruments), the null hypothesis is that J =0, meaning that the overidentification restrictions are valid
Hansen degrees of freedom: degrees-of-freedom adjustment for the number of instruments
AR(1): Arellano-Bond test of first-order serial correlation, null hypothesis = no serial correlation
AR(2): Arellano-Bond test of second-order serial correlation, used to detect autocorrelation in the underlying levels variables in first differences. The presence of significant AR(2) is a diagnostic test of the validity of the instruments, complementary to the standard Sargan–Hansen test of overidentifying restrictions, null hypothesis = no serial correlation
AR(3): Arellano-Bond test of third-order serial correlation, null hypothesis = no serial correlation

Conclusion

Drawing on 10 years of individual-level longitudinal data from the Russia Longitudinal Monitoring Survey (RLMS-HSE) and regional-level government statistics, in this comprehensive study of Russian smoking patterns we contributed to both the epidemiological and health economic literature on smoking in the context of an important country with a large population. Throughout the thesis we make a number of smaller contributions and important observations and clarifications but our **4 most important contributions** to the literature are as follows:

1) We develop an updated and comprehensive descriptive **profile of smoking patterns in Russia** in the first decade of the 21st century. We do so with a very careful and rigorous construction of a representative sample with the RLMS data. This is far from trivial, and as we argue in various parts of the thesis, misuse of the RLMS data can produce misleading descriptive and analytical findings. Our descriptive analysis of the associations of smoking with key socioeconomic and geographic characteristics in the first decade of the 2000s provides compelling evidence on the pronounced gender differences in smoking and their dynamics: while male smoking patterns are relatively similar across the country, female smoking rates differ strongly across regions and settlement types, with the highest concentration of smokers in Moscow and St. Petersburg. The uniting feature of male and female smoking is the strong educational gradient, with individuals with higher education being considerably less likely to smoke. An important finding emerging in this context is that, while characterised by consistently high smoking rates from one cohort to the next, male smoking prevalence has been on a downward trend since 2007, particularly among the younger age groups. This descriptive profiling, crucial in its own right, provides the foundation for the life course, static and dynamic analytical work which follows.

2) Our analysis of **life-course smoking patterns**, in chapter 3, established that while male smoking has been stable at levels above 50 percent since the mid-20th century, female smoking exhibits strong cohort patterns, with prevalence rates

rising from one cohort to the next. However, in *contrast* to what has been argued in the epidemiological literature to date, we show that female smoking rates started rising well before the transition period and should therefore be interpreted in the context of broader cultural shifts and changing gender norms towards smoking, rather than simply as the direct result of the marketing activities of Transnational Tobacco Companies (TTCs). This is important and speaks to a broader and ongoing debate in the literature about the continuity in health and health-related behaviours across the Soviet and post-Soviet period which tends to be overlooked by non-Russian scholars who get caught out by over-concentrating on the euphemistically named 'transition'. Indeed, in some ways, our argument is akin to that of Gerry (2012), who illustrates persuasively that the popular contention that mass privatisation *caused* higher mortality rates in the post-communist region was erroneous and stemmed directly from an excessive focus on a hypothetical temporal discontinuity, as Soviet became post-Soviet. Of course, we by no means want to downplay the influence of the aggressive marketing strategies adopted by TTCs in the 1990s – quite to the contrary, a better understanding of the ways in which tobacco companies exploit existing cultural dynamics to propagate smoking initiation and continuation might also help design interventions to reduce the attractiveness of smoking and to promote cessation.

3) We present **a robust and comprehensive set of estimates for Russian cigarette demand**, starting from a static framework that rigorously addresses the empirical challenges related to the nature of the dependent variable and then moving into a dynamic approach to model the persistence of cigarette consumption stemming from the habit-forming/addictive nature of smoking. In line with the previous Russian literature using static demand models we find that both participation and consumption are rather unresponsive to price, and low compared to the range in the international literature. However, while small, these price elasticities might still have some sizeable effects if the government implements the tax increases as planned, especially given the very low average price of 12 roubles per packet over the sample period. For males, our dynamic specifications largely confirm the results from the static model, with the effects of price being larger once we model persistence in consumption. This is what we would expect since not taking into account persistence in consumption will impart downward bias on the coefficients. If this is correct it has important implications for the effectiveness of

the current Russian government's strategies for reducing smoking. For females, however, prices are not significant in the dynamic model. While not ruling out that females may in fact not be responsive to price (at least at the low price levels observed in the period under observation), this result at least partly stems from the higher share of zero observations in the female sample, which makes the sample specification for a single-equation estimator more problematic and goes someway to adjusting our careful two-part strategy in chapter 6. Indeed, our comparison between different sample specifications with regard to the zero observations lends further support to the importance of allowing for different data generating processes underlying the zeroes and the positive consumption values. This is an important area for future research using Russian data.

4) In being one of the very few comprehensive studies of smoking to use the RLMS data and to exploit both its cross-sectional representative element as well as its longitudinal element we have identified a number of important **empirical and methodological lessons** for users of the RLMS as well as for researchers investigating smoking patterns and persistence more generally. We detail some of these separately below.

LESSONS FROM THE EMPIRICAL AND METHODOLOGICAL CHALLENGES

A key focus in the third part of the thesis was to draw on the full range of smoking literature in addressing the various empirical challenges related to the nature of the dependent variable in microeconometric analyses of cigarette demand. In individual-level survey data cigarette consumption data is typically reported as a count, i.e. a non-negative, integer variable, and is characterised by a large share of zero observations that can reflect both genuine non-consumers as well as corner solutions. In our case, the dependent variable was additionally characterised by a strong clustering of observed values in multiples of five, i.e. fractions and multiples of cigarette packs, which likely reflects recall, and with this, measurement error. Given that the zeroes are a separate quantity of interest, the standard approach in the literature is to separate observed consumption into separate participation and consumption decisions, each with their own data generating process. The two central questions in specifying such a two-equation structure relate to (1) the assumptions regarding the types of zero observations in the data (genuine/permanent non-smoking and/or corner solutions i.e. a smoker but not smoking now) and (2) the relationship between the unobserved factors and thus error terms in the two parts. Our understanding of the way in which the RLMS data are collected in combination with only strictly positive reported consumption values reported by those who are current smokers, as well as the very low prices in the period under consideration, led us to argue that, in the static context, corner solutions are unlikely to be present, especially in the female sample with its 80 percent of non-smokers. Additionally, while allowing for a correlated error structure in the form of a selection model is theoretically appealing, the absence of good instruments, exogenous to our data, led us to opt for a two-part model in which the participation and consumption levels are estimated separately. For the RLMS, we contend that the first decision is absolutely correct, while the second prompts an important question for future research about identifying external instruments for smoking participation.

Our results from both the static and dynamic models suggest that, in addition to the conceptual appeal, the **distinction between participation and consumption is important empirically** since in the static approach, the qualitative results and magnitude of effects for the various covariates differ between the two parts of the model. This makes sense intuitively, especially if we rule out corner solutions, since the (genuine, non-smoking) zeroes are likely to be driven by different factors than the positive observations. For example, health concerns are more likely to be relevant for the choice between zero and positive smoking, than for smoking 10 or 15 cigarettes. In our static pooled cross-sectional approach, assuming independence between the participation and consumption decisions is acceptable since our primary goal was to address the complexities of the modelling procedure. Among the other major empirical and conceptual challenges of chapter 6, we found that, contrary to our prior belief, even the strong degree of heaping (measurement error) in our dependent variable turned out to be of minor importance for the choice of estimator in the consumption equation, with a range of linear and count data estimators yielding very similar results. Overall, it seems that once the zeroes are separated from the positive observations, **the choice between linear and count data estimators is a matter of taste** and should be seen in conjunction with other aims of the analysis, with the results cross-checked against the range of estimators to establish robustness.

In chapter 7 we made use of the longitudinal element of the RLMS and relaxed the rather restrictive assumptions of the static model in developing a dynamic framework that took into account the time trajectory and specifically persistence in cigarette consumption. However, given the host of econometric challenges related to dynamic models we opted against the two-part structure of chapter 6 and focused on modelling the consumption decision. We faced the important question of how to specify the sample, that is, how to treat the zeroes, since individuals may transition between smoking and not smoking over the time they are observed. In order to assess the impact of the sample specification on the estimates, we estimated our dynamic model, following lessons from the literature, using (1) a more restrictive specification which included only individuals who smoke in every year that they are observed, for a minimum of three consecutive years, and (2) a specification that included individuals who smoked in at least one year and so only dropping from the sample those individuals who are always non-smokers or have less than three consecutive observations. Our results from the two specifications suggest that while excluding all the zeroes comes at the risk of introducing selection bias, leaving in anyone who fulfils the minimum of one smoking observation conflates the effects of participation and consumption, especially in the female case where the two samples differ more strongly. This provides further evidence that **allowing for separate data generating processes underlying the zeroes and the positive consumption values** is important in order to obtain reliable results, and even more so in the dynamic case.

One of the key lessons of chapter 7 is that **the longitudinal element of the RLMS data**, while needing very careful handling, is a strong enough panel to undertake dynamic analysis and is therefore an important source of information and evidence, both in terms of understanding Russian health behaviours and profiles, but also in terms of international comparisons with other major household surveys.

LESSONS FOR POLICY-MAKING

Based on our careful descriptive analysis of the longer-term and more recent developments of smoking patterns and the econometric analyses of cigarette demand we can draw a number of conclusions regarding the potential of the tax increases that are being implemented with the 2013 anti-smoking law. We find that both participation and consumption are responsive to price, but consistent with the previous findings for Russia, the effects are rather small.

However, while we find that both smoking participation and consumption are relatively unresponsive to price, the tax increases could still yield sizeable effects if the government pushes through with raising the price level to the average in the WHO European region. This will be particularly the case if our dynamic specification results are to be believed.

The results of chapters 6 and 7 provide strong evidence that the price elasticity of demand for cigarettes in Russia is low in absolute terms and is low relative to other upper income countries. It is true both for men and for women and for consumption as well as for participation per se. This is an important finding, for policy makers, health professionals and for industry. The main implication of the result is that, even though substantive price increases in tobacco have been implemented and more have been promised, the impact that these increases alone will have on cigarette consumption is likely to be small. The fundamental reasons for this are twofold: first, the price of cigarettes, even with recent increases, remains low and so even relatively large proportional price hikes fail to render cigarettes unaffordable, or even a luxury, for most people; second, there has been and remains ample opportunity within the Russian cigarette market for substitution in response to price changes. It remains an important object of future research to ascertain how and whether the price elasticity changes as and when the planned price rises start to further increase the financial costs of smoking.

While we only made some initial inroads into considering the complementarities between alcohol and cigarette consumption in chapter 6, it is well established that these two behaviours tend to move together, as evidenced by the fact that 90 percent of heavy alcohol consumers were also smokers (Zaridze et al., 2014). Thus, alcohol and cigarette consumption are likely to reinforce each other as the major drivers behind the high level of cardiovascular disease and premature cardiovascular mortality in Russia. This suggests that policies to reduce alcohol consumption are likely to have positive spill-over effects for cigarette consumption too, a second type of multiplier effect. As with smoking, alcohol consumption has been decreasing since the mid-2000s, suggesting that we might see the very tentative beginning of an emerging healthier behavioural profile among the younger generation.

These recent trends are particularly concentrated in Moscow and St. Petersburg, which can be seen as the most progressive, ‘trend-setting’ regions in Russia. It remains to be seen whether the two cities are on a different trajectory from the rest of the country or only ahead of the other regions. The fact that smoking patterns typically exhibit strong cohort effects reflecting the social norms of people growing up in the same time period would suggest that we might see a catching up of the other regions too, especially in the age of social media. However, for policy makers, monitoring and understanding the future trajectory of health behaviours across the regions is vital, as also is maintaining a potential for the implementation of region specific policies.

Finally, notwithstanding the importance of the policy package implemented with the 2013 anti-smoking law, we will almost certainly not be able to tease out what component of the law *caused* smoking decreases, particularly as we find these changes preceding the law. This is another potent reminder that, in any analysis, we need to consider the longer-term prevailing trends for slowly changing behaviours such as smoking or alcohol consumption, instead of jumping to the conclusion that a moment in time change happened.

FUTURE RESEARCH

Turning finally and briefly to some thoughts on where we go from here. While we argue that this research is important in answering a number of open questions regarding smoking in Russia, it also prompts a number of intriguing lines for future research. Chief among these are:

1. To examine the impact of peer effects/social interactions in smoking with a view to clarifying whether these impact on participation or consumption.

2. To explore specifications which can provide evidence on potential sample selection bias in both the static and dynamic demand models.

3. To undertake a more nuanced investigation of the education gradient and its interaction with different sub-groups of the population, in order to identify whether and when it captures a social effect, rather than or as well as a human capital effect.

4. To analyse in greater depth the relationship between smoking and alcohol consumption, as potentially mutually reinforcing (bad) health behaviours and in both cases, to try to identify the Russian specific ‘causes’ that underpin negative health behaviours of the type that we observe in Russia.

5. To assess the implications of behavioural changes among the middle and older cohorts on healthy ageing. Reductions in smoking will reduce morbidity and with this increase healthy life expectancy, which is particularly important given the demographic pressures and resulting financial pressures on the health system, but will in turn pose questions relating to the role of the labour market, the pension fund and the system of long-term care.

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