

## Life-Cycle Consumption Patterns at Older Ages in the United States and the United Kingdom: Can Medical Expenditures Explain the Difference?<sup>†</sup>

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*This paper documents significantly steeper declines in nondurable expenditures at older ages in the United Kingdom compared to the United States, in spite of income paths being similar. Several possible causes are explored, including different employment paths, housing ownership and expenses, levels and paths of health status, number of household members, and out-of-pocket medical expenditures. Among all the potential explanations considered, those relating to health care—differences in levels and age paths in medical expenses and medical expenditure risk—can fully account for the steeper declines in nondurable consumption in the United Kingdom compared to the United States. (JEL D14, D15, I11, J14)*

As populations in advanced countries continue to age, a key concern for policymakers is whether individuals have saved enough to fund their consumption needs over increasingly long retirement periods. Understanding trajectories of consumption and wealth as individuals age is crucial to resolving this question. Research on life-cycle consumption patterns has typically concentrated on working ages with an emphasis on expected paths in labor income, economic wage shocks, and retirement; see, for example, the *Review of Economic Dynamics* special issue on micro facts (Violante 2010). However, this leaves out an important and growing span of life during the post-retirement years where other factors such as health, mortality, health expenses, and shifts in housing expenditures and recreation may play an increasingly central role. Moreover, these are areas where there

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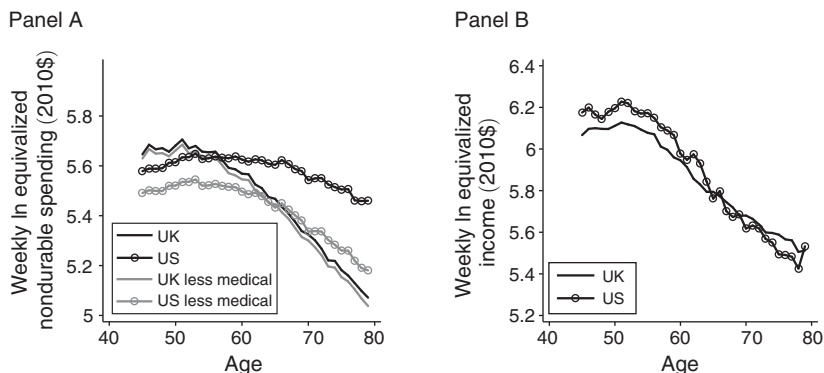


FIGURE 1. NONDURABLE SPENDING AND INCOMES IN THE UNITED STATES AND UNITED KINGDOM BY AGE, 1984–2010

*Notes:* Values are in US 2010 dollars. Figures equalized using the modified OECD scale. The definition of spending includes medical expenditures.

*Source:* Authors' calculations using BLS Consumer Expenditure Survey 1984–2010 and ONS Living Costs and Food Survey 1984–2010

are large cross-country institutional differences—for example in housing markets and in whether medical care is privately or government financed—that may have important implications for patterns of nondurable consumption at older ages.

In the United Kingdom, average nondurable expenditure between the ages of 45 and 79 falls by 2.2 percent each year. This compares to 1.4 percent for the United States. To illustrate, the first panel of Figure 1 plots nondurable expenditures in the United Kingdom and United States by age averaged across birth cohorts. It's clear that spending falls only gradually after age 50 in the United States while it falls much more rapidly in the United Kingdom.

What can explain a difference of this magnitude? An obvious starting point is to examine age paths of income to assess the extent to which consumption expenditures are tracking age paths in household income. But the second panel in Figure 1, which plots cohort averaged paths of household income at older ages in the two countries, demonstrates that, if anything, incomes decline at a slightly faster rate in the United States than the United Kingdom.<sup>1</sup> This therefore seems unlikely to be the major reason for a flatter spending profile in the United States. In this paper, we investigate other possible reasons that may explain the dramatically different patterns of nondurable consumption of older ages in the two countries by investigating differences in inter-temporal consumption for households around and beyond retirement age.

The set of factors that we explore in this paper include: differential cohort effects in the two countries that may distort average life-cycle age profiles, differences in timing of retirement in the presence of separabilities with employment, differential paths of housing expenditures possibly driven by institutional differences in housing markets between countries, level and path differences in health status and mortality,

<sup>1</sup> In both countries, income is measured as the sum of salary, investment, interest, rental, and transfer income and other income net of tax payments. In neither country does income include capital gains on property or other investments. UK prices are converted to US dollars with PPP indexes.

and finally, the levels, prices, and volatility of medical spending, as in the United States deteriorating health with age leads to higher spending there, while this is not true in the United Kingdom because of the National Health Service (NHS). We include out-of-pocket spending on nonmedical nondurables in the two countries in Figure 1. It is immediately clear that this helps account for a significant fraction, though not all, of the difference between the two countries.<sup>2</sup> As we detail below, once medical expenditures are removed, the difference in the decline in spending between the two countries shrinks by around three-quarters. Different papers have made different decisions about whether medical expenditures should be included in the definition of nondurable consumption. For instance, Heathcote, Perri, and Violante (2010) and Attanasio and Pistaferri (2014) include medical spending in their measures of expenditure, while, for instance, Attanasio and Weber (1995); Banks, Blundell, and Lewbel (1997); Blundell, Pistaferri, and Preston (2008); and Attanasio, Hurst, and Pistaferri (2012) do not (often on the grounds that spending on health care is more akin to investment than consumption spending). Our results highlight the importance of giving careful consideration to such choices.

Medical spending is not the only difference between the two countries however. We therefore move on to quantify cross-country differences in three potential factors—employment, housing status, and health—and look for any immediate differences that might explain the differential consumption paths observed in Figure 1. While there are some differences in the way these variables evolve in the two countries, these differences do not seem large enough to account for the cross-country difference in spending patterns.

We examine this hypothesis more formally in a regression context, finding that controlling for these factors only marginally reduces the cross-country difference in the decline in nondurable consumption spending with age when medical expenditure is included. We then turn to model nonmedical consumption *conditional* on health status and real medical expenditures. This approach allows preferences for nonmedical consumption to change in a non-separable way with health and the consumption of medical goods. It also captures any substitution effects driven by the change in the relative price of medical consumption. We also consider the role medical expense uncertainty may play in explaining consumption profiles in the United States, partly by exploiting differences in the institutional environments in the two countries. We find suggestive evidence that precautionary savings against medical expense risk play an important role in US consumption decisions. Controlling for both medical uncertainty and relative prices fully explains the cross-country difference in spending declines. Our regression estimates imply that medical uncertainty increases consumption growth at older ages in the United States by around 0.90 percentage points

<sup>2</sup> Changes in medical spending at older ages could in principle be driven by changes in medical consumption in the two countries or differences in the prices paid for medical care. Purchasing Power Parities (PPP) for medical care from the OECD suggest that the level of prices (paid by both government and consumers) is consistently higher in the United States than the United Kingdom (see <http://stats.oecd.org/Index.aspx?DataSetCode=PPP2014>). In 2005, for example, UK prices were estimated to be 78 percent of costs in the United States. In online Appendix B, we also consider the rate of change of medical prices in the United States versus the United Kingdom for the period 1988–2010. Price movements in the two countries track each other quite closely for much of this period, but US medical price inflation is higher in the latter years of the sample. If medical care is a normal good, this would tend to reduce US consumption of medical care relative to the United Kingdom.

per year on average for the ages we consider. Precautionary motives against medical expense risk in the United Kingdom are, by contrast, negligible.

The rest of the paper is organized as follows. In the next section, we describe in more detail the essential features of the data we assemble to look at these issues and document cohort specific paths of nondurable spending and household income for both countries. We then move on to look at various potential explanations for the cross-country differences in turn. Section II provides a description for cohort specific age paths in employment in the two countries and discusses their implications for consumption profiles, Section III provides a parallel treatment for housing by describing age paths of housing ownership, and Section IV focuses on levels and paths of health status and differential levels and age patterns of medical expenditures. Section V presents results obtained from an inter-temporal model of growth rates in total nondurable expenditures for each country to identify factors that may account for different shaped consumption paths at older ages. The final section highlights our main conclusions.

### **I. The Life-Cycle Pattern of Consumption and Income**

We use two repeated cross-sectional surveys widely viewed as containing the highest quality measurement of household expenditure and its components in each country—the Consumer Expenditure Survey (CEX) in the United States and the Living Costs and Food Survey (LCFS) in the United Kingdom. While these surveys do not cover the same individuals for long periods of time, we organize the data to create a pseudo-panel and track cohort consumption behavior by age (in the manner of Browning, Deaton, and Irish 1985). To do this, we group individual observations by five-year birth cohorts and take averages within each year. Cohorts are determined by the age of household head. Following this approach allows us to merge in information from other surveys at the cohort-year level where necessary.

The LCFS is an annual cross-sectional survey that has been running in one form or another since 1961. The LCFS, formerly known as the Family Expenditure Survey, is conducted by the Office for National Statistics (ONS), the United Kingdom's national statistical agency, and has been the basis of a number of studies of intra- and inter-temporal spending patterns. Currently it interviews around 6,000 households throughout the United Kingdom and continuously throughout the year. The survey begins with an interview with questions about demographic characteristics, income, large purchases over the last year, and regular expenditures (such as magazine subscriptions, internet subscription costs, and so on). Each household member over 16 then records all spending in a diary over the next 2 weeks.

For the United States, we make use of the Consumer Expenditure survey (CEX). This survey has been carried out by the Bureau of Labor Statistics (BLS) on a continuous basis since 1980. For some quarters prior to 1984, the survey only covered households living in urban areas. The CEX includes two separate surveys, a diary survey which works much like the LCFS, and an interview survey, where households are asked to recall their spending on a range of spending categories over the previous three months. The interview survey is also a short panel, as the same households are interviewed on up to five occasions. The first of these interviews collects some basic

data on family characteristics. Each subsequent interview updates this information and asks questions concerning household spending over the previous three months. Information on incomes and labor force participation are, however, only collected in the second and fifth interviews (except for new household members and members who have newly started work), meaning that income and spending data for the third and fourth interviews need not cover the same time periods. In this paper, we only make use of the interview survey.<sup>3</sup> Around 5,000–8,000 households are interviewed in each quarter.

In both UK and US surveys, spending data are provided for hundreds of highly disaggregated individual product codes. We allocate these goods into eight broader categories defined to be consistent across the two countries: food in, food out, other nondurables, medical, housing related, recreation and transport, and durables. Some examples of what are included in these categories are given in Table 1. We do not include rental payments or mortgage interest in any of these definitions as we do not observe the “shadow price” of owned housing in the LCFS, nor can we estimate it easily (the CEX does include a self-reported imputed rental cost for owned properties). We define total nondurable expenditures to include all rows in Table 1 with the exception of the final row measuring durable spending.

Household income data are derived from the same surveys and cohort age profiles obtained in the same manner. Household income is defined comprehensively to include all sources of income for the head of household, the spouse/partner, and all other household members net of taxes. US expenditures and incomes are deflated to 2010 terms using the Consumer Price Index (CPI). UK variables are deflated to 2010 terms using the Retail Prices Index and then converted into dollars using PPP exchange rates for that year taken from the OECD. Both surveys contain measures of standard definitions of labor force participation. From 1994 onward, the CEX also contains detailed questions on the nature of households’ health insurance policies and Medicare coverage. In both datasets, we restrict our attention to households where the head is aged 45–79. This is because ages in the LCFS are top-coded at age 80 from 2002 onward.<sup>4</sup>

To control for measurement error and impacts of extreme values on life-cycle paths, we trim households in the top or bottom 1 percent of distribution of income and expenditure. In the CEX, we take data from 1984 (to consistently include a nationwide sample) until 2010. For the LCFS, we take data from 1978 until 2010. We stop in 2010 in both countries as we do not have mortality data for either country after this date.

Figure 1 shows spending at different ages averaged across different birth cohorts and different years. This means that differences between the two countries shown there may partly be driven by differences in cohort and time effects. To understand whether the patterns in Figure 1 are driven by cohort effects, Figures 2 and 3 show

<sup>3</sup> While the methodology employed in the CEX diary survey is arguably more similar to that used in the LCFS than the interview survey, the diary survey has lower sample sizes, tends to exhibit greater variability in responses, and tends to underreport spending relative to the interview survey (Bee, Meyer, and Sullivan 2015). For these reasons, we make use of the interview survey instead.

<sup>4</sup> We also plotted spending, income, and demographics up to age 85 in the two countries using data up to 2001 only. The patterns in the two countries are very similar. Results are available on request.

TABLE 1—SPENDING CATEGORIES

Food in	Food at home
Food out	Food in restaurants, school dinners, catering
Other nondurables	Alcohol, tobacco, clothes, books, child care, pet goods, and services
Medical	Health insurance premia, fees for services from health professionals, drugs, medical equipment, care in nursing homes, care of invalids
Housing related	Electricity, gas, and water bills, domestic services, repairs, building insurance
Recreation	Sporting goods, musical instruments, CDs, entertainment, holidays
Transport	Motoring costs, petrol, fares for public transport, air fares
Durables	Vehicles, appliances, entertainment equipment

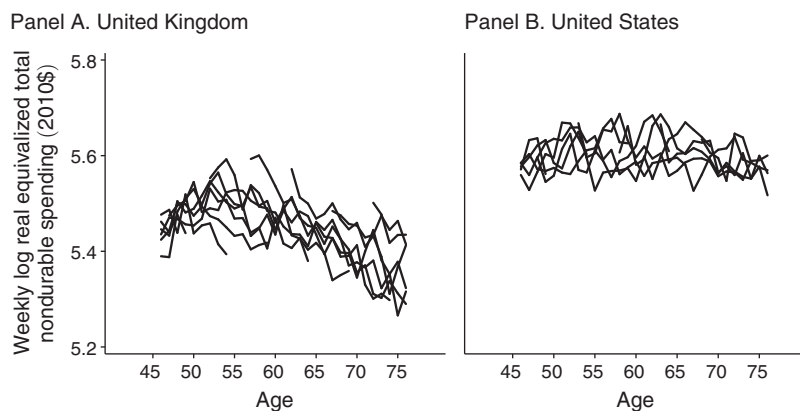


FIGURE 2. NONDURABLE SPENDING BY COHORT AND AGE

*Notes:* Each line represents average log nondurable expenditures at each age for five-year birth cohorts over the periods they are observed between ages 45 and 79 over the period 1984–2010. Average differences across cohorts are removed by regressing spending on cohort dummies and taking the residuals. Values are in US 2010 dollars. UK prices are converted to dollars with PPP indexes. Figures equalized using the modified OECD scale.

*Source:* Data from LCFS in the United Kingdom and CEX for the United States

how spending and incomes decline *within* cohorts in the two countries. Before plotting these, we remove average differences across cohorts by regressing spending and income on cohort dummies and taking the residuals. It is clear that cohort effects by themselves cannot account for the main puzzle with which we motivated this paper. Although the spending decline observed in the United Kingdom is somewhat smaller when one looks within individual cohorts rather than averaging across them, the age pattern of nondurable consumption at older ages in the United States remains relatively flat. Within-cohort declines in incomes are also similar across the countries.<sup>5</sup>

<sup>5</sup> In the CEX, there were two changes to the way incomes were measured that matter for Figure 3. One occurred in 2001 and the other in 2004. The first introduced a bracketing question for those who did not report their incomes the first time round. The second introduced imputation for nonresponders. The income definition we employ makes



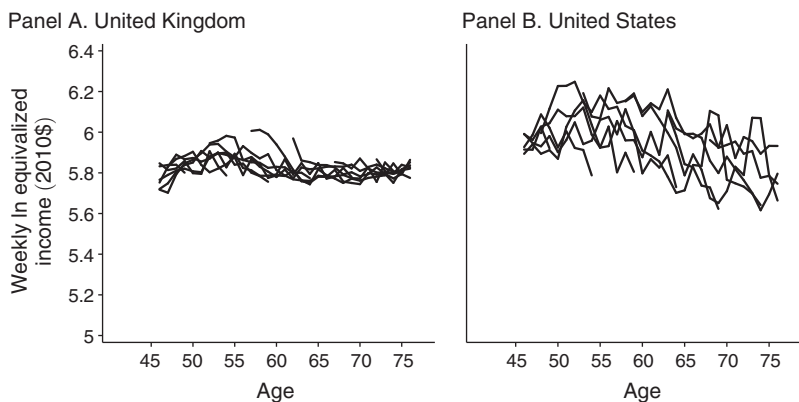


FIGURE 3. LOG HOUSEHOLD INCOME BY COHORT AND AGE

*Notes:* Each line represents average log incomes at each age for five-year birth cohorts over the periods they are observed between ages 45 and 79 over the period 1984–2010. Average differences across cohorts are removed by regressing incomes on cohort dummies and taking the residuals. Values are in US 2010 dollars. Figures equivalized using the modified OECD scale.

*Source:* Data from LCFS in the United Kingdom and CEX for the United States

## II. Differences in Employment and Retirement

One dimension of labor force behavior at older ages that has been studied in the context of consumption age profiles involves the impact of retirement on levels and time paths of consumption. Consumption levels and paths may not be independent of the retirement decision if preferences over employment and consumption are not separable, or individuals do not fully anticipate income reductions coincident with labor market retirement (Banks, Blundell, and Tanner 1998). The importance of this in explaining consumption trajectories at older ages is substantial. In the United States, it has been estimated that work-related expenditures account for the entire decline in nondurable spending from middle age to age 75 (Aguiar and Hurst 2013). In addition to any direct costs associated with work, movements out of employment may also be associated with having more time to spend shopping for discounts or for home production of some goods (Aguiar and Hurst 2007). This could partially explain cross-country differences if there are differences in the links between labor supply and consumption expenditures in the two countries, or if declines in employment were more rapid in one country than another (or both).

These declines in male employment by age are somewhat more rapid in the United Kingdom compared to the United States. However, in the absence of non-separabilities in employment and consumption, differences in paths of employment at older ages in the two countries do not seem large enough to be the major explanation for the substantial differences in consumption profiles. We will examine the role of non-separabilities between labor supply and consumption in explaining

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use of non-bracketed responses only from 2001 and non-imputed values for income from 2006 onward. In 2004 and 2005, it is not possible to remove non-imputed income values.

the cross-country difference in consumption profiles in more detail in Section V below.<sup>6</sup>

### III. Housing Ownership and Downsizing

Housing-related decisions and expenditures represent another spending category in which there are important institutional differences between the countries that may affect levels and age paths of expenditures at older ages. Banks et al. (2010, 2012) provides evidence that there exists far less geographical mobility in Britain compared to the United States and more downsizing in the United States compared to the United Kingdom as a meaningful fraction of older Americans move to smaller homes (i.e., fewer rooms) with little evidence of such downsizing in Britain. While this lower rate of British mobility was characteristic of both owners and renters, the differential was particularly high among renters.

For British households over age 50, the probability of being a homeowner is about 13 percentage points lower than for an American household, a deficit mostly offset by a higher probability of renting in highly subsidized “social” housing. The major secular changes in housing tenure at older ages have decidedly taken place in the United Kingdom and not the United States. The fraction of older British people owning their own home increased by almost 30 percentage points (from less than half to over 80 percent) from the 1908–1912 cohort to the 1943–1947 cohort. In contrast, over the same set of birth cohorts and age groups, the fraction of older American households who were homeowners has remained relatively stable at around 80 percent.

The primary reason for this secular change in home ownership rates for older British households is due to changes in the proportion of individuals in social housing. In the United Kingdom, there is a system of subsidized housing, often referred to as local authority, social, or council housing. Those who are allocated a property pay a below-market rent, and the landlord will be either the local authority or a housing association. Individuals entitled to such a rental property are placed on a waiting list until suitable accommodation becomes available. While entitlement to live in social housing is subject to a strict means test, once allocated a property, tenants can usually stay for life irrespective of any changes in circumstance. Social renters have a severely reduced incentive and ability to move or to downsize their property, for several reasons. Even if a tenant’s current circumstances mean that they are still entitled to social housing, moving can be very difficult because of shortages of social housing. Existing tenants are treated the same as new applicants, so if they are not in a priority group, they may not be allocated a different property. For those whose circumstances have changed in such a way that they would no longer be entitled to social housing if they were to reapply, there is a large incentive not to move as they may not be allocated a different property at all and may have to move into the private sector and pay full market rent.

<sup>6</sup> Age paths for women (not shown) also display the same pattern of rapid declining employment rates with age as women exit the labor force in both countries.



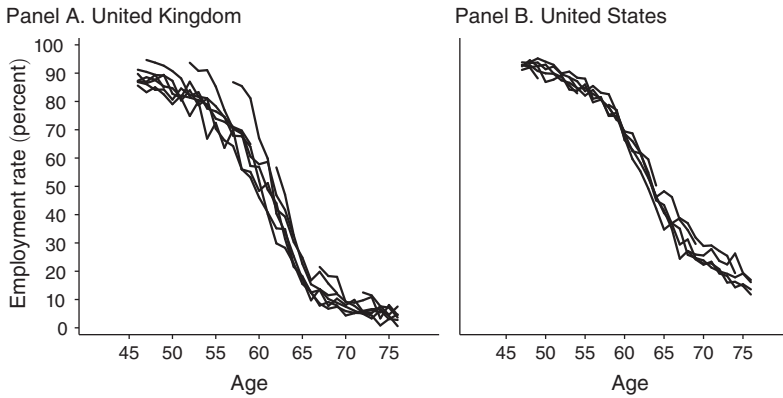


FIGURE 4

*Note:* Each line represents average employment rates for men at each age for five-year birth cohorts over the periods they are observed between ages 45 and 79 over the period 1984–2010.

*Source:* Data from LCFS in the United Kingdom and CEX for the United States

There has been a sharp across-cohort decline in social rental housing in the United Kingdom that parallels the increase in home ownership across cohorts (which for space considerations we do not plot). There was an almost 30 percentage point decline in the fraction of British households in social rental housing, which is pretty much the same percentage point increase observed in home ownership. Over the same set of birth cohorts, ages, and years, there was little change in the fraction of households in private rental housing. These changes reflect the introduction of a “Right-to-buy” in 1980, which required local authorities to sell council-owned housing at a discount to eligible tenants (the policy was later extended to other forms of social housing).

The differences in levels and trends in ownership patterns between the two countries may partially contribute to an understanding of the differences in age-consumption profiles. We examine the impact conditioning on these differences might play in Section V below.

#### IV. Health and the Divergence of Medical Expenditures

Our health measures are based on self-reported health status, age-specific mortality rates, and out-of-pocket medical expenditures by cohort, age, and gender. Neither the CEX nor LCFS include information on health or mortality, so we draw these from other sources.

##### A. Health Status

For the United Kingdom, health status data come from two cross-sectional surveys—the Health Survey for England (HSE) and the General Household survey (GHS). These surveys contain information on household’s self-reported health, which we average by age, sex, and cohort. Two surveys are used as we do not have

GHS data after 2006 and HSE data before 1991. In addition, there are two breaks in the GHS (in 1997 and 1999), due to redesigns of the survey, which interrupt the series. We make use of GHS data up to 1997 and HSE data from 1997 onward. In the GHS, respondents are asked about their general health status over the last 12 months, which they answer on a three-point scale: answers can be good, fairly good, or poor. In the HSE, households are asked to report their general health on a five-point scale—very good, good, fair, bad, or very bad. For consistency, we group these into three categories (by putting the final three responses into a single worst health group). We then average health status by age, year, and sex and use this information to impute health of household heads in the LCFS. The switch from the GHS to the HSE surveys introduces a downward shift in the level of self-reported health statuses beginning in 1997. In what follows, we remove this discontinuity by regressing health status in both surveys on a GHS dummy and taking the residuals. To our self-reported health data, we add data on mortality rates by age, sex, and cohort/year from the ONS mortality tables.

For the United States, we use the National Health Interview Surveys (NHIS). NHIS is an ongoing nationwide survey of about 40,000 households. Since 1982, NHIS used a five-point scale to measure respondents' general health status: "Would you say your health in general was excellent, very good, good, fair, or poor?" We create three categories for consistency with our UK measure. These three groups are excellent or very good, good, and fair or poor. We use these to impute health statuses to household heads and spouses in the CEX in the same way we do for the LCFS. We also calculate the proportion of responses that are self-reported in each cell to use as a control. Mortality data for the United States are obtained from the Berkeley life tables, which also give death rates by age, gender, and year (<http://www.demog.berkeley.edu/~bmd/states.html>).

Figure 5 plots proportions of those in worst health in both countries showing several distinct patterns in health status in both countries. First, levels of worse health are always higher in the United Kingdom than in the United States. However, these different levels of subjective health status in the United Kingdom compared to the United States have been shown to be due to different subjective health thresholds between the two countries. In the age groups we are considering, the British are typically healthier than the Americans with prevalence of almost all diseases higher in the United States compared to the United Kingdom (Banks et al. 2006). At the same objective health levels, the British report themselves in worse health on subjective scales. The second pattern to note in Figure 5 is that the fraction of a cohort in poor health rises with age in both countries. The third pattern concerns cohort effects in these paths of health at older ages. While there is little evidence of cohort differences in the United Kingdom, cohort differences are however apparent in the United States. Finally, we note that subjective health declines faster with age in the United Kingdom than the United States. We attempt to account for the potential role of health status in explaining the different expenditure patterns we observe in Figure 1 in our regression analysis below.

The impact of declining health on consumption decisions in a life-cycle model will depend on how it affects the marginal utility of consumption. If poor health reduces the marginal utility of consumption, then we will observe that

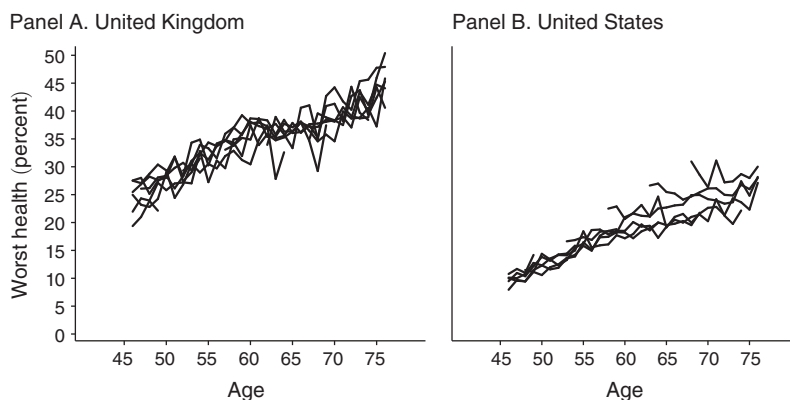


FIGURE 5. PROPORTION OF RESPONDERS IN WORST HEALTH BY COHORT AND AGE

*Note:* Each line represents proportion of household heads reporting being in the worst health condition at each age for five-year birth cohorts over the periods they are observed between ages 45 and 79 over the period 1984–2010.

*Source:* Data for the United Kingdom is from the HSE and GHS surveys spliced together (adjusted to remove discontinuity between the surveys). Data for the United States is from the NHIS.

consumption declines more steeply with age as health deteriorates. Various papers have investigated the dependence of the marginal utility of consumption on health without achieving consensus on either its sign or magnitude (Finkelstein, Luttmer, and Notowidigdo 2009 for a survey of the available literature). Lillard and Weiss (1997) find that there is substantial positive effect on marginal utility using panel data on consumption (as inferred from income flows and asset changes) and health shocks. By contrast, employing a novel approach that combines data on permanent income, utility proxies, and health data, Finkelstein, Luttmer, and Notowidigdo (2013) finds a substantial negative effect. Other studies have essentially found no effect. De Nardi, French, and Jones (2010) estimates a model allowing preferences over consumption to be health dependent. They find that the parameter governing the effect of health on the marginal utility is negative but statistically insignificant.

### B. Life Expectancies and Age Paths of Mortality

We present information on life expectancies at different ages in two countries in Table 2. Panel A shows life expectancies in 1984. Panel B shows equivalent figures for 2010. For both men and women, life expectancies at each given age tended to be greater in the United States than the United Kingdom in the early part of our sample (these differences had largely disappeared by the end of our sample period in 2010).

In the standard life-cycle model, higher age-specific mortality risk acts like a decline in the interest rate encouraging current consumption and producing a steeper decline in consumption with age. Mortality risk rises steeply with age in both countries with mortality risk about 10 times larger at age 70 compared to

TABLE 2—LIFE EXPECTANCIES AT DIFFERENT AGES, 1984 AND 2010

Age	United Kingdom	United States
<i>Panel A. 1984</i>		
Males		
60	16.60	17.79
65	13.24	14.48
70	10.31	11.52
75	7.86	8.99
80	5.91	6.82
Females		
60	21.06	22.48
65	17.20	18.63
70	13.63	15.03
75	10.44	11.77
80	7.70	8.85
<i>Panel B. 2010</i>		
Males		
60	22.03	21.64
65	18.03	17.89
70	14.33	14.39
75	11.00	11.19
80	8.10	8.37
Females		
60	24.92	24.63
65	20.66	20.50
70	16.61	16.63
75	12.88	13.05
80	9.55	9.83

*Source:* For the United Kingdom, these are taken from the ONS life tables. United States figures are obtained from the Human Mortality Database (<http://www.demog.berkeley.edu/~bmd/states.html>).

age 45. There is evidence of cohort improvements in mortality that are larger in the United Kingdom compared to the United States. However, the shape of the age mortality risk function appears to be similar in the two countries suggesting once again that differential mortality risk by age, see Hurd (1989), does not appear to be the likely source of the significantly differently age shapes in consumption in the two countries documented in Figure 1. In any case, we account for mortality's potential role in explaining spending differences within a regression framework in what follows.

### C. Medical Expenses

On the health side of potential explanations, we have so far explored age patterns at older ages in general health status and mortality. While both health dimensions may play a role in shaping consumption profiles at older ages, their ability either alone or together to account for the much flatter nondurable consumption with age in the United States compared to the United Kingdom seems

limited. The final health dimension we examine—health expenditures—appears to us to offer far more potential since there are large differences between the two countries. While consumption of medical services may increase in both countries as individuals age, differences in how the costs of these are financed will show up as differences in both the level of measured out-of-pocket expenditures and their dispersion.

How health costs are financed at older ages in the two countries are quite different. To a large extent, UK medical costs at all ages are paid by the state with very little absorbed by the individual.<sup>7</sup> State provision not only includes medications and doctor visits, but hospitalizations as well. Charges are, however, typically levied for prescription drugs and dental care. There are also often charges for long-term care costs as we discuss below.

The situation is very different in the United States where government assistance for health care is incomplete and a large proportion of the costs of medical insurance are met by employers or directly by households rather than by government. Government assistance for health care in the United States is mostly provided through the Medicare and Medicaid programs.<sup>8</sup> Figure 6 shows enrollment under the two schemes over the ages we consider. Medicare provides some insurance for the vast majority (over 90 percent) of households with heads over 65 but only a limited proportion of younger households. The share of households that report receiving some support from Medicaid increases somewhat from around 7 percent to around 10 percent as individuals' age from 45 to 75.

While previous studies have found that Medicare eligibility reduces both the mean and variance of out-of-pocket (OOP) medical expenditures (Barcellos and Jacobson 2015), it does not eliminate the need for them entirely. Coverage is neither free nor comprehensive with various direct costs for households. While hospital insurance (Medicare Part A) is typically provided free of charge, insurance for doctor's services and prescription drugs (covered under Parts B and D) involve income-contingent premia. Individuals covered under Medicare Part C (or Medicare advantage) contract with a private company to receive their part A and B coverage and may pay a higher premium for additional coverage. In addition, Medicare does not cover the costs of all treatments and even when treatments are covered, patients must pay deductibles, co-payments, and coinsurance from their own resources. A further institutional difference between the two countries is that, in the United States, a large fraction of individuals have their private insurance costs

<sup>7</sup> In 2016, for example, health care expenditures totaled \$4,192 per capita in the United Kingdom, of which roughly 80 percent was paid for by the government. This compared to \$9,892 in the United States, of which roughly 50 percent was public expenditure (see <https://data.oecd.org/healthres/health-spending.htm>).

<sup>8</sup> Medicare is a government insurance program for the elderly. Most individuals become eligible for the scheme when they turn 65. Eligibility is automatic for those who have worked and accumulated Social Security credits for at least ten years prior to reaching this age, but those who do not meet this requirement may also qualify on the basis of their spouse's contribution history. There are, however, some groups who can qualify at younger ages. For example, those who have received Social Security disability benefits for at least 24 months automatically receive partial coverage. Around 12 percent of the population is already enrolled by the time they reach age 65 (Card, Dobkin, and Maestas 2009). Medicaid is a general scheme that provides reduced cost or free health services for low-income and low-wealth households, including those attempting to meet the costs of their long-term care. Exactly who or what is eligible varies from state to state with the federal government specifying minimum standards of coverage. Over half of long-term care costs are paid through Medicaid (O'Shaughnessy 2014).

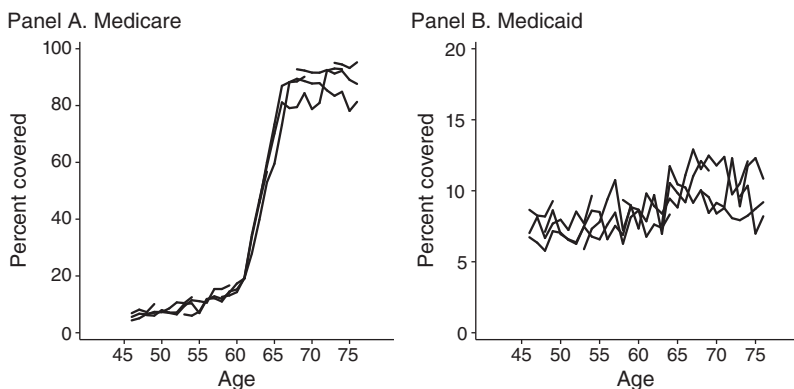


FIGURE 6. PROPORTIONS COVERED BY GOVERNMENT PROGRAMS, UNITED STATES

*Note:* Each line represents proportions of households with at least one member covered by Medicare or Medicaid at each age for five-year birth cohorts over the periods they are observed between ages 45 and 79 over the period 1994–2010.

*Source:* Data from CEX

covered by third parties (usually employers). This proportion tends to decline with age, however, as individuals retire and leave the labor market. Prior to age 65, a majority of American households have their insurance at least partially paid for by some third party, but this falls to around 40 percent at age 70 as panel A in Figure 7 shows. Similarly, the proportion of households who have insurance but pay nothing (shown in Figure 7, panel B) falls from 20 percent at age 45 to less than 3 percent at 75. For workers, the share of health costs paid by employers is substantial, at around 75–80 percent of the total.<sup>9</sup>

The institutions in the two countries naturally have consequences for paths of medical expenditures as individual's age. We plot the budget shares for medical spending for the two countries in the two panels of Figure 8. Not only are medical costs in the United Kingdom lower as a share of the budget (always under 5 percent), but there are only modest increases in this share with age. In contrast, the US graph indicates much higher and sharply rising medical costs shares at older ages in the United States that are not due solely to cohort effects. To illustrate, medical costs shares in the United States are approximately 8 percent at age 45 and rise steadily until they are around 20 percent of the total budget by age 70. The decomposition of these medical expenditures for a single cohort is shown in Figure 9.<sup>10</sup> In the United Kingdom, the majority of medical spending goes towards non-insurance costs. In the United States, insurance premia are far more important.

Medicare spending begins to rise when the head reaches age 65, but the trajectory of overall spending is smooth.

<sup>9</sup> See Exhibit 4.1 in [http://meps.ahrq.gov/mepsweb/data\\_stats/MEPSICChartbook.pdf](http://meps.ahrq.gov/mepsweb/data_stats/MEPSICChartbook.pdf).

<sup>10</sup> Results from other cohorts are very similar.



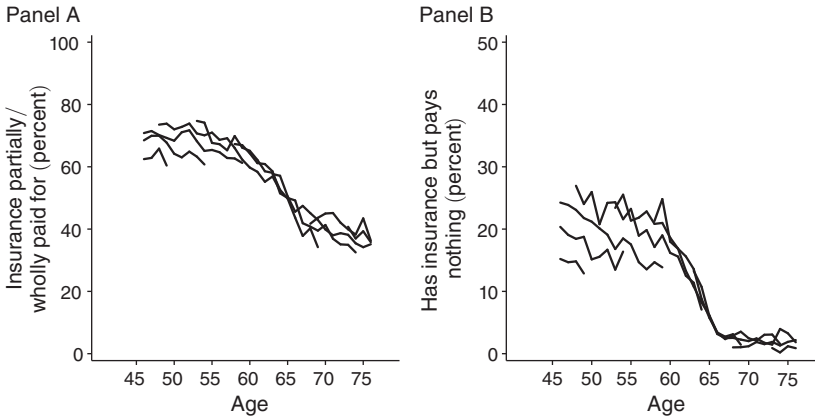


FIGURE 7. INSURANCE PAID FOR BY OTHERS, UNITED STATES

Notes: Each line represents average coverage rates at each age for five-year birth cohorts over the periods they are observed between ages 45 and 79 over the period 1994–2010. Panel A shows the proportion of households who report insurance policies wholly or partially financed by third parties. Panel B shows the proportion of households who pay no insurance costs but report being covered by insurance paid for by third parties.

Source: Data from CEX

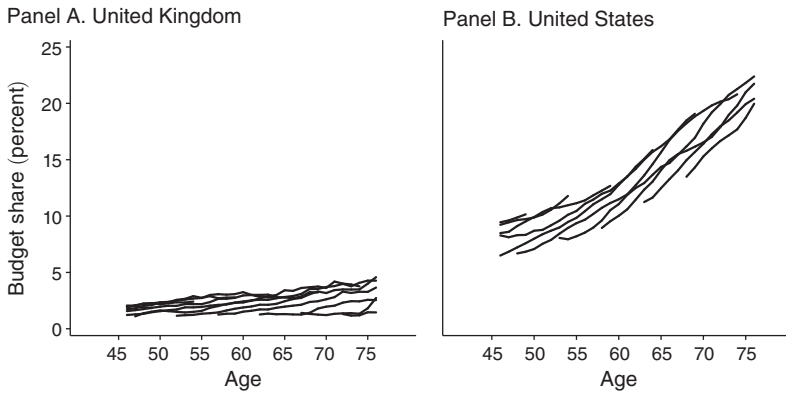


FIGURE 8. SHARE OF COHORT SPENDING ON MEDICAL CARE

Note: Each line represents average budget shares out of nondurable expenditures at each age for five-year birth cohorts over the periods they are observed between ages 45 and 79 over the period 1984–2010.

Source: Data from LCFS in the United Kingdom and CEX for the United States

Information on the distribution of medical expenses, and the riskiness of such expenses, is harder to come by, particularly in the United Kingdom. Table 3 compares the distribution of annual OOP medical expenses by major categories in the United Kingdom and United States, for all households aged 60 or over.<sup>11</sup> The

<sup>11</sup> The best source of information to break down such expenses is the longitudinal aging surveys, and we use the US Health and Retirement Survey for this analysis. Since the level of out OOP medical expenses is so low, the English equivalent of the HRS does not collect information on such spending, so we use the cross-sectional LCFS data as in the rest of our analysis above.

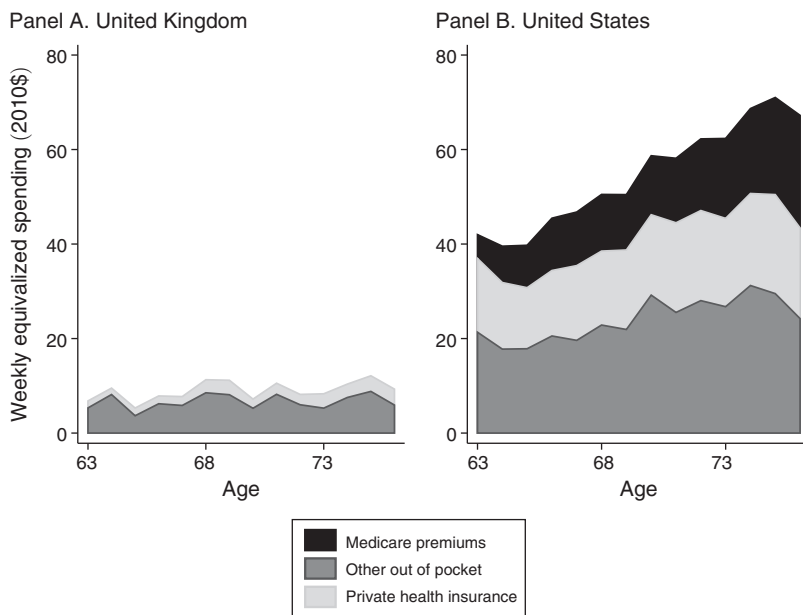


FIGURE 9. COMPOSITION OF OOP MEDICAL SPENDING (1928–1932 BIRTH COHORT)

Notes: Values shown over the period 1994–2010. Values are in US 2010 dollars.

Source: Data from LCFS in the United Kingdom and CEX for the United States

TABLE 3—YEARLY OOP MEDICAL EXPENDITURES BY COUNTRY:  
2000–2006 AGE 60+

Variable	Mean	P25	Median	P75	P90	P95
<i>Panel A. United Kingdom</i>						
Total	762	0	46	375	1,729	3,788
Excluding insurance	574	0	13	255	989	2,243
Private insurance	188	0	0	0	88	881
Prescription drugs	118	0	0	129	342	553
Health services	234	0	0	0	0	1,118
Hospital	41	0	0	0	0	0
Medical equipment	180	0	0	0	0	145
<i>Panel B. United States</i>						
Total	5,201	443	2,458	6,125	11,929	17,313
Excluding insurance	3,361	225	1,122	3,025	6,568	11,152
Private insurance	1,772	32	509	1,592	3,711	5,889
Prescription drugs	1,841	0	150	2,429	5,701	8,236
Health services	964	6	189	718	1,838	2,952
Hospital	301	0	0	0	365	1,062

Notes: Values are annual averages for households where at least one member is aged 60 or over. Values are in US 2010 dollars. Figures exclude spending on nursing homes.

Source: Data from the Health and Retirement Survey in the United States and LCFS in the United Kingdom

HRS only includes medical equipment spending in later years, and so these are not included in the US data. Consistent with the graphs for the 1928–1932 cohort in Figure 9 above, the table shows that average costs are almost 7 times larger in the United States than they are in the United Kingdom, with a mean of over \$5,201 per year compared to just \$762 in the United Kingdom. Even though insurance makes up proportionately more of the US expenses, the country differences are of the same order of magnitude if we exclude insurance payments. But the US data also exhibit considerably greater variance. To illustrate, health expenses at the ninety-fifth percentile are around \$17,313 per year (compared to \$3,788 in the United Kingdom), indicating a much larger risk of very large medical costs in the United States.<sup>12</sup>

One final “institutional” difference between the two countries may be in the nature or extent of family ties and caring by family members, and this may have effects on medical expenses. A full investigation of the links between family care and other medical expenses is an important topic for future research, but it is beyond the scope of this paper. We briefly investigated the link between health, family care, and OOP medical expenses in the HRS data. For individuals reporting 3 or more limitations in Instrumental Activities of Daily Living (IADLs), 97 percent reported receiving some assistance from family, but this had no relationship with OOP expenses. In the United Kingdom, we cannot make a similar calculation since there is no dataset with OOP expenses and health, disability, or the receipt of family care; however, since OOP expenses are so low for so many individuals, as discussed above, such a relationship between family caring and OOP medical expenses is unlikely to be important.

#### *D. Long-Term Care Costs*

One important source of medical cost uncertainty is in the cost of long-term care. This tends to be most important at older ages (for instance, rising over three-fold in the United States for those aged over 85 compared to those aged 75–84 (Fahle, McGarry, and Skinner 2016)). However, in so far as these expenses also generate precautionary motives, they may also affect spending behavior of households within our sample (Ameriks et al. 2015).

In the United Kingdom, long-term care costs are not typically covered by the NHS, though care costs are often paid for, wholly or partially subject to a means test of resources by local authorities. Estimates on the relative importance of private versus public spending on long-term care indicates that the majority of costs in the United Kingdom are paid for by the public sector. Private spending on formal care is roughly half the value of spending by local authorities (National Audit Office 2014) and only around a quarter of over 65-year-olds receiving formal care report paying for it themselves (Crawford and Stoye 2017).

<sup>12</sup> Since the HRS data are a panel, we can also look at longer term spending totals, and indeed the persistence of expenses over time. As well as being highly concentrated, medical expenses are also shown to be strongly persistent over the 6-year period, with the correlation between total medical expenditures in 2002 and total medical expenditures 2 and 4 years later being 0.66 and 0.6, respectively. (Full results available from authors on request).

In the United States, Medicare does not directly cover the costs of long-term nursing care, though it can cover related costs such as care in skilled nursing facilities and home health care. Long-term care costs are often covered under the Medicaid program, subject to a means test of resources. In 2004, the proportion of total long-term care costs paid for under these 2 programs was nearly 60 percent (CBO 2004).

Despite differences in the institutions for funding long-term care costs, both the overall level and proportion of long-term care financed through private spending is similar in the two countries (OECD 2005). Census data show that the proportion of population aged 65 and over who are residents in institutions is also very similar in the 2 countries at around 3.6 percent in the United Kingdom and 4.1 percent in the United States (Peeters, Debels, and Verpoorten 2013, Figure 1).

Nursing home costs are not well covered in our household expenditure surveys so to make what comparisons we can, we draw on the English Longitudinal Study of Ageing (ELSA), which only includes nursing home care costs in its most recent wave (covering spending in the period 2014–2016). We then compare this to the latest wave of the HRS to which we have access (covering the period 2012–2014). Even in these two surveys, which focus specifically on the older population, the measurement of costs, and even the coverage of the survey, is not comparable for those who are residents in institutions, with the main difference being that the ELSA data does not currently include any measures of spending for those currently residing in institutions. In this respect, HRS data has 3.7 percent of households over aged 60 with at least one member resident in an institution and a mean spending over the last 2 years of \$847 in 2010 prices. This is lower than all but 1 component of OOP medical expenses identified in panel B of Table 3 for the United States. But the distribution is highly skewed for those who do incur costs (median OOP spending over the previous 2 years amongst those in institutions was \$930, the seventy-fifth percentile was \$31,157, and the ninety-fifth percentile was \$104,950).

The aging surveys do, however, have comparable measures for OOP nursing home spending over the last two years for those currently residing in the household sector. Once again, mean spending is low, although a minority of households pay high costs. These patterns are similar in the two countries. 98.3 percent of the US household population over aged 60 either did not use nursing home or institutional care in the previous two years or else paid nothing for their usage. The corresponding number in England is 99.4 percent. Mean annual spending was \$53 in the United States and \$30 in England and, conditional on having to pay something, the top of the distribution in each country was rather similar. Further details of the distribution of these transitory nursing home costs is in Table A1 of online Appendix A.

Taking all this evidence together, it is clear that nursing home costs are small on average, but a significant expense but for a small minority of households as would be expected. But the risks of high nursing home expenses and the size of the OOP costs if they are incurred are both somewhat similar in the two countries.

## V. Inter-temporal Allocations of Consumption

In the previous sections, we noted possible links between trends in demographic variables and consumption at older ages. We highlighted differences in particular in the decline in employment, and the pattern of home ownership between the two countries. We also noted strikingly different patterns of medical expenditures, summarized in Figure 8, largely reflecting differences in the delivery of health services in the United States and the United Kingdom.

To motivate our regression analysis of consumption growth, we consider the case where inter-temporal preferences for nonmedical consumption had the CRRA form, and where health and medical consumption is non-separable with nonmedical consumption. We then write the following (approximate) conditional Euler equation governing inter-temporal spending allocations:<sup>13</sup>

$$(1) \quad \Delta \ln c_{i,t} = \alpha \ln r_t + \Delta X_{it} \beta + \zeta \Delta H_{i,t} + \eta \Delta \ln p_{h,t} + u_{i,t},$$

where  $\Delta$  is the first difference operator (i.e.,  $\Delta x_t = x_t - x_{t-1}$ );  $r_t$  is the real interest rate;  $c_{i,t}$  is nonmedical consumption;  $h_{i,t}$  is medical consumption;  $\Delta X_{it}$  is the change in a variety of demographic and household characteristics which we detail below;  $\Delta H_{i,t}$  is a measure of the change in health status by household members. The change in the real price of medical consumption  $\Delta \ln p_{h,t}$ , captures the non-separability with medical consumption.<sup>14</sup> For example, this price term allows for substitution away from medical consumption as the relative price of medical consumption increases.

In the application, we additionally allow for uncertainty in medical expenses that might induce precautionary saving. To do this, we follow Banks, Blundell, and Brugiavini (2001), and incorporate an additional conditional variance term in the consumption growth equation (1) to reflect uncertainty over shocks to future medical expenses.<sup>15</sup> This is explained in more detail in section B below.

### A. Growth Rates in Consumer Expenditures

We now turn to our analysis of inter-temporal consumption changes controlling for differences in health, labor supply, mortality, and tenure, again tracking group level averages over time. In this section, we split households into groups defined by education (whether or not the household head or their spouse completed high school), as well as year and five-year birth cohorts.

Table 4 shows results from taking an average over the rates of decline in spending for nondurable goods, and nondurable goods not including OOP medical spending

<sup>13</sup> See, for example, Blundell, Browning, and Meghir (1994).

<sup>14</sup> We could have conditioned directly on the change in medical consumption  $h_{i,t}$  and used changes in medical prices as instruments. We decided instead to include the price term to directly capture the effect of medical price inflation.

<sup>15</sup> As the preceding discussion shows, non-separabilities may be present within period (affecting relative demands for particular goods, but not the level of spending) or across time (affecting the inter-temporal allocation of consumption). In the online Appendix, we examine the shares of expenditure on different goods and look for within-period non-separabilities.

TABLE 4—AVERAGE PERCENT CONSUMPTION GROWTH RATES

	United Kingdom	United States	Country difference
<i>Panel A. Expenditure</i>			
Nondurable	−2.21	−1.37	−0.84
Nondurable less medical	−2.28	−2.05	−0.23
<i>Panel B. Equivalized expenditure</i>			
Nondurable	−0.65	−0.05	−0.59
Nondurable less medical	−0.72	−0.72	0.00

*Notes:* Observations weighted by cell size. Equivalized using the OECD scale. The OECD scale is 1 for first adult, 0.5 for each additional adult and child 14 and over, and 0.3 for each child under 14.

for our different cohort-education groups. Nondurable expenditures decline by 2.21 percent a year on average for cohort-education groups in the United Kingdom compared to 1.37 percent in the United States, giving a statistically significant difference of 0.84 percent between the countries ( $p$ -value 0.034). This difference in consumption expenditures before equivalization between the two countries falls by just under three-quarters when OOP medical spending is taken out. This suggests that differing health care financing institutions may explain a significant part of the difference between the countries.<sup>16</sup>

One reason consumption declines at middle and older ages is that people leave the household for several reasons, which include the exit of adult children into homes of their own, divorce and the death of a spouse. This pattern is illustrated for both countries in Figure 10, which plots by age and cohort the fraction of households who contain three or more adults. These fractions decline significantly with age in both countries, especially between ages 45 and 60, continuing at a somewhat slower pace after age 60.

Declines in the number of adults in the household will of course play a role in producing consumption declines at older ages. When we use equivalized consumption expenditures instead in panel B of Table 4, not surprisingly we see that rates of decline in both measures of consumption are significantly reduced in both countries. This indicates that reductions in the number of people in the household, primarily the exit of children and death of spouses, play an important role in the rates of decline in both measures of consumption among those ages 45 and above. However, the difference between the 2 countries in declines in total nondurable consumption remains large (at 0.59 percent). Once again, this difference between the

<sup>16</sup> Both surveys have seen declines in expenditure relative to aggregate measures of household spending as reported in the countries' respective National Accounts. This steady decline in coverage may have implications for cross-country differences estimated here. For the definition of spending we are considering, however, changes in coverage over time do not appear important for our results. We discuss this further in online Appendix D.



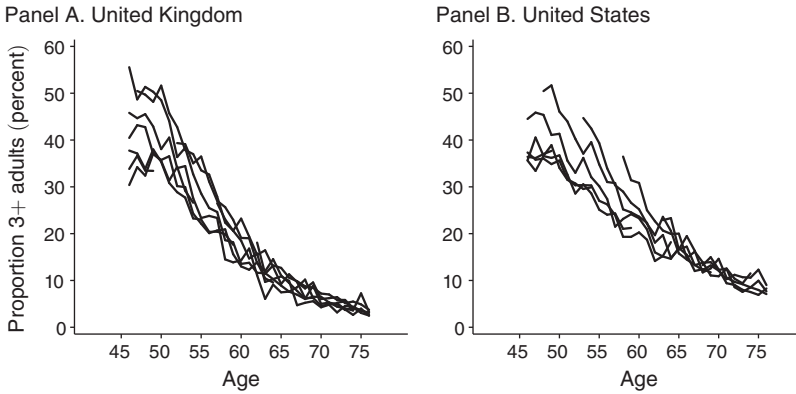


FIGURE 10. PROPORTION OF HOUSEHOLDS WITH THREE OR MORE ADULTS

*Note:* Each line represents proportions of households with three or more adults (individuals over 16) for five-year birth cohorts over the periods they are observed between ages 45 and 79.

*Source:* Data from LCFS in the United Kingdom and CEX for the United States

countries disappears when we examine nondurable consumption less OOP medical expenses.<sup>17, 18</sup>

In addition to the role of OOP medical expenses, however, the results in the previous section also highlight the potential importance of other key determinants—for instance, relating to housing and employment. To see the extent to which controlling for changes in these and other demographic trends can explain the steeper decline in nondurable nonmedical consumption that we see in the United Kingdom, we estimate an extended consumption growth equation of the form:

$$(2) \quad \Delta \ln c_{s,k,t} = \gamma_1 US + \gamma_2 UK + \alpha \ln r_{s,t} + \theta \ln m_{s,k,t} + \Delta X_{s,k,t} \beta + \eta \Delta \ln p_{h,t} + u_{s,k,t}$$

where  $c_{s,k,t}$  denotes nondurable consumption for a cohort-education group  $k$ , in country  $s$ , and year  $t$  (initially including OOP medical expenses which we later remove). The variable  $US$  denotes a dummy for the United States and  $UK$  a dummy for the United Kingdom,  $\ln r_{s,t}$  is the log real interest rate,  $\ln m_{s,k,t}$  is the log mortality rate, and  $X_{s,k,t}$  is a set of demographic controls including family size, employment, health status, and housing tenure. Following the discussion of non-separability between medical and nonmedical consumption, for specifications where we exclude medical expenditures, we include a term for the change in real medical consumption prices,  $\Delta \ln p_{h,t}$ .

<sup>17</sup> For completeness, we include a full decomposition of spending on different categories for a given cohort in online Appendix C. Declines in expenditure for nonmedical spending categories are remarkably similar across the two countries.

<sup>18</sup> In addition to considering differences in mean expenditure, we also examine growth across the twenty-fifth, fiftieth, seventy-fifth, ninetieth and ninety-fifth percentiles of the spending distribution. While the decline in spending growth in both countries is faster toward the bottom of the distribution, there is no clear evidence that cross-country difference in expenditure declines varies much across the spending distribution. This suggests that the UK-US differences are not driven by a few high spending individuals at the top of the distribution in the United States.

The difference between coefficients  $\gamma_1$  and  $\gamma_2$  in (2) indicates how much faster expenditures decline in the United States relative to the United Kingdom once other factors are controlled; note there is no constant term. We think of this difference as the unexplained component of the cross-country difference, and report it separately in the regression results that follow (multiplied by 100 to give value in percentage point terms).<sup>19</sup>

Results for different versions of model (2) are shown in Table 5. Column 1 shows results using weighted least squares (using cohort cell sizes as weights) with no controls and including medical spending in the consumption measure. These results are the same as those shown in Table 4 except that to maintain comparability across regression models, we use the same sample as we will use in subsequent regressions. The difference in the average rates of decline across the two countries is around 0.9 percentage points and significant at the 5 percent level.

Column 2 of Table 5 adds additional controls for employment, renter status, mortality, and health, as well as the interest rate. These additional controls, capturing possible non-separabilities and macroeconomic differences between the two countries, do not appear to explain the different rates of consumption growth between the two countries. Declines in rates of employment and increases in the proportion of renters within each group are both associated with lower spending growth. The faster employment declines in the United Kingdom shown in Figure 4 therefore help account for some of the differences between the countries. However, the effect of this on the unexplained element of the cross-country difference is offset by the larger increase in the proportion of renters in the United States, which other things equal imply faster spending declines there than the United Kingdom. Overall, the unexplained component of the spending difference with these controls is around 0.7 percentage points.

Column 3 of Table 5 takes the specification used in column 2 but removes medical expenditures from the consumption variable and allows for the possibility of non-separability between medical and nonmedical expenses by including the change in log relative medical prices in the regression (as implied in equation (1)). Relative medical prices are computed relative to nonmedical non-durable consumption spending using a Stone price index as described in online Appendix B. The relative price term enters significantly and indicates a negative gross substitution effect of medical consumption. Other things that equal a 1 percent increase in real medical prices from one period to the next are expected to reduce consumption growth by 0.4 percentage points. Even after allowing demographics and real medical prices, there is still an unexplained gap in spending growth between the two countries of similar magnitude to what we had before medical expenditures were omitted.

We might expect some of the characteristics on the right-hand side of the consumption growth specifications in columns 2 and 3 of Table 5 to be endogenous. Households that move out of employment or change their tenure status may

<sup>19</sup> We also run specifications including country-age interaction terms. These were not significant for either country, suggesting that the difference in the rates of decline in spending between the two countries does not change with age.

TABLE 5—CHANGES IN LOG NONDURABLE EXPENDITURE

	Including medical expenditure		Excluding medical expenditure	
	(1)	(2)	(3)	(4)
United States	-0.013 (0.003)	-0.001 (0.011)	-0.004 (0.012)	-0.025 (0.016)
United Kingdom	-0.022 (0.003)	-0.008 (0.012)	-0.011 (0.012)	-0.026 (0.014)
Interest rate		0.040 (0.093)	0.163 (0.096)	0.206 (0.097)
log mortality		0.001 (0.003)	-0.000 (0.003)	-0.003 (0.003)
$\Delta$ Head employed		0.082 (0.045)	0.095 (0.045)	0.093 (0.045)
$\Delta$ Renter		-0.419 (0.052)	-0.400 (0.053)	-0.404 (0.052)
$\Delta$ Number of kids		-0.009 (0.041)	-0.009 (0.042)	-0.003 (0.041)
$\Delta$ Number of adults		0.228 (0.030)	0.222 (0.030)	0.220 (0.030)
$\Delta$ Single		-0.249 (0.056)	-0.226 (0.057)	-0.228 (0.056)
$\Delta$ Worst health		-0.216 (0.075)	-0.239 (0.076)	-0.236 (0.075)
$\Delta$ log medical price			-0.394 (0.073)	-0.388 (0.072)
$\pi_{s,k,t-1}^2 \phi_{s,k,t}$				0.002 (0.001)
$(US - UK) \times 100$	0.877 (0.415)	0.691 (0.390)	0.747 (0.415)	0.106 (0.543)
Observations	616	616	616	616

Notes: Estimates presented are for weighted regressions with weights given by cell sizes in each education-year-cohort cell. The dependent variable is log nondurable consumption (columns 1 and 2 with medical expenditure, columns 3 and 4 without). We also include a control variable to capture the switch from GHS to HSE surveys in the United Kingdom, as well as controls for the change in the proportion of the households responding to subjective health questions and the change in the proportion of households where heads report their own health (as opposed to responses being given by a proxy) in the United States. In column 4, we instrument the conditional risk term  $\pi_{s,k,t-1}^2 \phi_{s,k,t}$  with its lag value. Comparisons of columns 2 and 3 with fully instrumented regressions described in the text are available in online Appendix E; differences in parameters were not found to be significant.

adjust their spending because these developments are responses to unexpected shocks that also lead households to reassess the value of their lifetime resources. For instance, estimating the average change in consumption when households change their employer statement may exaggerate the causal impact of employment on spending changes if households did not already anticipate the change in job status. To account for this, we run weighted instrumental variable regressions in which we instrument changes in employment, housing tenure, health, and mortality with their first and second lags. Under standard rational expectations assumptions, these should be correlated with current realizations of these variables uncorrelated with unanticipated shocks that enter  $u_{s,k,t}$  (we calculate lagged means excluding observations from those interviewed in the following period for CEX).

However, these IV models do not produce significantly different results to those reported in Table 5, and Durbin-Wu-Hausman tests for endogeneity of these variables does not reject the null of exogeneity. The parameters and test statistics are reported in online Appendix E.

### B. *Precautionary Motives*

One omitted factor from our consumption growth analysis so far is uncertainty over future OOP medical expenditures. As we showed in Table 3, older households in the United States still face a high risk of large OOP medical expenses in spite of the Medicare and Medicaid programs. The important role these risks potentially play in wealth and consumption dynamics in retirement in the United States have been emphasized in Palumbo (1999) and De Nardi, French, and Jones (2010). The risks of such expenses are much lower in the United Kingdom where households effectively enjoy a much greater degree of health insurance coverage. The differences in the extent of risks of incurring high OOP medical expenses are illustrated in Figure 11, where we plot the average differences between the ninetieth and fiftieth percentiles of the distributions of OOP medical expenses in the two countries within cohort-education cells at different ages. We plot the ninetieth to fiftieth difference since, as we saw in Table 3, the distribution of OOP medical is highly positively skewed in both the United States and the United Kingdom, and the main risk households in the United States face is the relatively small but nontrivial probability of very high OOP medical expenses. Figure 11 shows that in the United Kingdom, this measure is roughly a quarter of the size it is in the United States. It also tends to increase with age and is larger for more educated households.

What implications might these differences in the dispersion of OOP medical expenses have for consumption profiles? A simple theoretical analysis, such as that in Banks, Blundell, and Brugiavini (2001), suggests that the effect of uncertainty over shocks to future medical expenses on consumption growth will depend on the product of three factors  $\kappa \pi_{s,k,t-1}^2 \phi_{s,k,t}$ , where  $\kappa$  is a constant scaling factor reflecting both the persistence of shocks and the consumer's risk aversion,  $\pi_{s,k,t-1}$  reflects the contribution of uncertainty in medical expenses to uncertainty in overall wealth for group  $k$  in country  $s$  and period  $t - 1$ , and  $\phi_{s,k,t}$  is some measure of the dispersion in OOP medical expenses conditional on information available to each individual consumer in period  $t - 1$ .

Of the three factors,  $\pi_{s,k,t-1}^2$  can be approximated by the squared ratio of OOP medical expenses to nondurable consumption excluding medical expenses in period  $t - 1$ . This can be readily estimated from our cross-sectional data (which we do using cohort level averages by education group).<sup>20</sup> The patterns across cohorts and countries is very similar to the patterns shown in Figure 8. The choice for the measure of dispersion  $\phi_{s,k,t}$  is less straightforward. We take  $\phi_{s,k,t}$  to be the period  $t$  fiftieth–ninetieth range in OOP medical expenses in each cohort education group as

<sup>20</sup> Specifically, the approximation to  $\pi_{s,k,t-1}$  is calculated as the square of the cohort-level ratio of medical expenditures to nonmedical nondurable spending in each cohort-age-education cell.

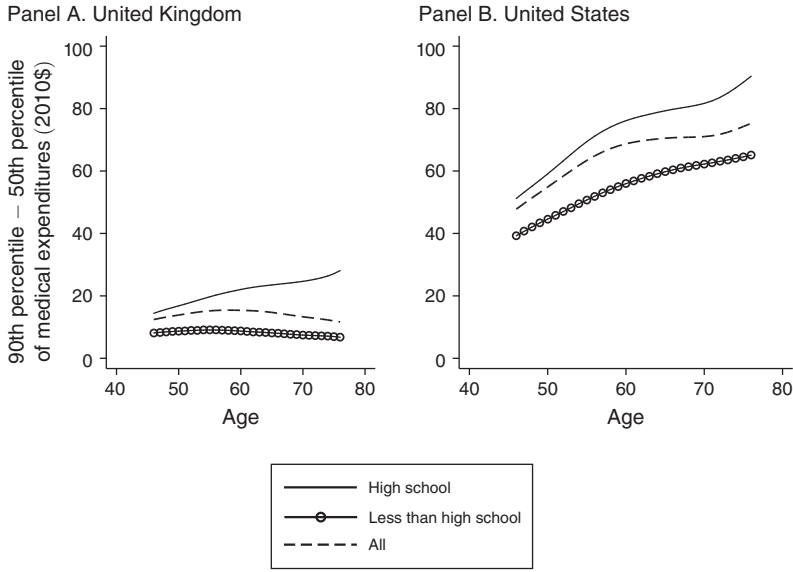


FIGURE 11. DISPERSION IN OOP MEDICAL EXPENSES

Notes: Each line represents averages in the ninetyth–fiftieth percentiles of the distribution of medical expenses within five-year birth cohorts. Lines are smoothed using locally weighted regressions.

Source: Data from LCFS in the United Kingdom and CEX for the United States

plotted in Figure 11. We then add  $\pi_{s,k,t-1}^2 \phi_{s,k,t}$  into the regression model in (2) and instrument with its lag since the term depends on  $t - 1$  spending and is therefore endogenous. The coefficient on this term will then reflect the value of  $\kappa$ .<sup>21</sup> This approach identifies the scale of precautionary effects using cohort variation in the importance of medical spending uncertainty. The effects of including this term in our regression model are reported in the final column 4 of Table 5.<sup>22</sup>

The uncertainty term enters with the expected positive coefficient and is significant at the 10 percent level. The unexplained difference between the 2 countries falls from 0.75 to 0.11 percentage points: a remaining difference that is not statistically significant. Thus, controlling for medical uncertainty eliminates the remaining gap in spending growth between the two countries.

Our results also allow us to estimate the scale of precautionary motives to save against OOP medical expense risk in both countries. To calculate this, we take

<sup>21</sup> Ideally,  $\phi_{s,k,t}$  should not include any predictable changes in medical expenses, as these do not generate precautionary motives. Calculating risk within cells defined by age, cohort, and education eliminates important sources of this heterogeneity. Other sources of heterogeneity that lead to multiplicative differences between the conditional and unconditional risk (that might arise if lagged medical expenditures affect current spending through an autoregressive process, for example) will be absorbed in the coefficient on  $\pi_{s,k,t-1}^2 \phi_{s,k,t}$ .

<sup>22</sup> To understand whether other sources of risk may create precautionary motives in the United States, we have also run a specification (otherwise the same as that in column 4) where we include a term for income risk that is analogous to the term we use for medical expense risk. This enters the regression insignificantly and does not greatly affect the magnitude or sign of the medical expense risk term.

the predicted spending profiles using our regression results and compare them with those predicted for a counterfactual world in which there was no medical uncertainty (using results corresponding to the model in column 4 of Table 5 and households from the cohort born in the years 1933–1937). With medical uncertainty, the expected average annual decline in spending (excluding medical) is 2.21 percent per year in the United States and 1.80 percent in the United Kingdom. Without medical uncertainty, the predicted declines are 3.10 percent in the United States and 1.81 percent in the United Kingdom. We therefore estimate that precautionary motives raise consumption growth in the United States by around 0.90 percentage points per year on average for the ages we consider.

## VI. Conclusions

For many years, debates surrounding the question of whether individuals' have saved enough to fund their consumption needs have focused on whether documented declines in consumption spending over the retirement period could be fully accounted for by optimal behavior within the framework of the life-cycle model. For instance, early work on the "retirement savings puzzle" attributed declines in spending between pre- and post-retirement periods to a failure of consumption smoothing that indicated a lack of preparedness for retirement (Bernheim, Skinner, and Weinberg 2001). More recent work has argued that those declines that are observed can be fully accounted for through a combination of home production and non-separable preferences (Hurst 2008).

The work we have reported in this paper has emphasized how the interpretation of such profiles must be understood in terms of the institutional environment that individuals face, and in particular, the extent to which individuals are exposed to uninsured OOP medical cost risks and uncertainties. Relatively large and uninsured risks can generate modestly declining spending profiles on average, which do not necessarily indicate sufficiency of resources. We have compared consumption trajectories for older households in the United Kingdom and the United States. In the United States, spending tends to remain relatively flat at older ages, while it declines quite steeply in the United Kingdom. These differences persist when we control for other variables including employment, health, and so on, that evolve differently in the two countries.

A key component in explaining this difference is OOP medical spending, which rises in the United States much faster than in the United Kingdom where medical expenses tend to be covered by the state. Taking out OOP medical spending from our comparison reduces the gap in the average decline in consumption spending by roughly three-quarters. Although other differences such as inheritance taxes, house price movements, long-term care costs and risks, and income risk may also play a role in explaining these differences, we find suggestive evidence that precautionary motives to save in the face of greater OOP medical risk in the United States are sufficient to eliminate the remaining gap.

These findings have relevance for discussions of consumption behavior at older ages. It is often found that older households, particularly in the United States, tend to continue to amass wealth as they age (see Love, Palumbo, and



Smith 2009). In this paper, we point out and account for differences between US households and households in an environment where the risks of high medical expenses have been effectively eliminated and for whom spending declines by much more.

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