Testing the Security Hypothesis as explanation for Chilean burglary trends

Hugo Soto

Department of Security and Crime Science
University College London

This Thesis is submitted in support of a Ph.D. in Security and Crime Science

September, 2020

Declaration of Authorship

I, Hugo Soto, 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.

[redacted]

Signed: H. Soto
Date: 23/09/2020

Acknowledgements

I express my thanks to the Chilean Government (Becas Chile – CONICYT) who granted me with a scholarship that made possible this PhD studies at University College London, Department of Security and Crime Science, and to live in London.

I would like to thank my supervisors Dr Kevin Chetty and Nick Tilley for their dedication and support towards my work, for his useful advices, and for his meticulous work of revision in all the stages of the process, but especially for their fraternal understanding in the difficult periods. I will be always indebted to both of you for being so generous with your time, and most of all, for accepting to supervise this work in the first place.

I have used administrative and survey data from different sources. I am grateful to every person who responded Chile's ENUSC survey, and to the researchers and surveyors, who have designed, gathered, and disseminated these datasets.

I am grateful to the community in the Jill Dando Institute for day-to-day friendly atmosphere and access to interesting lectures and seminars. The Institute and UCL have provided me with a very stimulating environment in what concerns the extraordinary quality of its academic and research staff, and that experience will leave marks beyond this thesis.

Finally, thank you Maria Jose for your patience and for being supportive all the way.

Abstract

The aim of this thesis is to test the security hypothesis in the context of a developing country like Chile. This country has experienced a notable reduction in victimization rates since 2005, and no research has been made on the nature and extension of that phenomenon. The security hypothesis has been proposed to explain the Crime Drop in western industrialized countries, but little is known about its applicability in developing countries that have also experienced falls in victimization rates. This thesis contributes to filling that gap by focusing on the validity of the security hypothesis for explaining burglary trends in Chile.

Analyses of secondary data are conducted using the Chilean national crime survey (ENUSC) data to test whether there actually was a drop in burglary rates and to test whether the availability of security devices affected victimization rates and trends during the studied period. Results suggest that the Crime Opportunity theories are a useful theoretical framework for modelling crime in a developing country like Chile, and that the Security hypothesis is a reasonable hypothesis to explain the downward trend observed in Chilean burglary rates.

Impact

As a whole, this thesis contributes to filling a gap in research concerning specific crime types in Chile, and particularly, the enormous deficit in research about the observed decrease in victimization rates for some offences. The Chilean victimization survey (ENUSC) is a rich and reliable source of data about victimization and characteristics of victims and incidents; however, it is still massively underutilized. Extending analyses in this work to other offences measured by ENUSC would be useful not only to develop a better understanding of crime rates in Chile, but also to inform crime prevention policies and practices.

The application of crime theories from industrialized countries, such as opportunity theory and the security hypothesis, in a developing country like Chile provides an opportunity to test the applicability of those theories beyond the context in which they have typically been developed and applied. Particularly, the applicability of the environmental criminology perspective in developing countries is challenged not only by differences in the socio-cultural settings , but also by differences in the layout of cities that may have features that are far less prevalent or even non–existent in typical European cities. Thus, examining those theories with data from developing counties may assist further theoretical improvements, and their ability to explain global phenomena like the international crime drop.

In practical terms, these findings have the potential to inform the design of crime prevention policies, and particularly, the implementation of situational crime prevention measures in Chile. By analyzing residential burglary victimization patterns, this research revealed several factors associated with the level of burglary risk, which may support assessment of the appropriate responses in terms of preventive strategies and resource allocation.

Table of Contents

Chapter 1: Introduction

The aim of this thesis is to test the security hypothesis in the context of a developing country like Chile. This country has experienced a notable reduction in victimization rates since 2005, and no research has been made on the nature and extension of that phenomenon. The security hypothesis has been proposed to explain the Crime Drop in western industrialized countries, but little is known about its applicability in developing countries that have also experienced falls in victimization rates. This thesis contributes to filling that gap by focusing on the validity of the security hypothesis for explaining burglary trends in Chile. Analyses of secondary data are conducted using the Chilean national crime survey (ENUSC) data to test whether there actually was a drop in burglary rates and to test whether the availability of security devices affected victimization rates and trends during the studied period. It is hoped that results from this research may inform both subsequent theories regarding the fall in crime and future crime prevention strategy in Chile.

1.1 The International Crime Drop context

Decrease in victimization rates have been observed in several countries since the mid-nineties (van Dijk et al., 2005; Zimring, 2007; Rosenfeld, 2009; van Dijk et al., 2012). Firstly observed in the USA, a drop in victimization has also been documented in countries like Canada, England and Wales, and Australia. In the United States police recorded homicide, robbery, and burglary rates decreased by more than 40% from 1993 to 2000 (Rosenfeld 2004). In the UK, according to British Crime Survey's figures, violent crime fell by 49%, burglary by 59%, and car theft by 65% between 1995 and 2007. Eisner (2008) showed that homicide rates fell by 43% between early 1990s and the middle of the 2000s in Austria, Germany, Italy, France, Switzerland, and Portugal. Regarding property crime, Aebi and Linde (2010) also showed significant declines among Western European countries.

Tseloni et al. (2010) have shown that declines in property crime are widely spread across the globe. By using multi-level statistical modelling, they examined data from the International Crime Victimization Survey, carried out in 26 countries. They showed that between 1995 and 2004 rates of property victimization fell significantly among those countries, with average reductions of "77.1% in theft-from-cars, 60.3% in theft from person, 26% in burglary, 20.6% in assault, and 16.8% in theft-of-car". The International Crime Victimization Survey also showed that burglary incidence and prevalence rates fell even faster in Latin-American countries like Brazil and Argentina. In conclusion there is strong evidence showing that downward trends in victimization are not a national phenomenon, but a feature shared by countries across the world. As consequence, this widespread drop in victimization rates has been the focus of a growing number of articles looking for explanations for this unexpected phenomenon.

Most of the available hypotheses to explain decreases in victimization rates are confined to the U.S.A. experience. The "American crime drop" between the early nineties and around 2002 has been deeply studied. The crime drop was observed in both property and violent crime across all major American cities. Several hypotheses to explain this pattern have been tested using panel data from American police records (Blumstein & Wallman, 2000, 2006; Levitt, 2004). The most lauded of such hypotheses refer to demographic changes (Blumstein, 2000; Fox, 2000), increasing incarceration rates (Langan & Farrington, 1998; Levitt, 2004), changes in police numbers and strategies (Marvell & Moody, 1996; Levitt, 2004), changes in cocaine/crack drug market (Levitt, 2004), gun control (Rosenfeld, 1996), legalization of abortion (Donahue & Levitt, 2001; Levitt, 2004), and stronger economies (Field, 1999; Fielding et al., 2000; Rosenfeld & Messner, 2009). In his review of potential causes of the crime drop in the USA, Levitt (2004) concluded that only four factors were important: increased number of police, increased rates of imprisonment, legalization of abortion, and the decline in crack markets. As stated before, most of this explanation seems not be valid in countries different to the USA.

For example, the incarceration hypothesis does not fit the experience of several European countries with downwards trends in victimization rates (Van Dijk et al, 2005); similarly, increased abortion is clearly not relevant to explain the victimization decrease in Chile.

The security hypothesis (Farrell et al., 2008 ;2010; 2011a; 2011b; Tseloni et al., 2010) and changes in lifestyles and routine activities (Farrell et. al., 2010) are promising hypothesis to overcome the "methodological nationalism" (Beck, 2007) involved in the American hypotheses. Supported by the theoretical framework provided by opportunity theories of crime, the security hypothesis is part of a broader research agenda for establishing the role of opportunity changes in generating the international crime falls (Tseloni et. al., 2012). The Security hypothesis suggests that "change in the quantity and quality of security was a key driver of the crime drop" in western countries (Farrell et. al, 2011). That suggestion is supported by evidence from analyses of the International Crime Victim Survey (van Dijk et al., 2007) which documented that remarkable increases in private security and personal protection measures coincided with the international crime drop. Further research in that line has suggested that falls in vehicle crime rates in Australia, the U.S.A., England and Wales, and the Netherlands may be attributed to improved vehicle security, particularly central locking systems and electronic immobilizers (Kriven & Zeirsch, 2007; Farrell et al., 2011a, 2011b; Fujita & Maxfield, 2012; van Ours & Vollaard, 2013). There is also evidence from the ICVS and from research conducted in England and Wales, that improved household security might have caused the decline in household burglary (van Dijk et al., 2007; Tseloni et. al, 2017).

The security hypothesis is located within the crime opportunity theoretical framework which suggests the opportunities are crime-specific. According to opportunity theories, the offender`s motivation, risk factors, and protective measures associated with individual crime types are likely to be diverse; thus, analyzing crime types, in as much detail as possible, is strongly recommended in opportunity theories in order to avoid misleading analyses based on aggregate or composite measures of crime. Additionally, the crime-specific approach of opportunity theories provides the security hypothesis with the theoretical flexibility required to be “compatible for some crime to increase (as opportunities for those crimes increase) at the same time as other crimes decrease (as opportunities for those crimes decrease)” (Farrell et. al., 2014).

In order to adopt a crime-specific approach, the focus of this research is on burglary victimization. As is shown in the next section, there was a step fall in burglary victimization in Chile: burglary incidents reported through the Chilean national crime survey (ENUSC) dropped by 61% between 2005 and 2013. Thus, burglary is an obvious candidate for testing the security hypothesis as feasible explanation of victimization trends in Chile.

The Chilean national victimization survey is a rich and reliable source of data on burglary that can be used in formulating and testing explanations. The ENUSC offers a wide range of information over a time period which is used in this research for modelling burglary victimization rates and their relationship to availability of household’s security protections. The advantage of using survey data rather than police recorded data is that the ENUSC recording practices remained consistent over the studied period, unlike police data, which may be influenced by varying reporting and recording practices. To my knowledge there is no research in Chile exploring burglary victimization trends, nor modelling burglary rates from the theoretical framework of opportunity theories.

1.2 The general picture of Chilean decreasing victimization rates

Between 2005 and 2013 there was a notable decrease in the prevalence of victimization for most offences measured in the Chilean victimization survey (ENUSC). Figures 1.1 and 1.2 show prevalence rates of victimisation among households and percentage changes in prevalence rates related to levels of victimisation in 2005, respectively. ENUSC includes an initial general question about crime victimization where respondents are asked whether he/she or any other member of his/her household was victim of crime during the last 12 months. Prevalence of household victimization, those who answered “yes” to that question, decreased by 35% between 2005 and 2013 (figure 1.2), from 38.3% to 24.8% (figure 1.1).

Regarding specific offences, figures show that most offences considered in the survey decline between 2003 and 2013. The exception is theft of car that shows marked fluctuations in its prevalence, likely because of the small number of victims of this crime. The greatest fall is shown by theft from car (among those who own a car) and “snatching”, whose prevalence rates decreased by 60% over the period. On the contrary, the smallest decline is shown by stealth theft that decreased by only 29% between 2005 and 2013. Similarly to robbery, burglary prevalence decreased by 46% over the period, from 7.8% in 2005 to 4.2% in 2013. More detailed discussion regarding burglary trends in risk, incidence and concentration are contained in Chapter four.

The general picture of victimization trends in Chile shows a steady decline over the 2005-2013 periods. Compared to the crime drop observed in industrialized countries, the decrease in Chilean victimization rates is similar in terms that it includes a range of offence types, and regarding the magnitude and duration of downward trends.

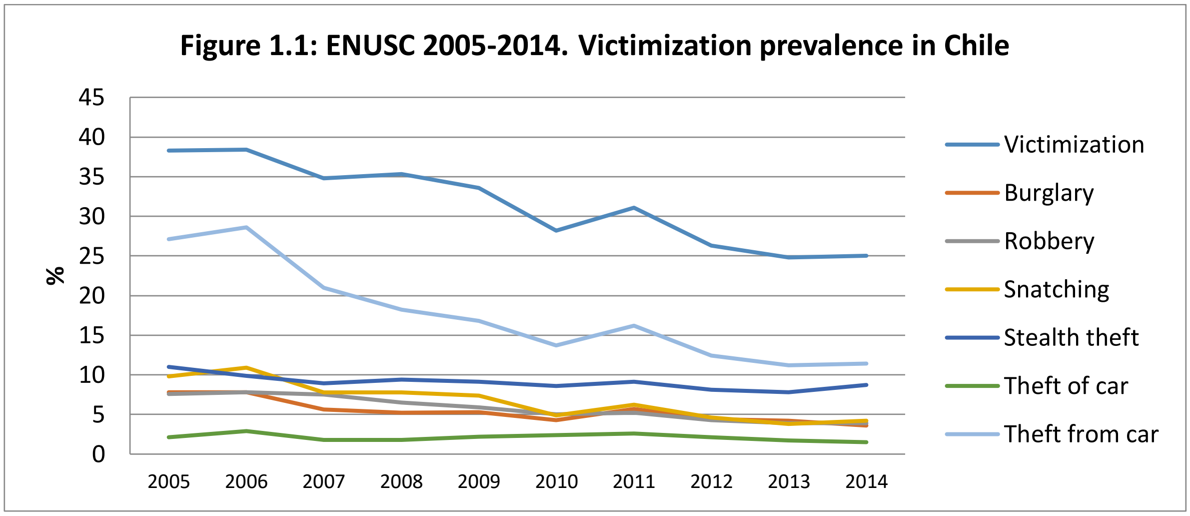


Figure 1.1: ENUSC 2005-2014. Victimization prevalence in Chile
%
45
40
35
30
25
20
15
10
5
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Victimization
Burglary
Robbery
Snatching
Stealth theft
Theft of car
Theft from car

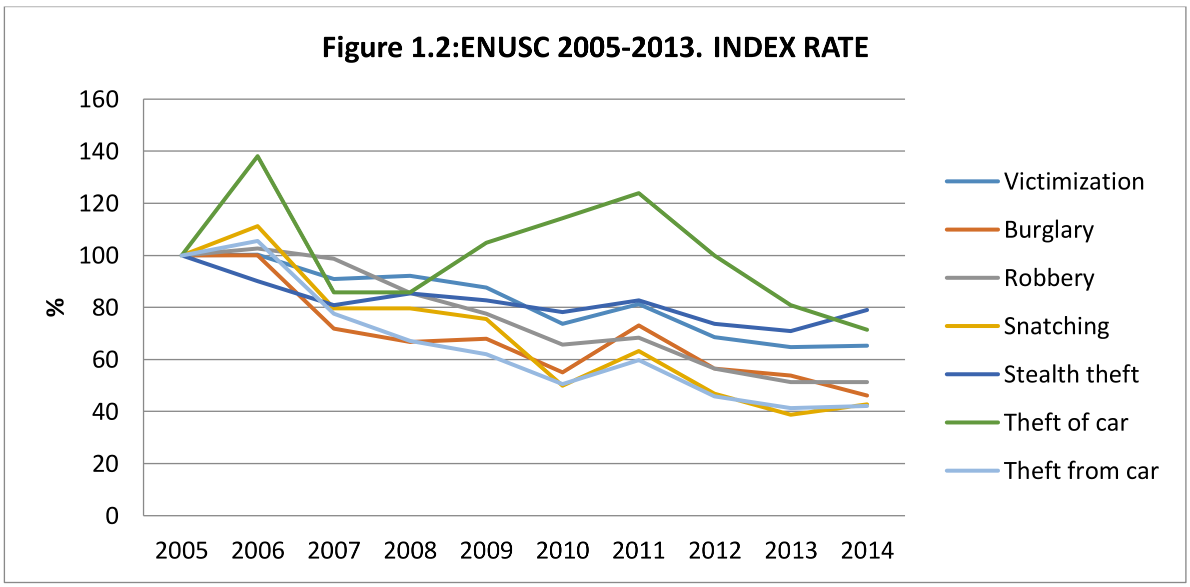


Figure 1.2:ENUSC 2005-2013. INDEX RATE
%
160
140
120
100
80
60
40
20
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Victimization
Burglary
Robbery
Snatching
Stealth theft
Theft of car
Theft from car

1.3 Aims and objectives

The primary aim of this thesis is to test the applicability of the security hypothesis as an explanation for falls in Chilean burglary rates. Nine sweeps of ENUSC are employed to explore burglary trends and their relationship to temporal changes in the availability of household`s security protection. This investigation explores three areas in relation to burglary in Chile: trends and temporal changes in victimization rates, risk factors associated with burglary victimization in Chile, and the macro-level determinants of burglary rates over time. Those areas are explored for answering the following research questions that guide this investigation:

1. Was there actually a national and significant decrease in Chilean burglary rates? Could it be that the observed downward trend was an artifact yielded by averaging aggregated data? Is it correct to call it national decrease, despite regional variance?
2. Was there a correlation between burglary rates and availability of household`s security protection? Are they effective for preventing burglary victimization? Were changes in its prevalence associated with changes in burglary rates over the studied period? What was its relative effect compared to other relevant factors identified by literature on crime trends?

To answer those question, this research use data of burglaries from the Chilean national victimization survey (ENUSC), which measures burglary by **asking the respondents whether someone steal something from his dwelling, during the last 12 months**. This definition of burglary, therefore, focus on the stealing before the breaking-in. Also, it does not take into account attempts of burglaries nor cases where someone got into the house and “tried” to steal something, unlike other victimization surveys - for example, the British crime survey (BCS) and the International crime victimization survey (ICVS). Another difference is that in the Chilean survey victims of burglary can respond any number when asked how many burglaries they have suffered, unlike many victim surveys where burglaries experiences are truncated at four or more victimizations.

In the interest of exploring the drop in Chilean burglary rates and its relationship with changes in prevalence of security devices, this research adopts the following strategy: first, there is an exhaustive analysis of burglary trends to evaluate whether they significantly decreased; then there is an analysis on the correlation between burglary rates and availability of security measures. Correlations between those variables were analyzed by using cross-sectional methodologies at household level, and longitudinal methodologies at region (area) level.

It is supposed that to be considered as feasible factor in producing burglary trends at the national level, security devices should firstly be effective at the individual level; otherwise analyses might be based on spurious correlations between aggregated data. Hence, burglary rates are modeled at household level to assess the effect of burglary protection devices (and different combinations of them) on burglary victimization. Then, the relationship between changes in prevalence of security devices at regional level and changes in regional burglary rates over time is assessed by employing longitudinal models which control for usual explanations of burglary trends, namely: law enforcement, incarceration, economic and demographic variables.

Thus, in order to answer the above-mentioned questions, the following hypotheses are considered:

- H1: Between 2005 and 2013 there was a statistically significant drop in burglary rates across Chilean households

- H2: The availability of security protection at household level was negatively correlated to burglary victimization, after controlling by other relevant variables.

- H3: Prevalence of household security devices was negatively correlated with regional burglary rates between 2005 and 2013, after controlling by other relevant variables.

In exploring these hypotheses and identifying determinants of burglary rates over time, it is hoped that this research contributes to a better understanding of the downward trends in victimization in Chile and their causes. It is also hoped that findings of this research may assist designing and targeting of crime prevention policies. This research contributes to filling the current gap in victimization risk research in Chile, particularly regarding its trends. In addition, it is hoped this thesis makes a contribution to the development of theory, particularly in its application to the crime drop.

1.4 Thesis contribution

This research provides a number of contributions to the modelling of victimization rates in Chile; and its changes over time. To my knowledge, this research constitutes the first in-depth analysis of burglary risk, and its trends in Chile. The main contributions can be summarized as follows:

- That is the first modelling of burglary victimization (or any crime type) using the theoretical framework of Opportunity theories in Chile.
- Both burglary incidence and burglary risk are modelled by employing appropriate statistical methods for each. Statistical modelling in the form of multilevel logistic and multilevel negative binomial regression has been utilized to this end.
- A number of factors associated with burglary victimization in Chile have been identified, by taking into account both borough and household effects.
- Longitudinal analyses on change of burglary rates over time have been conducted. Hence, this thesis contributes to literature on the crime drop

by extending the scope of that phenomenon to a developing country like Chile.

- The “cross-national” property of the security hypothesis is tested by exploring its applicability in a developing country like Chile. That is a major contribution of this thesis since most evidence supporting the security hypothesis has been obtained from western-industrialized country data.
- Different security devices and combinations of them have been analyzed to compare their relative effect on burglary risk.

As a whole, this thesis contributes to filling a gap in research concerning specific crime types in Chile, and particularly, the enormous deficit in research about the observed decrease in victimization rates for some offences. The Chilean victimization survey (ENUSC) is a rich and reliable source of data about victimization and characteristics of victims and incidents; however, it is still massively underutilized. Extending analyses in this work to other offences measured by ENUSC would be useful not only to develop a better understanding of crime rates in Chile, but also to inform crime prevention policies and practices.

The application of crime theories from industrialized countries, such as opportunity theory and the security hypothesis, in a developing country like Chile provides an opportunity to test the applicability of those theories beyond the context in which they have typically been developed and applied. Particularly, the applicability of the environmental criminology perspective in developing countries is challenged not only by differences in the socio-cultural settings , but also by differences in the layout of cities that may have features that are far less prevalent or even non–existent in typical European cities. Thus, examining those theories with data from developing counties may assist further theoretical improvements, and their ability to explain global phenomena like the international crime drop.

1.5 Structure of the Thesis

The thesis is comprised of seven chapters. The next chapter provides a review of the literature divided in two parts: the first addresses available hypotheses to explain the crime drop, including the security hypothesis, while the second addresses opportunity theories as the theoretical framework used to explain why security prevalence may affect burglary rates. Chapter three presents an overview of data utilized in this research and the methodologies employed to analyze them. Cross-sectional and longitudinal regression models are discussed.

Following the first three chapters, the next three present and discuss the findings of this research. Chapter four presents a detailed overview of the distribution of burglary victimization from 2005 to 2013. Chapter five presents finding on the association between burglary victimization and household and area characteristics. It considers availability of different security device configurations in order to assess if their presence were associated to estimations of household`s burglary risk and the expected number of burglaries. Thus, logistic and negative binomial regressions are employed. In this chapter analyses are made at households level, and a number of household`s characteristics and area features are included in analytical models. By using multilevel techniques, borough no observed-effects are also considered in models.

Chapter six reports the results from longitudinal analyses on the association between changes in prevalence of security devices and changes in burglary victimization rates. Models in this chapter include control variables such as law enforcement, incarceration, economic and demographic measures. A concluding chapter summarizes the main findings and considers the theoretical contributions of this research as well as crime prevention and future research recommendations.

Chapter 2: Literature Review

2.1 Useful hypotheses to explain the Chilean decrease on victimization rates

Research on the American crime drop has provided a number of plausible hypotheses to explain the decrease in crime rates in the United States. The key hypotheses proposed are demographic changes (Blumstein, 2000; Fox, 2000; Levitt, 2004); increasing prison populations (Langan & Farrington, 1998; Levitt, 2004); changes in policing strategies (Eck & Maguire, 2000); increasing number of police officers (Marvell & Moody, 1996; Levitt, 2004), gun control policy (Rosenfeld, 1996; Levitt, 2004); changing in crack markets (Levitt, 2004); legalization of abortion (Donohue & Levitt 2001); and economic factors, as derived from the classical Becker's model of crime (Becker, 1968).

However, several of those hypotheses are in advance not relevant for the Chilean case. Take, for example, abortion law. In Chile this has not changed in the last years. Abortion is still covered by one of the toughest prohibitive law across the world (even therapeutic abortion is forbidden). Changes in crack or drug markets are also not relevant for Chile, given the fact that they have never reached the epidemic characteristics observed in the USA during the 1980s and early 1990s. The same observation is valid about gun proliferation and, therefore, about gun control policy as an explanation for the decline in victimization rates.

This section reviews the other hypothesis proposed to explain the decrease of crime in the USA that might be applicable to the Chilean case: increasing incarceration rates, changes in policing, demographic changes, and economic factors. Each of them is discussed in terms of the evidence available for the USA, Europe and Chile. The purpose of this review is to assess the relevance of such hypotheses for explaining the decrease on burglary victimization in Chile, and their inclusion, as control variables, in models testing the applicability of Security Hypothesis to explain changes in Chilean burglary rates over time.

The final part of this section presents the Security Hypothesis, which is the main hypothesis of this research. In the case of Chile, the Security Hypothesis seems to be a promising explanation for the decline in burglary, given the huge growth of the security industry in Chile and the consequent increase on prevalence of security protection in Chilean households.

2.1.1 Increasing incarceration rates

Imprisonment may reduce crime rates through three main mechanisms: deterrence – the behavioral response to the threat of punishment; incapacitation – the offender cannot commit further crimes while incarcerated; and rehabilitation or specific deterrence – the behavioral response to the experience of incarceration. Based on such premises several studies in both the USA and Europe have tried to measure the effect of incarceration on crime rates.

In the USA such attempts have been particularly strong because this country has increased its prison population by around 400% in the last 25 years. Thus, estimating the effectiveness of incarceration for preventing crime has been a major policy issue. As reported by Spelman (2000) both simulation studies and econometrics analysis meeting the American National Research Council (NRC) quality standards have found significant negative relationships between incarceration rates and crime rates. Simulation studies (Dilulio & Piehl, 1991; Spelman, 1994; Piehl & Dilulio, 1995), which estimate the potential reduction on crime rates due to incapacitation, found that the elasticity of crime rates with regard to prison population ranged from -.16 to -.26; that is, for every one-per cent in the prison population, crime declines by between .16 and .26 per cent.

Econometric studies in the USA (Devine et. al, 1988; Marvell & Moody, 1994,1996; Levitt, 1996; Becsi, 1999) have found larger effects of imprisonment, which should not be a surprise given the fact that unlike simulation studies, econometric analysis accounts for both incapacitation and deterrent effects of prison. In this line, Devine et. al. (1988) found a robust link between changes in homicide, robbery and burglary rates and changes in prison population for the period 1948 to 1985. Those findings were updated and replicated by Marvell and Moody (1996) who used national time series data for the period 1958-1995. According to those studies, the elasticity of crime rates (all index crime) with respect to prison population would be -2.2 for incapacitation and -.93 for deterrent effect. The elasticity of violent and property crime would be around -2.84 and -1.99 in Devine's research, and -.79 and -.95 in Marvell and Moody analysis. However, analyses carried out at state level have shown elasticity to be remarkably lower than those found at national level. For example, the same authors Marvell and Moody (1994) found that at state level the elasticity of crime rates with regard to prison population were -.16 for all index crime, and -.25 for robbery and burglary. Another study carried out by Becsi (1999) with state level data from 1971 to 1994 found that elasticity for all index crime was -.087, and -.046 and -0.091 for violent and property crimes, respectively. Interestingly, both Becsi and Marvell & Moody found similar elasticity for vehicle theft (-.2).

Most of those studies have been criticized because they do not consider the fact that just as prison population may affect crime rates, so too crime rates may affect prison population (Spelman, 2000; Donohue, 2009; Durlauf & Nagin, 2011). By using instrumental variables to address the risk of simultaneity between prison population size and crime rates - that is, the possibility that not only prison population affects crime rates, but also that crime rates affect prison population - Levitt (1996) was able to estimate the effect of prison more accurately than other research in the U.S that had overlooked the simultaneity issue. Levitt used the Prison Overcrowding Litigation as an instrument for the size of prison population to estimate its impact on crime rates in 12 states of the United States. Thus, Levitt estimated an elasticity of crime rates with respect to size of prison population of -.31 for all crimes, and -.38 and -.26 for violent and property crimes, respectively (and -.40 for burglary, and -.26 for vehicle theft). A similar methodological strategy was used by Spelman (2005) who addressed simultaneity by using three instrumental variables: law enforcement resources, prosecutor and correctional resources, and police civilianization. This author found that elasticity for violent and property crimes in Texas counties were -.44 and -.26, respectively.

In Europe, research about the effect of imprisonment on crime rates has employed collective pardons or amnesties to generate an exogenous source of variation in prison population. In this line, Drago et. al. (2009) used a collective pardon implemented in Italy in 2006 (affecting around 40% of prison population) to measure the deterrence effect of an increase in expected prison sentence, and

> "*show that a marginal increase in the remaining sentence reduces the probability of recidivism by 0.16 percentage points (1.3 percent). This means that for former inmates, one month less time served in prison commuted into one month more in expected sentence significantly reduces their propensity to recommit a crime*"

Barbarino and Mastrobuoni (2008) also used Italian amnesties, but to estimate the incapacitation effect of imprisonment. By exploiting a series of prison amnesties in Italy between 1962 and 1995, these authors estimated that elasticity of total crime with respect to prison population was -.22 and -.31, depending on whether police or judiciary data were used. Finally, in their comparative analysis of crime trends in Europe and the U.S., Buonnono et al. (2011) exploit amnesties across five European countries as an instrumental variable for changes in prison population. Based on analysis of data from 1970 to 2008, these authors conclude that in Europe elasticity of total crime per capita to the incarceration rates was -.44, while elasticity of violent and property crime were -.37 and -.38, respectively.

Results showing a negative association between incarceration rates and crime rates in both Europe and the U.S. have led researchers to analyze the relationship between the crime drop and the increase in incarceration rates during the crime decline period. It is well-known that the American crime drop coincided with a dramatic increase on incarceration rates, which went from 110 per 100,000 population at the end of the 1970s to 700 per 100,000 population in 2005 (Blumstein, 2006). Although imprisonment levels were remarkably lower than those in the U.S., prison population also grew in European countries during the 1990s. The increase on prison population in Europe between 1992 and 2004 ranked from 10 per cent in France to more than 100% in the Netherlands, where the imprisonment rate doubled during this period (Rosenfeld & Messner, 2009). In this context researchers have considered whether the crime drop (or part of it) might be explained by the increasing incarceration rates.

Levitt (2004) stated that the growth in the prison population was one of the four reasons that explained the decline in crimes in the U.S. during the 1990s, and that this variable accounted for about one third of the observed decline in crime. Other authors such as Baumer (2008), Rosenfeld (2006), Zimring (2007) and Blumstein and Rosenfeld (2008) have also argued that increased imprisonment accounted for part of the crime drop in the US, and have attributed about 10 to 20 per cent of the crime drop over the 1990s to increased incarceration.

However, researchers in both the US and Europe have concluded that increasing incarceration rates are not enough to explain the crime drop in those places. Spelman (2000) used Levitt's analysis (1996) to estimate the contribution of the increase in the prison population to the crime drop in the United States. He found that growth in the prison population between 1972 and 1996 increased the drop in crime by 27 per cent. In other words, if increasing in prison population in the U.S. had not taken place, the violent crime rate would have dropped anyway, even though it would have been around one-fourth smaller. In Europe, Rosenfeld and Messner (2009) found that increasing incarceration rates were not associated with the decline in burglaries in Europe between 1993 and 2006. By analyzing data from nine European countries, those authors showed that incarceration rates were associated with temporal change in burglary rates only in the case of Italy, where a clemency measure dramatically reduced the size of prison population in 2006 (the amnesty studied by Drago et. al., as mentioned above). They concluded that the growth in prison population did not have a statistically significant effect on the European burglary decrease, even in the Netherlands where the imprisonment rates doubled between 1992 and 2004.

In the case of Chile, prison population growth is a feasible variable for explaining the fall in victimization levels between 2003 and 2011, as the number of individuals sentenced to prison increased by 235 per cent during this period, from 17,458 in 2001 to 63,213 in 2010 (Gendarmeria de Chile, 2013). In a national-level study, Ruiz et. al. (2007) correlated rates of police-recorded "theft with forced entry" (burglary and car theft) and rates of individuals incarcerated following "theft with force" charges, between 1995 and 2004. They found that incarceration rates (resulting from theft-with-force charges) were negatively correlated to the number of police-recorded theft-with-force incidents over the period.

However, the strength of the association must be interpreted cautiously because it is not observed in relation to "theft with violence" (robbery) trends. It is difficult to explain why incarceration rates might be effective in reducing crime rates for thefts that do not involve direct contact with victim (breaking-theft) but are not effective in reducing violent theft. In regard to incarceration, another study concluded that in the case of Chile, increasing incarceration rates have not had an effect on levels of crime (Matus, 2006).

2.1.2 Changes in police and policing

Since the decrease of crime rates in the U.S. during the 1990s coincided with remarkable changes in n policing, many people have attributed the decrease to an increase on police efficacy. Over the period not only did expenditures on and size of the police force grow substantially (Levitt, 2004), but there were also significant changes in police strategy. The introduction of Compast and mapping of "hot spots", the delivery of "broken windows" or "zero tolerance" policies, gun seizures strategies such as "stop and frisk" searches, and the introduction of some variant of community policing, are examples of major innovations at U.S. police departments for tackling crime in the 1990s. However, despite the claims about police efficacy, there is no consensus among researches about the effect of changes in policing on crime figures.

The effect of police on crime rates has been analyzed in terms of its size, efficacy, and strategies. The size of a police force might have a preventive impact on crime because of the deterrent effect of police presence on the streets. However, that relationship is not straightforward because of the same simultaneity issue mentioned regarding incarceration rates: just as size of police force may affect crime rates, so too crime rates may affect the actual size of police force. Precisely because of that; Levitt (2004) dismisses the efforts made during the 1970s and 1980s to study the association between the number of officers and crime.

According to Levitt, those studies, as reviewed by Cameron (1988), failed to take into account the endogeneity of both variables, which would explain the insignificant or positive relationship between crime and number of police effects that most of those studies have found. By contrast, research addressing the simultaneity between police size and crime by both using instrumental variables (Levitt, 1997, 2002; Lin, 2009) and using time series data and lagged variables (Marvell & Moody, 1996; Corman & Mocan, 2000; Kovandzic & Sloan, 2002) has found a consistent negative association between both variables. For example, Kovandzic and Sloan (2002) used county-level data collected from

Florida for the period 1980–1998 and a multiple time series design to study the police–crime relationship. That study found that increases police levels reduced most types of crime at the county level. In turn, Lin (2009) used a instrumental variable strategy to overcome the simultaneity between police size and crime, and found that the elasticity of police presence with respect to crime is about −1.1 for violent crime, and −0.9 for property crime.

Other studies have taken advantage from “natural experiments” where political and social conditions triggered abrupt changes in police presence. Take, for example, Shi (2009). Shi studied the decrease in police presence, which stemmed from a racial incident in Cincinnati. The events began when a white officer shot and killed an unarmed African American suspect. What followed was 'rioting, heavy media attention, federal civil rights investigation, and the indictment of the officer in question'. According to Shi, that situation then created an incentive for police officers to reduce their presence and interactions, especially in communities with larger proportions of African Americans in the population. Shi demonstrated the decrease in police productivity in the aftermath of the riots and documented the increase in criminal activity; he estimated that elasticity of crime to policing was -.5 and -.3 for violent crime and property crime, respectively. Similar results were found by DeAngelo and Hansen (2010) in their study on the effects of a decrease in police enforcement on roadway safety in Oregon.

Researchers also have took advantages of terrorism`s threat to measure the effect of increasing police presence on ‘common’ crime. A usual response to both terrorist attacks and alerts of terrorist attacks are deployment of extra police or concentrations of them in strategic points of the city. Following this, Klick and Tabarrock (2005) used changes in terror alert status in Washington D.C.; Draca et. al. (2008) examined the effect of the increased in police officer in the aftermath of the July, 2005 bombing in central London; and Di Tella and Schargrodsky (2004) analysed the effect of police response to a terrorist bomb in Buenos Aires on crime rates in those areas where police were concentrated (block containing Jewish institutions). All of those studies found a significant negative effect of police deployment on crime rates.

However, despite those few studies showing effects of police numbers on crime, many other have concluded that variation of police size over time do not affect crime rates, and that changes in police (in what actually police do) are more important regarding crime levels. In Blumstein and Wallman (2000, 2006), Eck and Maguire presented a fine analysis of the relationship between policing and the crime drop, and concluded that there is no empirical evidence to support the police efficacy hypothesis. By reviewing twenty-seven studies focused on the effects of police force size on violent crime, Eck and Maguire showed that in 49% of those studies there was no effect, and that among the studies showing effects the outcome was unexpected: only 20% of the reviewed studies found an association between an increase in police size and a decrease of violent crime rates, yet 30% found that increase in the number of police was associated with an increase of violent offences. Along these lines, Weisburd and Eck (2004) argued that a major concern regarding studies of police force size and crime rates is the fact that most of them fail to distinguish between the `effects of police force size and the factors that ordinarily are associated with police hiring such as changes in tactics or organizational structures`. The argument is that research on policing suggests that what police officers actually do on the street is very much more important than the size of police force per se (Sherman and Eck, 2002; Telep and Weisburg, 2011).

Several researchers have shown a negative association between crime rates and police arrest rates. Cameron (1988) reviewed a number of studies that examined the relationship between crime rates and arrest rates, and found that almost all of those papers showed the expected negative relationship. Similar results were obtained by Lott and Mustard (1997) in their study using FBI Uniform Crime Reports data. Levitt (1998) not only found a negative empirical relationship between arrest rates and crime, but also he was able to distinguish the deterrence effect of increasing arrest rates from the incapacitation effect[1]. By doing so, he found that deterrence effect of arrest rate was most important than its incapacitation effect for reducing crime, especially property crime.

Arrest rates have also been used as explanation of aggregate crime trends. Imrohoroglu et. al. (2004) stated that higher arrest rates were the most important factor accounting for the decrease in property crime between 1980 and 1996 in the U.S. In turn, Shoesmith (2010) showed that arrest rates were one out of four factors that explain crime trends between 1970 and 2003; including both the increases in U.S. violent and property crime during the period 1970-1991, and the decline of crime afterwards.

Weisburd and Eck (2004) questioned the effectiveness of intensive arrest polices based on the evidence about disorder policing, generalised field interrogations and traffic enforcement, and mandatory arrest polices for domestic violence. In his review of studies carried out in seven U.S. cities, Skogan (1990, 1992) found no evidence that increasing arrests had reduced disorder. Eck and Maguire also have questioned the arguments that, based on the decline of crime levels in New York city, argue that disorder policing has been effective in reducing criminality. According to those authors, most of the studies showing such effects confounded them with either other organizational changes, such as Compstat, or more general crime trends.

According to Weisburd and Eck (2004) the effectiveness of police increases as it moves away from standard model of policing – that is, random preventive patrol, rapid response to calls and general intensive arrest policies - to hotspots and problem oriented policing. Hotspots policing is based on evidence that

[1] Hi did it by combining elasticities of crime with respect to own-crime arrests and arrests for other crimes with information about the frequency of crime commission and expected time served. His assumption was that "if burglary and larceny are substitutes, deterrence predicts that an increase in the expected punishment for burglary should lead criminals to substitute away from burglaries toward larcenies. Incapacitation effects, on the other hand, imply that an increase in the arrest rate for burglary will lead to a greater number of bur glars who are behind bars. Having more burglars locked up should reduce the number of larcenies, assuming that burglars sometimes commit larceny as well (Levitt, 2008, pag 354)

crime is not randomly distributed, but is concentrated on a small number of places. Research has showed that a very small fraction of areas typically account for a disproportionate volume of crime (Ratcliffe, 2004; Sherman et. al., 1989) and even that a small number of street-segments may determine crime rates in a city (Weisburd et. al., 2004). Based on that premise a number of research projects have demonstrated the benefits of allocating police resources to high crime areas (Sherman et al. 1989; Sherman & Weisburd, 1995; Braga, 2001). Braga et al. (2012) summarized the findings from nineteen studies containing twenty-five tests of hotspots policing interventions; ten of those studies used randomised experimental designs and nine used a quasi-experimental design. Results of 20 out of 25 tests on hot spot policing showed remarkable reductions in crime and disorder in the intervention areas. The meta-analysis of these outcomes carried out by Braga and colleagues revealed a small, but significant mean effect size of hot spot policing in reducing citizen calls for service in treatment areas compared with control areas. From that evidence, Braga's review concluded there is fairly robust evidence to state that hot spots policing is an effective crime prevention strategy.

In the case of Chile, almost all available studies of determinants of crime levels have included some indicator of police efficacy; and most of them show a negative correlation between those indicators and rates of police recorded offences. Molina et. al. (2003) used a panel for the thirteen regions of Chile, from 1988 to 2000, to analyse the determinants of crime in Chile. In their study, Molina and colleagues used police recorded offences as the dependent variable to estimate the effect that police efficiency, measured as the ratio of arrest to recorded offences in time (t-1), had on rates of rape, homicide, violent crime, theft, drug-related crime, and fraud. They found that increasing police efficiency had a significant negative effect on theft, drug and fraud complaint rates. In the same way, both Gallardo et. al. (2012) and Vergara (2012) also found a significant negative relationship between the ratio of arrest to reported offences and rates of crime known by police

Rivera et. al. (2003) also found that police efficiency had a negative effect on rates of theft, drug, fraud, and also violent crime complaints. However, they distinguish the double effect of increasing the number of police officers. On the one hand, more officers decrease the “dark figure” of crime not reported to police, thereby, increasing the number of offences known by police (the dependent variable). On the other hand, a greater number of officers increase the ratio of arrests to reported crime, thereby, decreasing the crime rates. The authors concluded the net effect of increasing police strength on crime rates would be positive, that is the dark figure reduction effect, outweighs the increasing police efficiency effect.

The studies cited above about determinates of crime in Chile all used reported crime rates for the dependent variables, which have shown an upward trend during the last 20 years. However, these increasing rates of complaints might be related to variables other than an actual increase in crime level, for example an increase in the level of confidence in the Justice System that seemed to follow reforms made during the nineties or and which may have increased confidence that it was worth reporting crime. Or, as found by Rivera et. al (2003), greater police presence may have facilitated the reporting of crime incidents. Additionally, in every one of those studies there is a high risk that the negative coefficients found simply reflect the fact that reported crime (the dependent variable) are also in the denominator of the explanatory variable (Shoesmith, 2010).

However, police efficiency may still be a relevant factor in the study of victimization trends in Chile. This is the case in particular where victimization surveys are used to measure crime trends. In this case, the relationship between victimization (as measured by victimization surveys) and police efficiency does not present the endogeneity problem mentioned above where recorded crime is used in the analysis. As the following table shows, the ratio of arrested individuals to complaints increased during the same period that victimization decreased.

Table 2.1: reported crime and number of arrested individuals per 100,000 populations in Chile

	2005	2006	2007	2008	2009	2010
Total arrests	822.6	845.9	937.2	986.2	1079.0	1042.9
Total reported offences	2502.0	2489.5	2666.7	2714.7	2889.7	2780.3
Ratio	0.33	0.34	0.35	0.36	0.37	0.38

Built upon data from Balance Seguridad Ciudadana 2010, Fundacion Paz Ciudadana. 2011

2.1.3 Economic factors

Economic models of crime (Becker, 1968) suggest that economic factors might affect crime rates by affecting the balance between benefits and costs of crime and, thereby, individuals' decisions to engage in crime. In this line, economy may affect crime occurrence either because economic hardship may push people into crime to secure their incomes, or because economic prosperity may increase crime due to the greater availability of valued consumer goods (Cohen & Felson, 1979). Most researchers agree that economic factors played an important role in crime rate trends, but they disagree about both the mechanisms through which economic factors act, and about the size of its impact on crime rates.

Economic factors usually associated with crime rates may be divided into absolute factors and relative factors (LaFree, 1999). Among the absolute factors of economy´s influence on crime rates, the most frequently considered are poverty, income, and unemployment. Common relative factors are income inequality and inflation.

Unemployment may increase individual´s disposition to crime for two reasons. First, because the expected returns from legal work decrease if the probability of being (or remain) unemployed is higher. Second, because higher unemployment rates are associated with lower wage rates.

However, empirical evidence about the effect of unemployment rates on crime is far from being robust. On the one hand, several recent studies (Raphael & Winter-Ebmer, 2001; Gould et al., 2002; Lin, 2008; Oster & Agell, 2007; Fougere et al., 2009) have shown that increasing unemployment rates contributes to an increase in property crimes, but does not significantly impact on violent crimes. On the other hand, a number of research studies have concluded that changing rates of unemployment have not had any significant impact on property or violent crime (Imrohoroglu et al., 2004; Arvanites & Defina , 2006; Rosenfeld & Fornango, 2007; Baumer, 2008). A review by Kleck and Chiricos (2002) found that evidence about impacts of unemployment on crime rates was inconsistent.

Wage rates have been used as a more precise indicator of economic hardship than the too general (Blumstein & Rosenfeld, 2008) and imprecise (Greenberg, 2001) unemployment rate. The rationale behind using wage level as indicator is that as wages increase, the payoff of crime decreases; thereby, crime rates decrease too. Several researchers have found a negative relationship between crime rates and wage levels. For example, in explaining the American crime drop, it has been shown that while crime increased at the same time that wages fell in the 1970s and 1980s, it decreased when wages increased in the 1990s, especially for low-skilled workers (Zimring 2007; Baumer 2008). Additionally, the wage hypothesis might explain why people age out of crime (Barker, 2010) . Grogger (2006) estimated that the reduction of young-male-worker wages by 22% in the 1980s accounted for the increases in property crime committed by young males aged 16 to 24.

However, some researchers have pointed out that those absolute measures, while consistent with the 1990s crime drop figures in the US, fail to explain crime trends over wider periods. During the middle post-war years in the US (from about 1961 to 1973) rapidly increasing crime rates were paired with good unemployment and income indicators. This ‘paradox of crime amidst plenty’ (Wilson, 1975) casts doubt on the explanatory power of absolute economic factors, but not relative ones. Unlike income or unemployment indicators, relative measures like inequality and inflation were far from favorable during that period, and fitted better with long term crime rates. Along these lines, it is said that those indicators ‘have far been more successful at explaining longitudinal crime trends in post-was United States’ (Lafree and Drass, 1996; La Free, 1999, Devine et. al., 1988).

Inequality may be linked to crime rates either because inequality is associated with potential net gains from crime (Bourguignon, 2000; Imrohoroglu et. al., 2000, Ehrlich, 1973; Kelly, 2000) or because inequality leads some people to seek compensation by any means, including committing a crime against both poor and rich, as stated by ‘relative deprivation’ theory (Eberts P. and Schwirian K.P., 1970; Lea and Young, 1993).

Many researchers have tested correlations between inequality and crime rates (Witte, 1980; Tauchen et. al., 1994; Grogger. 1998; Fajnzylber et. al., 2002a; İmrohoroglu et. al. 2006); and, even though it has been warned that correlation between inequality and crime rates may be due to a third variable affecting them (Bourguignon, 2000), some of those studies have shown evidence about the causal relationship linking inequality and crime rates. For example, Fajnzylber and colleagues (2002b) used a panel data set for 39 countries to test whether there is a causal relationship between inequality and crime. In their study, they analyzed correlations between the Gini index and robbery and homicides rates controlling for other potential crime determinants, endogeneity of inequality and measurement error. They found that crime rates and inequality are positively correlated within countries, and particularly, between countries; they concluded by stating that this correlation ‘(reflected) causation from inequality to crime rates, even after controlling for other crime determinants’.

Imorohoroglu, Merlo and Rupert (2004) analysed the property crime drop between 1980 and 1996 in the USA, using a dynamic equilibrium model which incorporated police, economic and demographic variables. Their model was able to reproduce the property crime trends between 1975 and 1996, and they found that the main variables to explain the decrease in property offences between 1980 and 1996 were higher apprehension probability, increase in average income and the aging of the population. Thus, the findings of that paper suggest that if the only change to have occurred between those years were the observed increase in average income, the property crime rate would have been 20 per cent lower in 1996 than in 1980.

More recently, Rosenfeld and Fornango (2007) introduced “consumer sentiment” as an alternative measure of economic hardship. They argued that consumer sentiment is a better indicator than other ‘objective’ measures because it reflects subjective perceptions of economic changes. In their study of crime trends in the U.S. between 1970 and 2003, those authors found “consumer sentiment” significantly correlated with patterns of robbery and property crime, and concluded that an improved perception of economy conditions and economy expectations explained between 25% and 50% of the decline in such offences during the 1990s.

Consistently, in a comparative study about burglary decline in the U.S. and nine European countries, Rosenfeld and Messner (2009) found that the effect of consumer confidence on burglaries ‘is largely independent of the effects of unemployment and GPD per capita either in the full sample or when only European countries are considered.’ Thus, these authors estimated that ‘one standard deviation increase in consumer confidence is associated with an estimated burglary reduction the following year of about 5 per cent’.

In Chile, Nunez et. al. (2003), Rivera et. al. (2003) and Gallardo et. al. (2012) have found a positive association between regional rates of property crime and regional GDP, and a negative relationship between property crime and relative regional GDP (1- regional GDP/ national GDP). In line with Entorf and Spengler

(2000), those findings have been interpreted as GDP measuring illegal income opportunities, and relative GDP measuring legal income opportunities. Similarly, Benavente and Melo (2006) found that income is positively related to property crime complaints.

Regarding unemployment, a positive relationship has been found between regional unemployment rates and complaints rates of violent crimes and property crimes (Nunez et. al., 2003; Rivera et. al., 2003; Benavente & Melo, 2006, Vergara, 2012). Similarly, poverty rates were also found to have a positive relationship with property crime complaints at both regional level (Nunez et. al., 2003; Rivera et. al., 2003; Gallardo et. al., 2012) and municipal level (Benavente & Melo, 2006). Finally, in all these studies inequality rates, either at regional or municipal level, had no effect on rates of property crime, even though Nunez et. al. found a negative association with crime of violence, and a positive association with drug-related crimes.

Ruiz et. al. (2007) confirmed some of the relationships found in the above-mentioned studies, but also found contradictory evidence regarding poverty. These authors found that between 1996 and 2004, trends in reported burglary and robbery rates were positively correlated to several indicators of wages and incomes and to unemployment rates during the period. In the same line, they showed there was no significant correlation between complaint rates and inequality figures. However, unlike the other studies summarized, Ruiz. et. al. found that several indicators of poverty (poverty rates, prevalence of poverty among 15-29 year old population, urban poverty, and extreme poverty) were all negatively correlated to trends in reported burglary and robbery.

The relationship between economic indicators and crime levels in Chile is less clear when the latter is measured by victimization surveys. As shown previously, between 2003 and 2013 victimization prevalence steadily decreased from 43% to 24.8%. During the same period, economic indicators showed dissimilar trends. On the one hand, GDP rates – a measure of economy health - decreased from 7.1% average during the nineties to 3.4%

average for the period 2000-2005, and from there to 2.1% average for the period 2005-2009 (Larrañaga, 2010). On the other hand, poverty followed the pattern begun in the nineties and decreased from 20.2 per cent to 15.1 per cent between 2003 and 2009, which seems to confirm that poverty is positively correlated to victimization rates. Unemployment rates were stable at around 9-10% between 2001 and 2004, then decreased to reach 7% in 2007, and increased again to reach 9.7% in 2009; from there, unemployment rates decreased again to 5.9% in 2013. From those figures, economy growth rate and unemployment rates in Chile do not appear to have had an influence on the risk of victimization.

2.1.4 Demographic Changes

Demographic variables may help explain crime trends as long as criminality changes according to age, sex, and other demographic factors. Along these lines, it is said that some groups, for example, young people, males and some minorities, are more prone to commit and to be victims of crime, and therefore that the level of crime in a particular population varies along with variation of the relative size of those groups in the population. (Blumstein & Rosenfeld, 2008). Based on this premise, several researchers have focused on demographic factors to explain the rising crime level in the U.S during the nineteen sixties. By using different methods of demographic decomposition, time periods and geographical areas to assess the impact of population shifts on crime rates, all of them arrived at the same conclusion: “all else equal, violent-crime rates rise as the percentage of the population in the more violence-prone age-race-sex groups expands” (Fox, 2000).

Among the set of demographic factors, the relationship between age and crime have been specially studied. Most studies have concluded that youth people are overwhelmingly overrepresented in criminal events, either as offenders and/or as victims (Hirschi & Gottfredson, 1983; Nagin & Land, 1993; Farrington, 2003; Sampson & Laub 2003). Given this evidence, researchers have focused on the relationship between the percentage of youths and crime rates in the population. They have found a significant positive correlation between the relative size of the youth population - percentage over total population - and homicide rates (Cohen & Land, 1987; Fox & Piquero, 2003; Land et. al.,1990).

However, others authors have suggested that the relationship between these variables is not that clear. In a review of 90 studies that regress crime rates on age structure, Marvel and Moody (1991) found that only 30% of analyses for each separate crime type showed moderate or strong positive relationship between age structure and crime rates. Despite the fact that most of those studies (59) were cross sectional studies that presented collinearity problems, the time-series studies reviewed (30) still showed that only 60% of such studies found a moderate or strong positive correlation. Also, from the Marvell-Moody review it is possible to see that correlation between age structure and crime rates is more often found in time-series studies focused on property crime than in those focused on personal/violent crimes.

The aging of the population and the fact that “baby boomers” aged out of crime during the nineties have been one of the most popular explanations of the crime drop in the United States in that period, even though its contribution may be modest. For example, Zimring (2007) observed that the proportion of the population of young people aged fifteen to twenty-four year old in the U.S. declined by 26% between 1980 and 2000; and he suggested that this smaller “high-risk” group likely was a factor in the decline of American crime rates. However, as the same author pointed out, the fact that the reduction in youth as a proportion of the population was gradual while the decrease in crime was rapid and steep suggests that changes an age structure played only a small part in producing the decrease in crime.

Similarly, Fox (2000) also argued that shifts in the percentage of population in the most violence-prone age group, played a modest role in the decrease of homicide rates in the U.S. during the nineties. In his study, Fox showed that rates of homicide and the percentage of population aged 18-to-24 have been historically connected, except for the period 1986-1993 when homicide rates increased, while the size of young adult population continued to fall following a trend that began in 1980 . By using the rates of homicide recorded for different age-race-sex groups in 1991 (which for the case of 14-24 year olds were the highest recorded), Fox estimated the expected homicide rates for each year of the period 1992-1998 if only demographic changes would have occurred. Then the author compared those figures with the actual rates of homicide for each of those years, and concluded that demographic changes explained only around 10% of the decrease in homicides between 1991 and 1998.

Similar results were found by Imrohoroglu et. al. (2004) in relation to property crime. By using a dynamic model of agent engagement in crime, these authors estimated that if everything else were held constant, the decrease in the share of the population aged between 15 and 25 (from 20.5% to 15.15) would have reduced the property crime rate by 11% between 1980 and 1996.

However, most studies have shown that the effect of the age structure, if there be any, would hold for violent crimes, but not property crimes. In his study of the determinants of crime across 150 large U.S. cities, Bauer (2008) found that the city´s percentage of young males aged 15-24 was positively related to homicide, but not to property crimes such as burglary and motor-vehicle theft. In Europe, Buonanno and colleagues (2011) found that the percentage of males aged 15-34 was an important determinant of violent crime levels between 1970 and 2008, but they found no effect for property crimes. Similarly, in a comparative analysis of burglary in the U.S. and nine European countries between 1993 and 2006, Rosenfeld and Messner (2009) did not find significant correlations between burglaries and the percentage of males aged 15-24.

Similar results have been found in Chile. All available studies on determinants of crime in Chile have found no significant effect of young male rates on reported crime (Nuñez et. al. 2003; Rivera et. al. 2003; Benavente and Melo, 2006; Vergara, 2012; Gallardo et. al. 2012). Similarly, Ruiz et. al (2007) found no correlation between the percentage of urban young males and theft complaints rates between 1996 and 2004.

Figures showing both number and prevalence of youth males in the population between 2000 and 2010 also question the demographic hypothesis to explain decreases in victimization. During this period the number of males aged 15 to 24 went from 1,149,591 to 1,266,206, and its relative weight in population was 8.5% in 2002, and 8.2% in 2013[2].

Table 2.2: % of 15-24 males in Chilean population

Year	Total Pop.	Male 15-24	% Male 15-24
2002	13,567,241	1,149,591	8.5
2003	13,718,045	1,172,148	8.5
2004	13,865,843	1,195,775	8.6
2005	14,013,892	1,219,266	8.7
2006	14,167 ,474	1,239,039	8.7
2007	14,327,791	1,254,741	8.8
2008	14,498,584	1,266,206	8.7
2009	14,677,912	1,274,273	8.7
2010	14,855,979	1,275,745	8.6
2011	15,034,027	1,273,178	8.5
2012	15,211,974	1,266,611	8.3
2013	15,386,310	1,255,727	8.2

2.1.5 The security hypothesis

The security hypothesis was firstly proposed by Clarke and Newman (2006) and van Dijk (2007), and has been further developed by Farrell, Tilley and Tseloni (2010, 2011). From a theoretical framework provided by opportunity theories of crime, the Security hypothesis has proposed that "change in the quantity and quality of security was a key driver of the crime drop" in western countries (Farrell et. al, 2011).

Most hypotheses for the crime drop, claim security hypothesis proponents, have focused on violent crimes. They have, however, paid little attention to acquisitive crime and to the opposite trends for some of the specific acquisitive

[2] Chilean National Institute of Statistics; http://www.ine.cl/estadisticas/demograficas-y-vitales

crimes. According to these authors, offenders-based theories are unable to explain why some types of crime fell during the crime drop, while others have increased during the same period. Neither economic nor demographic hypotheses, for example, can explain why car theft rates decreased at the same time that phone theft increased. The security hypothesis, instead, is rooted in opportunity theories from which those crime trend differences can be sensibly explained, as they successfully explained the coincidence of increasing crime levels and increasing levels of wealth and welfare in western countries after the WWII (Cohen & Felson, 1979)

Consistent with the core statements of opportunity theories, the security hypothesis suggests that security devices and measures may affect crime rate by blocking crime opportunities as perceived by potential offenders. Along these lines, it is stated that security devices impact on perceived levels of effort and risk involved in the commission of a particular crime and, therefore, on the decision to committing or not to commit that offence. Thus, the security hypothesis proposes that the increasing prevalence of security devices has brought about a reduction of the number and suitability of targets and, therefore, a reduction in opportunities to commit those crimes prevented by security devices. More specifically, the security hypothesis is broken down as follows (Farrell et. al., 2010a):

1. Security improvements, including specific security devices, vary for different crimes but have been widely implemented

2. Different security measures work in different ways to reduce the crimes to which they are applied: they increase actual or perceived risk to the offender; and/or they reduce actual or perceived reward for the offender; and/or they increase actual or perceived effort for the offender

3. The different ways in which security measures work produce variations in expected changes in crime patterns associated with crime drops. These comprise expected security device crime change 'signatures'

4. The specific falls in crime produced by improvements in security alongside their associated diffusions of benefit (preventive effects spilling out beyond the operational range of measures) to other targets and methods of committing crime are not matched by equivalent displacement

While supporters of the security hypothesis have acknowledged that it is still an untested hypothesis (Farrell et. al., 2010), there is evidence about the effectiveness of target-hardening measures for preventing crime, especially burglary and car theft. Most of that evidence has been produced in the context of evaluating situational crime prevention initiatives, and has shown the effectiveness of initiatives such as alley gating, improving lighting, CCTVs, access controls, steering columns locks, to name but a few (Clarke 1997; Bowers et. al, 2004). Additionally, other studies have also shown that private measures for preventing victimization, such installing alarms (Di Tella et. al., 2006) and other household protection (Miethe & Meier, 1990; Miethe & McDowall, 1993; Budd, 1999, Wilcox et. al. 2007), reduce burglary victimization risk.

Similar evidence has been found regarding the effectiveness of car security devices for preventing car theft (Brown & Thomas, 2003; Brown, 2004; Farrell et. al., 2011; Kriven & Ziersch, 2007; Potter & Thomas, 2001; Webb, 2005). Furthermore, in their analysis of the impact of Lojack (a hidden radio transmitter installed in cars to aid in recovery after theft) Ayres and Levitt (1998) found that the benefits of such device went beyond its users and extended to cars which had not lojack fitted; along these lines, these authors concluded that a one percentage point increase in installations is associated with a 20 per cent decline in auto thefts in large cities and a five per cent reduction in the rest of the state.

If security devices and other protection measures are effective for preventing crime, it is reasonable to expect that increasing prevalence of security devices, either on households and cars, might have contributed to the observed decline on crime rates.

Farrell and associates (2011) build the case for the security hypothesis by analyzing the relationship between downward car-theft trends and the spread of car security devices since the early 90s in the case of the USA and England, and since 2001 in Australia. These authors analyzed data from the British Crime Survey (BCS) and the Comprehensive Auto-theft Research System (CARS) in Australia. They showed that in both countries the prevalence of security devices fitted to cars increased as the rate of vehicle theft declined. Additionally, they showed that during the period of security devices diffusion, the decline in temporary-theft rates was greater than the decline in rates of permanent-theft, the age of stolen cars increased, the entry method changed from door forcing to window breaking, and that victimization risks were greater among cars without security devices fitted than among cars with security devices which, in turn, have different impacts on different type of crime (Farrell et. al, 2011). All of these indicators accord with the hypothesis that security devices have been crucial in explaining auto-theft decrease in England and Wales and Australia.

Furthermore, by taking advantage of the Western Australia provincial government’s decision to require that electronic immobilizers be fitted to all vehicles, Farrell and colleagues took advantage of a natural experiment which showed a causal connection between the spread of immobilizers and the decrease of auto-theft rates in Australia. From their analysis, the authors concluded that there is strong evidence supporting the security hypothesis as an explanation for vehicle-theft trends in Australia and England and Wales, and that it might also be relevant to explaining the decrease of vehicle-theft decreasing rates in the USA as well as the decrease on other types of crime, including violent crimes in the USA.

Along similar lines, but with regard to burglary, Tilley et. al. (2011) argued that more and better household security contributed to the observed decrease in domestic burglaries between 1995 and 2008/2009 in England and Wales. By analyzing data from BCS, Tilley showed that availability of house protection increased during the period, particularly, among the most affluent section of population. The increase in prevalence of the more effective configuration of house protection, which the authors called enhanced security, was especially large among the better off households; on the other hand, the authors show that the decrease on burglary rates, although observed in all socio-economic groups, was also more pronounced among that segment of the population. These figures, argued the authors, are consistent with the security hypothesis as an explanation of the burglary drop in England and Wales and show how the spread of house protection acts to affect burglary trends, that is, by reducing the victimization risk of those who can afford security measures, thereby affecting the average rates of burglary.

The security hypothesis is a promising explanation for the decrease of burglary rates observed in Chilean victimization survey (ENUSC) between 2006 and 2012. Figures from ENUSC show that along with the decline in burglary there was an increase in the percentage of households with security measures to protect them. Between 2007 and 2013, the percentage of household with any protection grew by 18%, from 64.4% to 76.2%. The following table shows that CCTV increased by 70%, alarms increased by 42%, and security locks increased by 67%.

Table 2.3: prevalence of house' security devices in Chile, ENUSC 2007-2013

	2007	2008	2009	2010	2011	2012	2013	diff. %
Alarm	8.4	10.7	9.9	11.1	11.9	13.1	13.8	1.65
CCTV	2.8	4.1	3.3	4	4.7	4.7	4.8	1.70
Railing fitted to windows or doors	52.2	56	53.5	54.2	56.8	57.1	53.8	1.03
Electric protection added on fence	3.7	4.1	3.6	4.4	4.4	4.1	4.6	1.25
No-electric protection on fence	18.7	17.6	16.9	18.6	22.9	23.6	25.1	1.34
Security locks	24.3	29.3	32.6	33	38.8	39.9	40.6	1.67
Light or motion sensors	6.8	8.1	8	8.3	9.9	9.8	10.4	1.53

Even though there is no research about burglary in Chile (or about the effectiveness of house security devices), the increasing prevalence of security devices during the same period in which victimization rates decreased, supports the idea of such devices negatively impacting on burglary rates.

The next section presents the theoretical framework underpinning the relevance of Security Hypothesis as an explanation for the observed decrease in victimization rates

2.2 Theoretical framework of Security Hypothesis: Opportunity theories.

While most of the previously summarised factors of crime are claimed as explanations of why some individuals or collectives of individuals may be motivated to engage in crime, opportunity theories focus on specific criminal events rather than on offenders or their motives. From this perspective, the occurrence of criminal events involves not only an offender, but also other factors, namely targets and place features. Opportunities for committing an offence are given by particular configurations of those factors and not only by offender´s dispositions. While opportunity theory considerers the existence of a motivated offender as a given fact of modern social life (Garland, 1996), the theory focuses the role played by the others “situational” factors in explaining criminal events.

The core theoretical statement is that criminal events (and criminal behaviour) are the results of the interaction between the offender´s dispositions and his judgment about situational variables such as features of target and place, and manipulation of any of these factors affects the chance of an offence being committed. In other words, any given criminal event would be the outcomes of a situational process through which individuals perceive, evaluate and choose one specific action from two inputs: his background and his personal characteristic, synthesized in a given crime propensity and the setting of potential action.

The focus of opportunity theory is on the flux of crime-opportunities and how they are configured by situational variables, given a stock of motivated offenders. From this perspective, analyzing changes in properties of targets, and places where those targets are located, especially related to guardianship, might be a fruitful way to understand changes in the volume of crime and its distribution, therefore, to answer questions such as why levels of a specific crime increased or decreased?; why some products or houses or cars are targeted and not others?; why some places have disproportionate concentrations of volume crimes?; why crime is more prevalent in some portions of population than in others?; and so on.

This section provides a discussion of this theoretical framework and theoretical extensions that are important to understand the role played by security measures on victimisation risk. The first part presents Routine Activity theory, which identifies the elements present at any crime event, and highlights the role played by characteristics of targets and guardianship. The second part summarizes Rational Choice theory, which identifies the mechanisms through which each of the crime event´s elements may affect the risk of victimisation.

2.2.1 Routine Activities Theory

Cohen and Felson (1978) stated that crime opportunities are shaped by the convergence, at same time and place, of a motivated offender, a suitable target, and the absence of capable guardianship. Using this idea, Routine Activity Theory (RAT) attempts to explain the link between changes at social-macro levels and changes in the supply of opportunities required for an offence to be committed.

Developed by L. Cohen and M. Felson (1979), RAT assumes that a criminal event is the result of an interaction between offender´s disposition and situational factors. According to this theory, criminals make a decision to carry out a crime based on evaluations of situational factors made during the course of everyday activities such as commuting to work, going shopping, or during leisure activities (Braga, 2008; Felson, 1994; Felson & Clarke, 1989). At the same time, everyday activities affect the chance of encounters between offenders and victims, the supply of attractive targets and levels of guardianship, that is, the opportunity to complete a crime. Along these lines, Clarke and Felson (1993) stated that offenders based their decision on “where people are, what they are doing, and what happens to them”.

From RAT it has been learnt that, in order for a crime to occur, three minimal elements must convergence at space and time: a likely offender, a suitable target and lack of capable guardianship. A likely offender is someone likely, for whatever reason, to commit a specific offence.

By considering that everyone is capable of rationalising crime (Felson, 1994) and that criminals are not sufficiently different from anyone else (Clarke, 1985), RAT sidesteps considerations about individuals’ socioeconomic, psychological or racial motivations for committing a crime. Furthermore, it is posited that trying to identify the supposed differences between offenders and non-offenders in order to explain crime, is a fruitless task.

Obviously, some people are more motivated to commit a crime than others, but what explains whether that motivation is performed through unlawful acts are the opportunities that people encounter at a specific time and place. Therefore, according to this theory, those opportunities may be understood as ‘causes’ of crime occurrence (Felson & Clarke, 1989) as long as they are ‘necessary conditions for crime to occur’.

As opportunities are shaped by particular configurations of target and places attributes, it has been argued that focusing on the physical elements of crime events might be a more fruitful way for understanding crime than focusing on the controversial issue of what causes individuals to have a crime propensity or motivation. Accordingly with its definition of crime as a ‘normal risky event of modern life’ (Garland, 1996), RAT consider s the stock of motivated offenders as a given, and attempts to explain the (change in) volume and distribution of crime in terms of (changes) in characteristics of the settings where crime takes place, focusing on target and place attributes that encourage or discourage the commission of a crime.

The second element present in crime events is a suitable target. This target can be a person or an object that can be stolen (for example a radio) or broken into (for example a car). The use of the concept ´target' rather than ´victim´ aims to highlight the fact that the victim may be absent at the time of his/her victimization, while a target has always to be present; take for example, the theft of a car.

Cohen and Felson (1979) stated that the four attributes that contribute toward a target being at risk are Value, Inertia, Visibility, and Access, which are summarized by the acronym VIVA. Value refers to the fact that any potential target, either a person or an object, has a value for the offender (or others willing to pay for them). Secondly, in terms of inertia, targets are more attractive if they are portable; for example, cars may be driven away, but is unlikely that a burglar will steal a top-of-the range 70" LCD TV because it will be too heavy and large to carry and conceal. Visibility is important because that attribute allows the offender to know where attractive targets are, and whether they are easy to conceal and carry away. Finally, access is used to considerer immediate vulnerability of targets to offenders.

In later works Clarke (1999) and Felson (2002) coined the acronym CRAVED to better address the characteristics of a target that influence offender´s motivation to target it. CRAVED involves everything that VIVA does, but include Enjoyable and Disposable: Concealable, Removable, Available, Valuable, Enjoyable and Disposable. In the third edition of Crime and Everyday Life (2002), Felson shows how the CRAVED model can be applied to violent crime, thus showing that CRAVED is not restricted to property crime.

Finally, guardianship is defined as all formal and informal control mechanisms that protect the potential target and discourage crime from taking place. Along these lines, Felson has argued that a capable guardian against crime “serves by simple presence to prevent crime, and by absence to make crime more likely”.

By using a more complex definition of guardianship, Wilcox, Land and Hunt (2003) distinguish between individual and environmental levels of guardianship. At the individual level, guardianship is defined as “possessing qualities that relate to social ties and interpersonal control,” with interpersonal control referring to “the degree to which individuals and objects in a bounded locale can be observed and impeded from experiencing criminal acts because they are proximate and exposed to agents of formal control, agents of informal control, and non-human protection devices”. Environmental-level guardianship is “the collective degree to which individuals or objects in a bounded locale possess qualities related to social ties and social control,” with social control encompassing, again, “informal, formal, and nonhuman security” (Wilcox et. Al. 2003). Some examples of capable guardian are neighbours, security guards, bystanders, CCTV, door staff, parents, friends, relatives, alarm systems, locks, fences, barriers, to name but a few. Usually, police is not considered a capable guardian because they they “seldom are around to discover crimes in the act” (Felson and Clarke, 1993).

As stated above, from RAT it has been argued that the offender is not the most important actor for explaining crime, but the presence or absence of a capable guardian “play(s) an even more central role in crime and its prevention” (Felson, 1995). That statement is supported by his analysis of burglaries in the U.S. (Cohen & Felson, 1979) which showed that increases in burglaries were positively related to an increase in out-of-home activities, suggesting that the relationship could be explained by the fact that increases in out-of-home activities would also increase the likelihood that an offender would meet targets in the absence of guardians. Accordingly, a number of subsequent research studies have shown that several aggregate measures of guardianship are related to variations in aggregate crime rates, and therefore, that aggregate levels of guardianship might be a causal explanation for crime trends.

In 1986, Felson expanded the concept of guardianship by introducing the idea of "intimate handling" to take into account informal social controls of offenders. An intimate handler, therefore, would be someone who is in close proximity and knows the likely offender well, and is able to supervise and discourage him for committing a crime. In this line, the role of intimate handlers supervising likely offenders is similar to the role of a guardian who supervises a suitable target. As Felson (1995) stated in "both cases, direct physical contact serves to discourage crime from occurring". Examples of intimate handlers are parents, siblings, teachers, friends, peers or spouses.

In 1994, John Eck introduced the concept of "place manager" to highlight the role that those who control or monitor places have in discouraging crime. The main idea is that people who look after particular places[3] control crime by regulating the access to that place and the behavior of place users (Sherman, 1995). Examples of place managers are: homeowners, doormen, concierges, building managers, janitors, resident-owners, facility managers, close neighbors, receptionists, private security officers, bus drivers, restaurant managers, teachers in school, flight attendants and parking lot staff (Felson, 1995; Braga, 2008; Clarke and Eck, 2003)

All those elements were combined by Clarke and Eck (2003) in a model of crime analysis which has been called the Problem Analysis Triangle (PAT). These authors summarized the relation of each of these elements and crime events, positing that for a crime take place "all inner elements of the triangle must be present and all outer elements weak or absent" (Clarke and Eck, 2003).

[3] Eck defines places as "a very small area reserved for a narrow range of functions, often controlled by a single owner, and separated from the surrounding area…examples of places include stores, homes, apartment buildings, street corners, subway stations, and airports" (Eck, 1997)

Figure 2.1: Problem analysis triangle. (Clarke and Eck, 2003)

2.2.2 Rational Choice Theory

This theory states that criminal decisions are influenced by an offender´s perception of risk, effort and reward (Clarke & Cornish, 1986). The core claim of the Rational Choice perspective is that offenders decide to commit crime, taking advantage of a criminal opportunities based on judgments about the costs and benefits of such actions even though those judgments are often constrained by “limits of time and ability, and the availability of relevant information” (Clarke and Felson, 1993). Along these lines, the criminal event typically involves a decision-making process which is specific to each kind of offence. Also, in each case the crime event is influenced by “immediate circumstances”, “near circumstances” and “situational contingences”. Unlike the Economic Theory of crime, which defines the calculation made by offenders in terms of material rewards, the Rational Choice perspective assumes that crime may be motivated by the prospect of non-material utilities such as power or status.

As stated by Clarke and Cornish (1985) Rational Choice theory is an attempt to take into account the offender’s decision-making process, which has usually been ignored by most criminological theories. Along these lines, crime is understood not as the results of social or psychological determinants acting over a passive subject, but as the outcome of a “conscious thought processes that give purpose to and justify conduct, and the underlying cognitive mechanisms by which information about the world is selected, attended to, and processed" (Clarke and Cornish, 1985, p. 147). Accordingly, compared with mainstream criminology, which has focused on the criminal disposition of potential offenders rather than on situational variables, RC theory draws a model of offender's behaviour that is more responsive to changes in the risks and effort involved in some particular criminal activity (Clarke and Felson, 1993)

Although based on an economic approach to crime (Becker, 1968, 1976; Erlich, 1973, 1979), from which RC theory takes the importance given to incentives and deterrence to explain human behaviour, Clarke and Cornish's RC model differs from the classic rational choice approach as formulated by economists in two main respects. Firstly, the already mentioned importance given to non-instrumental motives of crime such as "status, sex, and excitement", which expands the range of goals and rewards aimed by offenders.

Secondly, the criminological model of RC softens the traditional economic definition of rationality and, instead, uses the idea of limited or bounded rationality (Simon, 1983), which better "fits the opportunistic, ill-considered and even reckless nature of much crime" (Clarke & Felson, 1993). From this perspective offenders are not seen as utility-maximizing decision-makers, but as people who make decisions that seek to reach satisfactory outcomes rather than the optimal one. In others words, offenders' decisions are not based on calculations to maximize utility, but to meet an acceptable threshold of satisfaction with the minimum of effort, even though that means neglecting potentially more profitable alternatives. Additionally, use of the concept of "limited rationality" recognises that offenders are far from having complete information to make their decisions, and that they are hardly capable of estimating all possible consequences of their actions, which are often misjudged or ignored. From this perspective what is also highlighted is acknowledgement that rationality may be limited by psychological features such as impulsiveness, previous experience, and limits of time and ability (Clarke & Cornish, 1985; Cornish & Clarke, 1986; Clarke & Felson, 1993).

Clarke and Cornish`s model of rational choice also differs from the economic model and its formulation of the decision-making process as that relating to that of a rational choice between "being a criminal" and legal (non-criminal) occupations in society. The economist’s perspective considerers that "being a criminal" is an occupational option fundamentally similar to legal occupations, and is more likely to be selected by people who consider that the legal options are less rewarding and that the risk faced in the case of taking the criminal way is not too high (Clarke & Felson, 1993). However, Clarke and Felson have questioned such a conception because it is unable to explain the fact that much crime is committed at work or by people who have a legal occupation. Indeed, some occupations help people to commit (more) crime. Also, according to these authors, the occupational model of economists would be fruitless at analysing juvenile delinquency because most of these offenders "are too young to be in the labour force anyway". Far from this conception of decision process as a career decision, the criminological model of rational choice focuses on the particular decisions made to meet the "offender’s commonplace needs" in specific settings.

By focusing on crime events, rather than on the offender´s disposition, the criminological perspective on rational choice raises the central role played by situational variables in the offender´s decision, thereby highlighting the importance of focusing on the shorter decision-making process made by the offender at the setting of the offence. From this perspective, rational choice refers not to the election or not of a criminal career, but mainly to the decision-making process of a potential offender facing a crime opportunity. Decisions about crucial aspects of the criminal event such as seizing or not seizing the opportunity, selecting the target, and the modus operandi, to name but a few, are seen as the outcome of a situated decision-making process in which situational variables, namely target features and guardianship, are crucial to explain why and how an offender would target some specific object, household or person. Thus, the rational choice theory of crime emphasises the importance of “the specific forms of crime committed” which are central to explain why the criminal event took place (Clarke & Felson, 1993).

In accordance with this, one of the major contributions of Clarke and Cornish’s model of RC is the distinction between criminal engagement (or criminality) and criminal events (or crime). This theory posits that “criminal involvement refers to the processes through which individuals choose to become initially involved in particular forms of crime, to continue, and to desist”; while a concern with the criminal event points to the processes involved in the commission of a particular crime, which are relatively shorter and based on circumscribed information regarding immediate circumstances and situational contingences (Cornish & Clarke, 1986; Clarke & Felson, 1993).

Thus, criminal involvement and crime events are taken to require two different sets of decisions each of which involves a number of additional stages. Involvement requires needs and desires, the generation of goals, knowledge of means to goals, evaluation and choice of means, and establishment of readiness to commit a crime. Event decision, in turn, refers to decision made in each stage of the crime script (Cornish, 1994a, 1994b), that is, decisions regarding selection of targets, preparation, entry to setting, preconditions, instruments initiation, instrumental actualization, post conditions, and exit from setting (Cornish, 1998; Clarke & Cornish, 2003). Consequently, since involvement and crime event decision process are influenced in each case by different set of factors, this perspective highlights the importance of both being separately modelled (Cornish & Clarke, 1986). Also, as this theory considers that “readiness” is constructed prior to, and usually in a different place from the criminal event itself” (Clarke & Cornish, 2003), the analysis of criminal events assumes an already motivated offender and focuses on the technicalities of the crime script and the situational cues utilised and assessed during the criminal event.

The rational choice criminological perspective adopts a crime-specific focus not only because of differences between the involvement and crime event decision process, but also because "the situational context of decision making and the information being handled will vary greatly" among different crime events (Cornish & Clarke, 1986; Clarke & Felson 1993)). This is another important difference between RCT and dispositional theories of crime, whose concern is about the social and psychological variables that explain criminal involvement. This has led the latter theories to attach "little importance to the specific forms of crime committed, which are seen to be largely a matter of chance" (Clarke & Felson, 1993). By contrast, the emphasis given by RCT to situational variables that affect the commission of a crime encourages a crime-specific analysis of variables that made the crime possible, which are seen as embedded in the particular settings where it occurs.

In accordance with this, from RCT it has been claimed that legal categories of crime are not useful enough to explain why, where and how crime happens because they usually encompass very different kinds of criminal act and the decision processes attached to them. For example, when analysing burglary, "it will be necessary to differentiate at least between commercial and residential burglaries and perhaps even between different kinds of commercial and residential burglaries" (Clarke & Cornish, 1985). It has also been shown that the decision sequence for shoplifting in a market is different from the decision sequence for shoplifting in a department store; or that the process for street robbery is different for the process for store robbery or bank robbery (Brantingham & Brantingham, 1993). Each of these criminal events may not only have its own motives, but also responds to different settings and opportunities such as perceived by a potential offender.

According to the rational choice model, opportunities and target characteristics influence motivation and the decision-making process by providing cues that give the motivated offender the information that he or she needs to carry out the offence that has already been chosen. In this line, situational cues are the informational aspects of target and place characteristics that alert the motivated offender about the presence of crime opportunities. Cornish & Clarke (2003) stated "that the cues in question are those of risk, efforts and reward" which are the information from the situation that offenders require and assess in deciding to commit a crime and the modus operandi to use.

In a paper published in 1987, Cornish and Clarke developed the concept of "choice-structuring properties", which was designed as an analytical tool for increasing an understanding of the interaction between characteristics of the offender and (the setting of) offences that he or she commits. Choice-structuring properties focus on properties of the setting (such as type and amount of pay-off, perceived risk, skills needed, likelihood of success, and so on) "which are perceived by the offender as being especially salient to his or her goals, motives, experience, abilities, expertise, and preferences" (Cornish & Clarke, 1987). Since those properties shape the decision taken among alternative courses of action, it is considered that they effectively structure the offender's choice. Therefore, choice-structuring properties are defined as "the characteristics of offenses which render them differentially attractive to particular individuals or subgroups of them or the same individuals and group at different times" (Cornish & Clarke, 1987). That is, 'choice-structuring properties' is a tool for analysing categories of target's properties evaluated in terms of costs, efforts, risks and rewards when offenders decide to engage in a particular crime and select targets, and modus operandi. Thus, a focus on the choice-structuring properties of targets and setting highlights the fact that some targets and settings may offer a constellation of properties sufficiently attractive to provide temptation to offend and to facilitate commission of the crime.

Focusing on the choice-structuring properties underlying criminal events drives research attention to distinctive features of particular targets and settings; in doing so, it facilitates comparison between different crimes. As Cornish and Clarke have shown in the cited paper (1987), identifying the salient property categories involved in two groups of crimes with different goals, theft involving cash and illegal substance abuse, helps to clarify not only the salient ways in which crime differ from each other, but also the fact that some categories of choice-structuring properties are common to crimes with different goals.

As stated above, it is important to stress that salient properties of targets and settings only structure offender's decisions through the subjective analysis of efforts, rewards and risks attached to each category of salient properties, in a context of limited information, time and abilities. Subjective analysis of risks involved at each stage of a particular offence, for example, may differ among individuals, and even when carried out by the same individual at different times. However, even though risk assessment of target characteristics inevitably depends on the offender's characteristics, motivation and background, which means that perceived risk levels associated to such characteristics may be diverse, it is clear that offenders make some kind of risk assessment of the target and setting when they select them and when deciding how the offence will be carried out. As Brantingham and Brantingham (1984) stated "some offences are so emotional or affective that consideration of risks does not occur, but in most offences it is clear that people committing the offence take some precautions". Those precautions are related to two primary concerns: "the chances of success or failure in achieving the criminal objective, and the risk and danger of the criminal situation." (Fattah, 1993). So, any modification of targets and setting that increase the perceived difficulty associated with the successful commission of crime or the perceived risk of being detected and apprehended, should affect the offender's decision about committing the crime and selecting the target.

2.2.3 Summary

Routine Activity and Rational Choice are complementary theories which, together, provide a fruitful theoretical framework to analyse crime and explain its distribution. Both theories share a set of independent statements which are summarised in the idea that “opportunity makes the theft”. That set of shared statements is listed by Felson and Clarke (1989) as following:

1. “Each individual makes choices in committing crime.
2. These choices may be influenced by an individual’s heredity and background, but are the direct outcomes of a perceived opportunity and a (frequently crude) situational calculus of the costs and benefits of committing the crime.
3. Nobody is exempt from the temptation to commit crime, since human weaknesses are widespread and not confined to any one segment of the population.
4. In weighing the costs of crime, the individual pays far more attention to the risk of being caught than to the severity of punishment.
5. Blame and punishment, though often necessary, are inefficient methods for guiding people towards non-criminal choices.
6. It is easier for policy to affect the situational inducements to commit crime than to combat fundamental human weakness.
7. Easy opportunities will create more crime and reduced opportunities will lead to less crime” (Felson and Clarke, 1989.)

Both theories also share a common divergence from dispositional theories, which focus on social and psychological features of offenders, while RAT and RCT focus on situational determinants of crime and how they affect offender’s decision-making. As a consequence, both theories see offenders as active subjects who make rational decisions (though restricted by limitations of information, abilities and time) in order to satisfy his or her needs, either economic or expressive. Both recognize the distinction between criminality or criminal involvement and crime events; and, despite the fact that RCT attempts to model both involvement and event decisions, both focus on the crime event as a privileged way to understand and explain crime. Thus, both theories share a need for crime-specific explanation. Finally, both offer (complementary) organizing perspectives for analysing crime – routine activity through the concept of minimal elements and the rational choice perspective through its four decision models (Clarke & Felson, 1993).

Considered together, RAT and RCT helps to shape the crime event as the outcome of the interaction between a potential offender and situational factors, thereby stressing the fact that crime cannot be explained exclusively by accounting for the offender's motives and disposition. Furthermore, from both perspectives it can be understood that offenders' motives are not the most important factor for explaining crime, its volume and distribution. Opportunities available for potential offenders seem to play a more central role to explain whether such dispositions are translated into criminal acts, and even to configure the offender's motivation. Such opportunities are evaluated in terms of the efforts, rewards and risks involved in committing a particular offence. Thus, the outcome of this assessment by an offender is crucial to explain why, where and how a crime occurs.

RAT and RCT are complementary theories in that they contribute different elements of the relationship between settings and crime. While RAT identifies the elements that, beyond offender characteristics, configure the setting's opportunity, namely target and guardianship features; RCT specifies how those factors that affect the likelihood of crime occurrence, this is, by affecting the perception of efforts, risks and expected rewards.

Choice-structuring properties of targets and settings emphasize the idea that crime should be seen as the product of interaction between characteristic of offenders and settings, and that the occurrence of crime will be determined by salient properties of settings, including target and guardianship features, which will affect offender's assessment of potential rewards, efforts and abilities required, and risks of detection and apprehension at each stage of the crime script. There is no doubt that 'choice structuring properties' is a more comprehensive term than that of the Viva and Craved acronyms, not least because the former includes assessment of the tools and abilities required, but both are complementary in their attempts to identify the setting properties that affect the occurrence of crime. Both RAT and RCT are useful theoretical tools to investigate the relationship between properties of targets and settings, such as presence of security devices or neighbourhood watching, and the volume and distribution of property crime, particularly burglary and car theft which are the focus of this research.

Despite the fact that RCT is focused on the decisions model of rational at the micro, individual level (Clarke & Felson, 1993), taken along with RAT collectively they suggest a causal link between crime opportunities, shaped by choice-structuring properties, and crime rates. Opportunity theory identifies both the factors affecting crime rates, namely salient properties of targets and settings, and the mechanisms through which those factors affect crime rates, i.e. by influencing offenders' perceptions of risk and likelihood of success. This causal relationship between opportunity and crime rates was expressed by Clarke and Felson (1989), when they stated that "Easy opportunities will create more crime and reduced opportunities will lead to less crime".

From this perspective, changes in crime opportunity structure, as brought about by changes in routine activities, will cause changes in crime rates, crime distribution, and patterns of crime displacement. Thus, their seminal work, Cohen and Felson (1979) showed that the increase in burglary rates in the U.S. after World War II was explained by women's incorporation into the labour force, and the subsequent increased proportion of empty homes, and the increase of attractive, portable electronic goods. That explanation has also been used to explain the rise in property crime in Europe after the Second World War. In a similar way, Wilkins (1964, cited in in Clarke and Felson, 1993) showed that the riss in car theft in Britain was correlated with increase in rates of new car registration.

More recently, Jasinki and Navarro (2012) have shown that RAT is a useful theoretical tool to explain the increasing prevalence of cyber-bullying.

At the individual level, opportunity theory is also able to explain why some individuals and groups of individuals are more prone than others to be victims of crime, and how that risk changes when lifestyle and daily activities change due to, for example, ageing or moving to new jobs. Accordingly, incorporation of preventive behaviour into routine activities should lead to a decrease of crime rates and victimisation risk; as long as they reduce opportunities by being perceived as increasing the risk of failure or detection, from the offender´s perspective.

Finally, both theories bring into focus the importance of victim features to explain crime rates and, therefore, highlight the importance of victimisation surveys to do so. Both RAT and RCT share a conception of crime as a mundane feature of social life displayed by decision-making individuals who are not essentially different from those individuals who decide not commit a crime. In the crime setting, opportunity theorists claim, it is not differences in social or psychological traits of offenders that most matter in the decision-making process, but the circumstances and settings where such decisions are taken. From this perspective, Cornish and Clarke conclude that trying to understand crime by searching for differences between offenders and no offenders is a fruitless exercise.

By contrast, the study of victim characteristics and behaviour, including how they manage their properties and the places where they are located, seems to be a more useful way to explain why those people are victimised (and re-victimised), the volume of crime, and the skewed distribution of crime and victimisation risk in time, space and within certain groups (Fattah, 1993). So, research on those elements of the crime event through victimisation surveys seems to be not only an easier way for getting empirical evidence about specific crimes, but also a more fruitful way to explain crime rates and crime distribution.

Chapter 3: Methodology

Chapter 2 reviewed the literature on the crime drop in industrialised countries and identified the gap in existing knowledge regarding the decline in crime in developing countries, particularly in Chile. The purpose of this chapter is to outline the research design and data analysis methodology employed in this thesis.

Although official Chilean victimisation rates demonstrate downward trends at the national level for burglary, theft from the person, robbery, and theft from a vehicle, there has been no research to date in Chile that explores this decrease in victimisation rates or tests the statistical significance of the trends. This research contributes to filling this gap by analysing the trends for one offence, burglary, and testing the significance of the security hypothesis to explain burglary trends in Chile.

The analyses in this thesis begin by testing whether the observed downward trend in burglary rates between 2007 and 2013 is statistically significant or if it represents the result of limited available data and/or the aggregation of regional figures. Thus, the analyses in Chapter 4 disaggregate the national averages for burglary rates and explore the actual evolution of burglary rates across Chilean administrative regions. By using longitudinal pseudo-panel analysis techniques (Cameron & Trivedi, 2005, p.770), this study tests whether there was a significant downward trend in burglary rates across Chilean regions.

The results in Chapters 5 and 6 derive from multivariate analyses to test the security hypothesis as a potential explanation for burglary trends in Chile. The effect of the prevalence of security devices was tested at both the individual (household) level and the area (region) level. To measure the individual effect of security devices, the analysis examined the relationship between burglary victimisation and the prevalence of household protection. This examination was achieved by performing cross-sectional analyses based on multilevel regression techniques, as detailed in Section 3.5.

Chapter 6 presents the results from the analyses of correlation between changes in the prevalence of security devices and temporal changes in regional rates of burglary. This inquiry represents a different question than the question posed in Chapter 5 and required different analytical techniques. By aggregating households at the region level, a pseudo-panel data set was created to estimate fixed and random models for the effects of the increasing prevalence of household protection on burglary rates, while controlling for other relevant variables.

The purpose of this chapter is to outline the above-mentioned analytical techniques and additional methodological aspects of this research. Firstly, the chapter provides an overview of the victimisation survey, including its advantages and disadvantages. Secondly, the chapter describes the data used in this thesis, including a brief description of how the data were manipulated to construct analytical data sets. The chapter subsequently presents an overview and justification of the statistical methods employed to test each of the following hypotheses outlined in Chapter 1:

- H1: Between 2005 and 2013, there was a statistically significant drop in burglary rates across Chilean households.

- H2: The prevalence of security protection at the household level is negatively correlated with burglary victimisation risk, controlling for other relevant variables.

- H3: The prevalence of household security devices is negatively correlated with regional burglary rates between 2005 and 2013, controlling for other relevant variables.

3.1 Chilean National Crime Victimisation Survey (ENUSC) data

The primary data used to explore Chilean burglary trends and the role played by household security devices was taken from the Chilean National Crime

Victimisation Survey (ENUSC), which is the largest nationally representative data set on criminal victimisation in Chile. The ENUSC is administered to a nationally representative sample of urban households by the National Institute of Statistics (INE) and is sponsored by the Ministry of Interior and the Undersecretary of Crime Prevention.

This face-to-face victimisation survey was first conducted in 2003 and has been conducted annually since 2005. Its purpose is to gather information about the levels of general victimisation (open question) in the country and about victimisation regarding eight specific types of offences: theft of car, theft from car, burglary, snatching, pickpocketing, mugging, assault and fraud. In addition, the survey gathers detailed situational information, where appropriate, regarding such victimisation experiences. The ENUSC also collects information on the respondents, including information on their households and area of residence and their feelings of insecurity and evaluation of the authorities responsible for public safety.

Despite the wealth of information that the ENUSC collects, its scope, and its reliability, the data gathered from the ENUSC have been underutilised in empirical victimisation research, and, to the researcher's knowledge, there has been no research effort to date that explores the downward trend in most offences.

3.1.1 ENUSC sampling design

The ENUSC samples adults over the age of 15 residing in prominent Chilean cities. The sampling design is probabilistic, tri-stage and stratified geographically and according to population size. First, the sampling design is probabilistic because, in each stage, every member of the population has a known and non-zero probability of being selected. Second, it is a tri-stage sampling design because, in each borough where the ENUSC is conducted, census tracts are randomly selected; in each of those selected tracts, a number of households are randomly selected, and from each of the selected households, a person over the age of 15 is randomly selected. Finally, the sampling design is geographically stratified because each borough has its own independent sample, and it is population-size-stratified because the number of census tracts selected depends on the size of the urban population in each borough.

The number of boroughs included in the sample steadily increased from 77 in 2003 to 101 in 2008-2013. The number of sampled households increased from 16,289 in 2003 to 25,933 in 2011-2013, which represents 85% of all Chilean households and 68% of the total Chilean population. The following table summarises the reach of the ENUSC in each year.

Table 3.1: ENUSC sample description

	2003	2005	2006	2007	2008	2009	2010	2011	2012	2013
N hh	16,289	19,875	20,487	22,304	25,931	25,933	25,933	25,933	25,933	25,933
N boroughs	77	92	92	96	101	101	101	101	101	101
National sample error*	0.57%	0.57%	0.57%	0.46%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Regional sample error*	3.2%	3.0%	3.0%	3.0%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%
Borough sample error*	4.5%	4.5%	4.5%	4.5%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%

*At 95% confidence. Source ENUSC´s technical report. Undersecretary of Crime Prevention.

The refusal rate was approximately 6% over the period 2003-2013. Refusal cases and cases in which there was no one at home after three visits, the dwelling unit was vacant, or no access to apartment buildings/gated community was obtained were replaced/substituted using a previously selected sample of households, which was equal to 30% of the theoretical sample to be collected in each census tract. Thus, the replacement/substitution rate was around 12%.[4]

[4] ttp://www.ine.cl/canales/chile_estadistico/encuestas_seguridadciudadana/pdf/memoria_enusc.pdf

3.1.2 Reference periods and questionnaire design

The ENUSC is conducted between September and November each year in order to avoid seasonality biases. The full recall period is the 12 months preceding the interview.

The structure of the ENUSC questionnaire is relatively simple. It consists of four modules: 1) safety concerns and prevention measures; 2) victimisation; 3) demands and evaluation of victim support services and 4) household characteristics and context.

The victimisation module is composed of distinct sections for each of the eight types of offences. Each section includes questions about the respondent's victimisation experiences, the incident details and whether the incident was reported to the police and why. Although there have been some additions and changes in the sequence, the main survey questions and wording have remained largely consistent over time to ensure comparability. The following questions are consistently asked in order to identify incidents of burglary:

> ***During the last 12 months, did anyone steal something from your dwelling through entering by force or breaking doors or windows, entering by means of false pretences or entering through any manner other than the entrance?***
>
> ***How many times did this happen?***

Since 2007, additional questions have been introduced in order to further characterise burglary incidents. These questions regard the time of the incident, methods of entry, stolen items, the presence of someone in the dwelling and reporting to police.

Since 2007, new questions have also been added regarding security measures at the individual household level and at the neighbourhood level. These questions include questions about the use of household security devices, such as alarms, CCTV, and motion-sensor lights. However, a methodological limitation of the ENUSC´s design is the fact that these questions are asked to the whole sample and refer to the use of security devices at the moment of the interview, not at the time of the burglary incident. As a result, it is not possible to know whether security devices were fitted before a burglary incident or as a response to it. Failing to consider this limitation may lead to inaccurate estimates of the effect of security devices, especially in a cross-sectional analysis of burglary. In order to overcome this endogeneity problem in the present study, cross-sectional analyses were employed only for cases in which security devices, if any, was installed before the victimisation reference year, as detailed in Sub-section 3.5.1.

3.2 Variables

The question content and wording has remained consistent in the ENUSC over time, including the response categories. Therefore, no harmonisation strategy was needed in order to compare variables over time. Tables 5.2.2 and 5.2.3 (in Chapter 5) list all of the variables used in this study and their respective categories.

3.2.1 Dependent variables

The dependent variables were extracted from the ENUSC dataset, specifically from the answers to the two questions listed above. The responses to those questions allowed for estimation of the risk of burglary and associated covariates. By aggregating the individual answers, the three crime rate measures – burglary incidence, burglary prevalence, and burglary concentration – were estimated. Burglary incidence is measured as the number of burglaries per 100 households. Burglary prevalence is measured as the percentage of victimised households in the respective population. Burglary concentration is measured as the number of burglaries per victimised household. Burglary incidence rates are generally higher than prevalence rates because some victims experience more than one burglary, with the average rate of repeated victimisation indicated by the concentration rate.

3.2.2 Security variables

Information about the prevalence of household security protection was also extracted from the ENUSC data. Since 2007, each ENUSC respondent has reported the presence in their houses of the following security devices:

- Alarm,
- CCTV,
- Door double-lock or deadlock,
- Door/window bars or grilles,
- Internal or external light on a timer or **s**ensor,
- Electric fencing and
- Non-electric protection added to fence.

From this list of security devices, the prevalence of household protection was analysed in three ways. Firstly, a dummy variable was created to indicate whether any of the security devices were available at the respondents' homes. The resulting analysis estimated the effect of having any security at home compared to no security at all.[5]

Secondly, the prevalence of each security device was also analysed to differentially test their preventive effects. Thus, dummy variables were created indicating whether each security device (e.g., alarm) was available at the respondents' homes. Although this dummy cannot distinguish the pure effects of individual security devices or their interaction effects, it captures the effects of devices with low prevalence more accurately than more restrictive operationalisations of security configurations.

The more restrictive operationalisation was the examination of specific combinations of security devices. The seven security devices listed above generate 128 possible security configurations. Given that analyses of all 128

[5] This measure of security´s presence is used in a number of studies, for example, Tseloni (2006); Tseloni et. al. (2004)

configurations would be useless for practical purposes, a cut-off point for the sample prevalence of each security configuration was utilised. Of the 128 combinations of security devices, only 21 were present in at least 500 households. These 21 configurations accounted for 93% of sample households**.** The 21 configurations were analysed using regression analysis in order to evaluate their effectiveness for reducing burglary risk (see Chapter 5).

Finally, the security devices were classified according to what preventive mechanism the device aims to activate. Following the rational choice theory of offenders' decisions (Cornish and Clarke, 1987), household protection devices may aim to increase the (perceived) difficulty of breaking into a dwelling, "hardening the target", or to increase the (perceived) risk of detection. The former group comprises double locks, bars or grilles and electric and non-electric protections on fences. The "risking" group comprises alarms, CCTV and light-sensor switches. From that classification, four dummy variables were created to indicate the type of security configuration in respondents' homes:

- *No protection*,
- *Hardening protection*,
- *Risking protection and*
- *Mixed protection,* regarding those households with at least one hardening and one risking protection.

3.2.3 Dwelling and household characteristic variables

The ENUSC provides a wealth of information regarding the respondents and the respondents' household characteristics, which allows for estimating the effect of security devices while controlling for the effect of other variables that also affect victimisation risk. Chapter 5 discusses variable selection and its theoretical grounding.

The following household variables were directly obtained from the ENUSC responses:

- Age of the head of household
- Sex of the head of household
- Employment status of the head of household
- Socio-economic status of household
- Type of accommodation
- Length of residence in area

Additional variables were computed from the information provided by respondents on other members of the respondents' households. The following measures of guardianship were computed in this way:

- Lone parent. A dummy variable indicating whether the head of household is a single parent.
- Occupancy. A dummy variable indicating whether the labour status of any member of the household is *housekeeper* or *retiree*.
- Children. A dummy variable indicating whether any member of the household is younger than 18 years-old.
- Number of adults: A variable indicating whether there are one, two or three or more adults at home.

3.2.4 Borough-level variables

Chapter 5 also further explores the following five characteristics of the respondents' boroughs:

- **Metropolitan borough**: A dummy variable indicating whether the respondent´s borough was part of Greater Santiago, Greater Valparaíso or Greater Concepción (the three metropolitan areas in Chile).
- **Proportion of working and precariat households in respondent's borough**. A variable generated by dividing the number of households whose socio-economic status was classified as "d" or "e" in the

respondent´s borough by the number of sampled households in the respondent´s borough.[6]

- **Proportion of flats**. A variable computed as the number of flat sampled in the respondent´s borough divided by the total number of accommodations sampled in the respondent´s borough.
- **Proportion of households with any anti-burglar protection**. A variable computed as the number of households with any security protection sampled in the respondent´s borough divided by the total number of households sampled in the respondent´s borough.
- **Proportion of households associated with neighbourhood watch schemes (NWS)**. A variable computed as the number of households associated to NWS sampled in the respondent´s borough divided by the total number of households sampled in the respondent´s borough.

3.2.5 Longitudinal control variables

In Chapter 6, additional variables are used to perform longitudinal analyses on the relationship between burglary and security variables. For each year of the observed period, administrative records from official sources provide information at the regional level on the police apprehension rate, the proportion of closed criminal cases that had condemnatory sentences, the incarceration rate and other economic and demographic variables which may affect victimisation incidence and prevalence trends according to the literature.

The longitudinal analyses in Chapter 6 are conducted using region-level data because estimations at that level are more accurate than other area level given the sample size and sample error (see Sub-section 3.2.1). In addition, some theoretically relevant variables, such as the incarceration rate and unemployment rates, are only available at the regional level. The following

[6] Households in ENUSC sample are classified in 5 categories: ABC1, C2, C3, D, and E; each of which classify respondent´s households as member of the upper-class, upper-middle class, middle-class, working class, and the most deprived and precariat class, respectively.

variables considered in the longitudinal analyses in Chapter 6 are measured at the regional level.

Regional burglary apprehension rates. This variable is measured as the ratio of arrests for burglary to the number of burglaries known to the police. According to rational theories of crime (Becker, 1968; Ehrlich, 1973; Clarke and Cornish, 1986; Clarke and Felson, 1993), a higher probability of apprehension increases the risk of committing a burglary. As a result, burglary rates should decrease due to the deterrent effect of a higher probability of apprehension.

The arrest ratio data were obtained from the "*Annual Report on Offences known to the Police and the apprehension rates*" published by the Chilean Ministry of Interior. This report separately provides the number of burglaries reported to the police and the number of apprehensions related to burglary at the borough and regional level. Thus, to calculate the arrest ratio, the number of arrests related to burglaries was divided by the number of burglaries reported to the police in each region.

Regional incarceration rates. The Chilean Prison Service (Gendarmería) provides information about the number of convicts in each administrative region and year. These figures were divided by the regional population size, provided by the INE, to obtain the regional incarceration rates:

$$Inc_{it} = nconvicts_{it}/pop_{it}$$

where Inc_{it} is the incarceration rate in region i in year t, and $nconvicts_{it}$ is the number of convicts in region i in year t.

Household income. The average household income data for each region were obtained from the Chilean Pension Supervisor. As discussed in Chapter 2, an increase in the average household income may have two opposing effects: it may reduce incentives for crime, but it may also increase opportunities for crime.

Increases in **regional unemployment rates** may similarly have two opposing effects: the short-term effect may be a decrease in burglary rates, as more people are at home. In the long term, unemployment rates may be positively related to burglary rates, because unemployment increases incentives to commit a burglary. The data on regional unemployment rates were obtained from the INE.

The demographic variables **regional urban population size** and **percentage of urban population aged 15-24** were also obtained from the INE.

3.3 Statistical methodology

There are several statistical methods employed throughout this thesis to analyse the specific research questions and hypotheses. This research poses the following hypotheses:

H1: The observed decrease in the average Chilean burglary rates between 2005 and 2013 is statistically significant, despite regional variance.

The security hypothesis (outlined in Chapter 2) may be an appropriate explanation of this downward trend in burglary rates if the prevalence of household protection increased during the same period. This relationship is evaluated by testing the effects of security protection on burglary rates at both the household-individual level and regional-area level.[7] The following hypotheses and sub-hypotheses are explored:

H2: The prevalence of security protection reduces the risk of burglary victimisation.

H2a: Different combinations or configurations of security devices have different effects on burglary risk.

H2b: The effects of security configurations vary across socio-economic groups.

H2c: The effects of security configurations vary across boroughs.

---

[7] It is assumed that neither individual effects of security devices can be deduced from aggregated data (because of ecological fallacy) nor effects at area level, such as city, region or country level, can be deduced from individual data. Thus, it was considered that in order to accept the suitability of security hypothesis for Chilean figures availability of security devices should be negatively correlated to burglary rates at both aggregated and individual level.

H3: Changes in the prevalence of household protection at the regional level are negatively correlated to the trends in burglary rates between 2005 and 2013, after controlling for relevant variables.

H3a: Burglary trends are differentially affected by changes in the prevalence of different security devices.

While the hypotheses about the statistical significance of the decrease in the burglary rate in Chile (H1) and about the effect of security variables and other covariates on burglary trends between 2005 and 2013 (H3) are tested through the use of longitudinal data and appropriate methodological approaches, Hypothesis 2 (H2) about the relationship between an individual's burglary victimisation risk and security protection (and other household features) is tested through the use of cross-sectional data and analyses.

Sub-sections 3.3.1 and 3.3.2 detail the analytical methodologies employed to test the hypotheses outlined above. For clarity of presentation, this thesis first presents the cross-sectional methodologies employed to test H2 (effect of security devices on burglary risk at the individual level). Because two measures are used to estimate household burglary risk (a dichotomous yes/no variable and the number of burglaries), Sub-section 3.3.1 describes two analytical techniques through which these measures are analysed: multilevel logit regression and multilevel negative binomial regression.

Sub-section 3.3.2 presents the methodological approach to test H1 and H3, which regard changes over time at the macro level. However, the ENUSC survey was designed for cross-sectional analyses and does not include repeated observations on households. Because Chapter 6 focuses on correlations at the macro level (country and region), it is appropriate to group individual observations by region to generate pseudo-panels, in which each region is treated as one entity measured several times (seven times from 2007 to 2013). Longitudinal analyses and panel techniques allowed for eliminating time-invariant variables related to victimisation risk and for estimating the correlations between crime rates and security prevalence at the regional level.

3.3.1 Cross-sectional individual-level analyses.

As mentioned in Sub-section 3.2.2, the first methodological challenge for testing the effect of security devices on households' burglary risk is the fact that ENUSC respondents are asked about possession of security devices at the moment of the interview, not at the time of the burglary incident. As a result, it is not possible to know whether security devices were fitted before a burglary incident or as a response to it. Neglecting this limitation may lead to misestimating the effect of security devices, especially in cross-sectional analyses of burglary.

This analysis used a sub-sample of the original sample to overcome the endogeneity problems stemming from the fact that security devices may have been fitted after a burglary. To do so, all households that fitted security devices in the reference period were eliminated from the sample. Therefore, the resulting analysis concerns the victimisation risk of households that did not fit a security device in the reference period (last 12 months).[8] The rationale of this methodological strategy is further explained in Chapter 5. Chapter 5 also provides a comparison of the full sample and the sub-sample of those households which did not fit a security protection in the reference period.

Two measures of victimisation were analysed to estimate the effect of security devices at the household level. The first is a binary variable that measures whether a household was the victim of burglary during the reference year

[8] Note that reverse causality between victimisation and security devices would be less problematic when the number of burglaries is counted. Hypothesis would be that households with security devices suffer less burglaries because security devices prevent repeat victimisation.

(yes/no). The second measure is the number of burglaries experienced during the reference year, with most households suffering zero burglaries, a smaller proportion suffering one burglary an even smaller proportion suffering two burglaries and so on. The analyses of each of the two measures of victimisation risk required different methods to account for the differences in the probability distribution of those measures.

3.3.1.a Logit model for binary measure of victimisation.

The yes/no measure of burglary victimisation follows a Bernoulli distribution; therefore, estimations must take into account that feature. Because the dependent variable is not Normally distributed and its error term is heteroscedastic,[9] an OLS estimator is not appropriate. In this case, the expected value of the dependent variable indicates the probability that the dependent variable is equal to 1 (yes). Therefore; the best way of modelling the probability of being victimised is not through a linear function, but through a cumulative distribution function, which ensures that the predicted probabilities are between 0 and 1 ($0 \leq p \leq 1$). In formal terms, the probability of y=1 conditional to the value of x is a function of a regressor **x** and a parameter β:

$$\Pr(y_i=1|x) = \pi = F({}_{i}\beta_0 + \beta_1 x_1) \qquad (3.1)$$

where *F(.)* is a specified cumulative distribution function that maps a probability π between 0 and 1 to any value in the range (-∞, +∞). The cumulative distribution function may regard different known distributions, with the logistic distribution (logit model) and the Normal distribution (probit model) the most common choices for this distribution (Steel, F. 2009).

In this study, the logit function was chosen due to interpretational convenience. As stated by Cameron and Trivedi (2005), “there is often little difference

[9] Ordinary Least Squares (OLS) assumes homoscedasticity of error terms. See Johnston, J. (1984) Econometric Methods, Singapore: McGraw-Hill.

between the predicted probabilities from logit and probit models, (which) is much less if the interest lies in marginal effects averaged over the sample rather than for each individual". However, the logit function allows for easy and straightforward interpretation of estimated coefficients in terms of the log-odds ratio.

The logit function is a logistic transformation of the linear predictor in Equation 3.1, z= $\beta_0 + \beta_1 x_1$ defined as:

$$\pi = F(z) = \frac{exp\ (z)}{1+exp\ (z)} = \frac{e^z}{1+ e^z} \qquad (3.2)$$

where *exp* and *e* both denote the exponential function.

Logistic transformation removes the 0-1 range restriction because exp(z) = exp ($\beta_0 + \beta_1 x_1$) will always be greater than zero. Regardless of the value of z, π = exp(z)/[1+ exp(z)] must always lie between 0 and 1. Thus, "as z gets larger in a negative direction (z → - ∞), exp(z)/[1+ exp(z)] approaches 0; and as z gets larger in a positive direction (z → + ∞), exp(z)/[1+ exp(z)] approaches 1" (Steel, 2009).

Through a simple algebraic transformation, the response probability in Equation 3.2 may be expressed as a linear function of z:$\pi = \frac{e^z}{1+ e^z}$

$(1 + e^z)\ \pi = e^z$

$\pi + e^z\pi = e^z$

$\pi = e^z - e^z\pi$

$\pi = e^z\ (1- \pi)$

$$\frac{\pi}{1-\pi} = e^z \qquad (3.3)$$

$$\text{Log}\ (\frac{\pi}{1-\pi}) = z = \beta_0 + \beta_1 x_1 \qquad (3.4)$$

Equation 3.3 express the probability π as odds

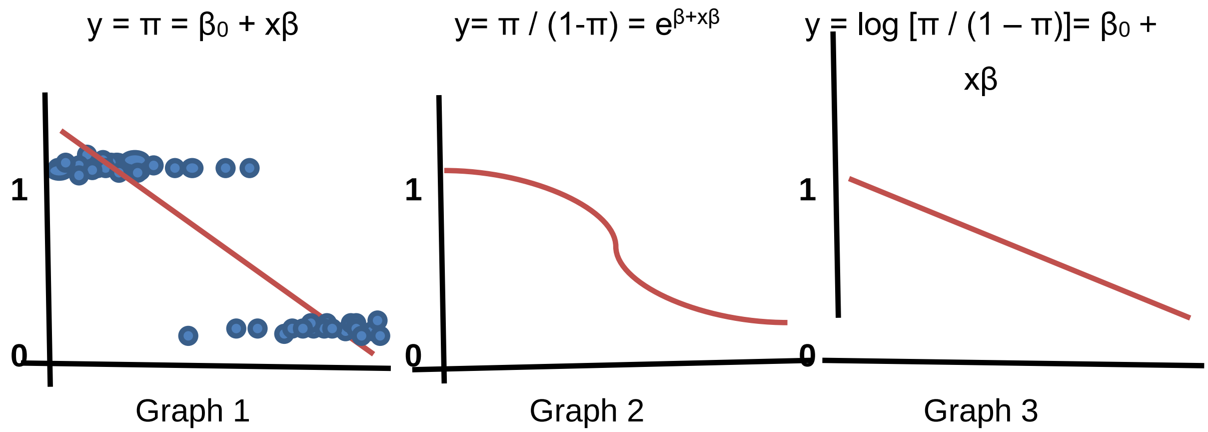
$$odds = \frac{\pi}{1 - \pi}$$

which measures the probability that y=1 (victimised) relative to the probability that y=0 (not victimised). By transforming π into odds, the right-hand side of the equation becomes an exponential function of covariates or explanatory variables that defines a sigmoidal or S-shaped relationship.

Equation 3.4 reverses Equation 3.3 to obtain the log-odds of being victimised, which is linear in the regressor. Thus, the S-curve of Equation 3.3 is translated into a straight line which can then be treated using the same approach as linear regression.

Figure 3.1 illustrates the logistic and logit transformation of Equations 3.3 and 3.4, respectively. The first graph illustrates that the distribution of cases is not linear and that fitting a linear function may lead to out-of-range values. To ensure that the predicted probabilities will always lie between 0 and 1, a non-linear transforming function is used, in this case a logistic function that model the odds of y (Graph 2). By applying the inverse of the transforming function (F-1) to the response probability π, a generalised linear model is obtained that sets a nonlinear transformation of the response probability while keeping the right-hand side of the equation linear (Graph 3). The estimated coefficients from the model in Graph 3 must be interpreted as the estimated change in victimisation **log-odds** ratio per unit change in the explanatory variables.

Figure 3.1. The logit transformation



As mentioned above, one advantage of using the logit function as a transforming function is that a logit function allows for easy and straightforward interpretation of the estimated coefficients. Statistical analyses and software often use the logit transformation (Graph 3) for estimations. Through exponentiating the estimated coefficients, it is possible to obtain an estimation of the effect of a one-unit change in a covariant on the odds of being victimised (y=1).

Equation 3.3 demonstrates that the relationship between the odds (of being burglarised) and a particular covariant *x* is defined as:

$$\pi /1- \pi = \exp (\beta_0 + \beta_1 x) = \exp (\beta_0) + \exp(\beta_1 x)$$

Now considering increasing *x* by one unit:

$$\pi /1- \pi = \exp [\beta_0 + \beta_1(x + 1)] = \exp (\beta_0) + \exp(\beta_1 x) + \exp (\beta_1)$$

The odds ratio increases by a multiple $exp(\beta_1)$. In other words, a one-unit increase in x increases the odds by a factor of $exp(\beta_1)$.

The outcome of most statistical packages is the logit coefficient; thus, the magnitude and direction of changes in the odds of *y*=1 due to changes in a specified explanatory variable can be obtained simply by exponentiating the estimated coefficient. For example, a logit model coefficient of 0.1 indicates that a one-unit increase in the regressor multiplies the initial log-odds ratio by 0.1. If that estimation is exponentiated, the initial odds ratio increases by $\exp(0.1) \approx 1.105$. This value amounts to a proportionate increase of 0.105 times the initial odds ratio and would mean that the relative probability of being burglarised, for example, increases 10.5% when variable x changes by one unit.

3.3.1.b Multilevel logit model

Multilevel logit models were used to test whether having security protection makes a difference in the burglary risk of households in the same borough. Multilevel logit models also tested whether the effect of security protection varies across boroughs.

Single-level models ignore the fact that individual household observations are nested in geographical areas, such as boroughs, and that the victimisation risk varies by area. Victimisation risk is likely to depend not only on a household's characteristics, but also on the (unobserved) features of boroughs, such as density and municipal security services.

Ignoring the borough effect may lead to misestimating the effect of household characteristics on victimisation risk. For example, if household wealth is negatively correlated to burglary risk and the mean household wealth varies substantially from borough to borough, it may be expected that household wealth is associated with unobserved borough-level determinants of victimisation risk, such as the availability and quality of municipal security services. If better services are offered in less-deprived areas and these areas have lower burglary victimisation risk, it would be expected that controlling for unobserved borough characteristics, as in multilevel models, would reduce the negative effect of household wealth.

In addition, ignoring the "clustering" of observations may lead to underestimating the standard errors of the regression coefficients and to erroneously inferring that a predictor has a significant effect on victimisation risk when in fact the effect could be ascribed to chance. As household victimisation is affected by unobserved borough features, which are shared for all observations in the same borough, the binary responses (yes/no) on which victimisation risk is based will be correlated. Such correlation within a borough implies that it would be possible, to some extent, to predict the response of a household based on the response of other households in the same borough. This implication suggests that not every observation provides an independent piece of information and that the total amount of information contained in a sample with clustering is less than that in a sample without clustering. Because the *effective sample size* is larger when clustering is not considered, the standard errors from single-level models are substantially lower than those from multilevel models. As a result, compared to multilevel models, the confidence intervals are more narrow and the *p-values* are smaller in single-level models. However, when observations are nested, the greater likelihood of finding statistically significant coefficients is simply an artefact of ignoring the dependence of observations.

Multilevel logit models take account of the "clustering" of observations by adding a borough error term μ to Equation 3.4:

$$\text{Log}\left(\frac{\pi}{1-\pi}\right) = \beta_0 + \beta_1 x_{1j} + \mu_j \qquad (3.5)$$

where μ_j is the difference between boroughs j´s victimisation risk and the overall victimisation risk. If no explanatory variable is included (x=0), the victimisation rate in borough j is equal to $\beta_0 + \mu_j$. The group effect or residual μ_j is assumed to follow a Normal distribution with a mean of zero and variance σ^2_μ .

As in the single-level model, β_1 is the effect of a one-unit change in x on the log-odds that y=1, but it is now the effect of x after adjusting for (or holding constant) the group effect u. If u is held constant, then the effect of x for individuals(households) within the same group (borough) is obtained.

Therefore, β_1 is usually referred to as a cluster-specific effect. If β_1 is exponentiated, exp(β_1) can be interpreted as an odds ratio, comparing the odds that y=1 for two individuals (in the same group) with x-values spaced one unit apart.

The term u_j is the group (random) effect; thus, the intercept for a given group j is $\beta_0 + u_j$. The variance of the intercepts across groups is var(u_j) = σ^2_u , which is referred to as the between-group variance adjusted for x, or the unexplained level-two variance.

3.3.1.c Random effect multilevel model

Model 3.5 allows the victimisation risk to vary across boroughs by adding a random term at level two, $\boldsymbol{u_j}$. In this random intercept model, $\boldsymbol{u_j}$ affects only the model intercept; thus, the intercept for borough $\boldsymbol{j}$ is $\boldsymbol{\beta_0}$ + $\boldsymbol{u_j}$. As a consequence, the random intercept model assumes that the effect of each individual-level explanatory variable is the same across boroughs.

Given this study's hypothesis and the purpose of testing whether the effect of household security devices varies across boroughs (H2.c), random effect models are also estimated. Random effect models allow for the effect of independent individual variables to vary across boroughs. To do so, a new term is added to Equation 3.5:

$$F^{-1}(\pi_{ij}) = \beta_0 + \beta_1 x_{1ij} + u_{0j} + u_{1j} x_{1ij} \qquad (3.6)$$

The new term $u_{1j}x_{1i}$ allows the effect of independent variable x_1 to vary across boroughs. A subscript 1 was also added to random intercept term u_j. Similar to Model 1, this model assumes that the random effects u_{0j} and u_{1j} follow a Normal distribution with mean zero, variance $\boldsymbol{\sigma^2_{u0}}$ and $\boldsymbol{\sigma^2_{u1}}$ and covariance $\boldsymbol{\sigma_{u01}}$. In Model 3.6, the slope of the relation between x_1 and the log-odds of y=1 is β_{10} +

u_{1j} for borough j and the covariance between random effects σ_{u01} is the covariance between borough intercepts and independent variable slopes.

3.3.1.d Negative binomial regression for number of burglaries

The second measure of burglary victimisation analysed in the cross-sectional component of this thesis is the number of burglaries suffered per household. Modelling the number of burglaries (incidence) is a departure from most previous empirical studies, in which the models for burglary victimisation risk were based on the victim-non-victim dichotomy (Kennedy & Forde, 1990; Sampson & Wooldredge, 1987; Trickett et. al, 1995; Wilcox et. al., 2007). The advantage of modelling the number of burglaries is that it considers the entire distribution of burglaries and can account for repeat victimisation and the concentration of burglaries (Osborne & Tseloni, 1998; Tseloni, 2006).

Similar to binary measure of victimisation, the distribution of the number of burglaries is not Normally distributed; linear modelling of this variable is therefore not appropriate. Burglaries are distributed as "rare event counts", where smaller values are much more common across households than larger values, with zero (not burglarised) as the most commonly observed value. Therefore, the distribution of frequencies of burglary events is highly positively skewed, with the bulk concentrated around low values and a long tail.

The basic model for count data is the Poisson distribution which assumes equality of mean and variance (McCullagh & Nelder, 1989; Cameron & Trivedi, 2005). If crimes are randomly distributed and independent of each other, the Poisson distribution is appropriate for modelling the number of crime incidents (Nelson, 1980).

However, several studies have found that burglaries are not randomly distributed; instead, they tend to be concentrated in some households and areas (Nelson, 1980; Ellingworth et. al., 1997; Osborne & Tseloni, 1998; Tseloni, 2006; Hope & Trickett, 2008). The non-random distribution of burglaries means that the variance may exceed the sample mean, over-dispersion, and thus the standard errors may be underestimated if a Poisson specification is chosen (Cameron & Trivedi, 2005). In this case, the negative binomial model is a more adequate choice to describe the observed frequency distribution of burglaries (Osborne & Tseloni, 1998, Tseloni, 2006, Hope & Trickett, 2008).

In more formal terms, the Poisson model assumes that the mean number of events (burglaries), or the expected number of burglaries for a household i, $\lambda = E(Y_i)$, is related to explanatory variables $\mathbf{x_i}$ through:

$$\ln(\lambda_i) = \beta' x_i \qquad (3.7)$$

and that the probability that Y_i takes the specific value y_i (y_i=0,1,2…) is given by:

$$\Pr(Y_i=y_i) = \exp(-\lambda_i)\, \lambda_i^{y_i} / y_i! \qquad (3.8)$$

These specifications assume that every household has the same chance of being burglarised and that $E(Y_i) = Var(Y_i) = \lambda_i$.

The negative binomial model adds an error term that allows for over-dispersion ($Var(Y_i) > E(Y_i)$):

$$\ln(\lambda_i) = \beta' x_i + \varepsilon_i \qquad (3.9)$$

where $\exp(\varepsilon_i)$ follows a gamma distribution with mean 1 and variance α (Cameron & Trivedi, 2005).

Thus, by combining Equation 3.9 with Equation 3.8, the negative binomial model is obtained to estimate the number of burglaries for household i (Cameron and Trivedi, 2005; Osborne and Tseloni, 1998):

$$\Pr(Y_i = y_i) = [\, \Gamma(\alpha_i^{-1} + y_i) / \Gamma(\alpha_i^{-1})\, y_i!\,]\, (\alpha_i^{-1} / \alpha_i^{-1} + \lambda_i)^{\alpha\text{^-}1}\, (\lambda_i / \alpha_i^{-1} + \lambda_i)^{y_i} \qquad (3.10)$$

where α^{-1} is the precision parameter and Γ is the gamma distribution.

As in the Poisson model, the expected number of burglaries is $E(Yi)= \lambda= \exp(\beta' x_i)$. However, in the negative binomial model, the variance is:

$$Var(Y_i)= \lambda_i + \alpha\lambda_i^2 \qquad (3.11)$$

where λ and α are positive such that the variance exceeds the mean. The model thereby allows for over-dispersion by capturing heterogeneity and/or event dependence across individuals (Osborne & Tseloni, 1998; Hope & Trickett, 2008).

3.3.1.e Multilevel negative binomial regression

The multilevel specification of the negative binomial model takes into account the fact that observations are "clustered" in boroughs (see Sub-section 3.5.1.1.b). Thus, the random multilevel negative binomial parameterisation of the relationship between the expected number of burglaries $\boldsymbol{\lambda_{ij}}$ (for household i in borough j) and covariates $\mathbf{x_i}$ is:

$$\ln(\lambda_{ij}) = (\beta' x_{ij} + u_{0j} + u_{qj}x_{qij}) + \varepsilon_i \qquad (3.11)$$

where μ_j, which is assumed to follow a Normal distribution with a mean of zero and variance σ^2_μ , is the departure from the jth borough (see Sub-section 3.5.1.1.b) and ε_i is the between-household variation in the expected number of burglaries, which follows a gamma distribution (see Sub-section 3.5.1.2.a).

The result of combining Equation 3.11 and the Poisson distribution (Equation 3.8) gives the multilevel extension of the negative binomial model defined in Equation 3.10:

$$Pr(Y_i = y_i) = [\ \Gamma(\alpha^{-1} + y_{ij}) / \Gamma(\alpha_i^{-1})y_{ij}\,!\ ]\ (\alpha^{-1} / \alpha^{-1} + \lambda_{ij})^{\alpha\text{^-}1}\ (\lambda_{ij}/ \alpha^{-1} + \lambda_{ij})^{yij} \quad (3.12)$$

with an expected mean of burglaries equal to

$E(Y_{ij})= \lambda_{ij}= \exp((\beta' x_{ij} + \mu_j),$

and variance

$Var(Y_ij) = \lambda_{ij} + \alpha\lambda_{ij}^2$

Thus, by means of the multilevel negative binomial model, the analyses in Chapter 5 are able to identify the unexplained variance due to both household and borough heterogeneity. The usage of this technique is appropriate because it is “the most complete currently available method of modelling crime” (Pease & Tseloni, 2014).

3.3.1.f Interpreting coefficients

The key variable in Chapter 5 is the prevalence of different security devices. This variable is represented by a dummy variable, which takes the value one when security protection is available at home and zero otherwise. The zero value – no security protection – is designated as the reference value, and its effect on the dependent variable – burglary victimisation – is incorporated in the constant term (β_0). The burglary rate for households with security protection is expressed as a ratio to the reference category (i.e., households without security protection). Thus, the estimated coefficient β_{sec} represents the estimated change in the log-odds of being burglarised when moving from considering a household without security protection to a household with security protection but otherwise identical characteristics. A negative coefficient implies a decrease in the probability or incidence of burglary for a household with security protection compared to a household without security protection.

Rather than presenting the coefficients for security protection and the control variables, which are difficult to interpret, the exponential of each coefficient is provided. Therefore, the presented coefficient must be interpreted as the predicted factor change in the number of burglaries (multilevel negative binomial model) or the predicted factor change in the odds of burglary victimisation (multilevel logit models) when compared to the reference household (holding all other variables constant, except the variable in question). The coefficient may alternatively be interpreted as the percentage change in the number of burglaries (multilevel negative binomial models) or percentage change in the odds of victimisation (multilevel logit models), calculated by [(exp(β_i)-1) *100], where i is the variable of interest.

Because in multilevel models the effect of explanatory variables on the burglary rate is estimated after adjusting for the borough effect (μ_j), the coefficients (β_i) for explanatory variables must be interpreted as the change in a household´s expected burglary rate compared to another household *in the same* borough.

3.3.2 Longitudinal analysis of burglary victimisation.

Both H1 (addressed in Chapter 4) and H3 (addressed in Chapter 6) concern changes in burglary rates over time. While Chapter 4 explores whether there was a significant decrease in burglary rates between 2005 and 2013, Chapter 6 explores whether changes in the prevalence of household security protection can explain the changes in burglary rates.

Panel data techniques are used in Chapter 4 and Chapter 6 to answer questions about the changes in burglary rate over time. Panel data (also known as longitudinal or cross-sectional time series data) refers to a data set in which the behaviour of units or entities is observed across time (Baltagi, 2005, Cameron & Trivedi, 2005). The main advantage of using panel data techniques, as explained below, is that it allows for controlling for unobserved variables and differences across entities (individual heterogeneity), which would otherwise bias estimations.

Given that the analyses in Chapters 4 and 6 are focussed on correlations at the regional level, the data from the ENUSC were aggregated at the regional level, and each region was considered the unit of observation. The aggregation of data to generate a pseudo panel is typically used to overcome the lack of genuine panel data by using available repeated cross-sectional data. This approach follows Deaton's (1985) suggestion to convert individual-level data into cohort data (such as region) and to treat the average within cohorts as observations in a panel to estimate panel fixed models (more details on pseudo panels in Chapter 6).

By aggregating data at the regional level, a panel of 15 “individuals” who were annually observed over a period of nine years (2005-2013) and a panel of 15 “individuals” who were annually observed over a period of seven years (because information about security protection is available since 2007) were obtained for the analyses in Chapters 4 and 6, respectively. The analysis in Chapter 4 includes 135 observations and the analysis in Chapter 6 includes 105 observations.

The regional level for data aggregation was chosen over the borough level because displacement from one region to another is less frequent than displacement from one borough to another, particularly in metropolitan areas. In addition, the control variables used in the models are only available at the region level.

3.3.2.1 Panel models

The analyses in Chapters 4 and 6 focus on burglary rates over time. Chapter 4 analyses whether there is a significant downward trend in Chilean burglary rates, controlling for regional differences and particularities. Chapter 6 later focuses on the relationship between burglary trends and changes in the prevalence of anti-burglar protection, along with other control variables. In contrast to the cross-sectional analyses in Chapter 5, which focus on the differences between households, Chapters 4 and 6 analyse temporal changes or within-region differences in Chile.

The main methodological change in the analyses in Chapters 4 and 6 is the isolation of temporal effects (i.e., the effects on burglary rate which are exclusively the result of time or temporal changes in security prevalence and other control variables) from the effects of region characteristics.

Not considering that region effects may lead to empirical models erroneously estimated by using the standard OLS method; thus, the basic equation form of the model would be specified as follows:

$$y_{it} = \beta_0 + \beta_i x_{it} + v \qquad (3.13)$$

in that specification crime rates is assumed to be affected by observed variables, shared trends and a random error term.

However, when data from repeat observations of the same region (panel data) are used, the observation-independence assumption of OLS models is violated (Baltagi, 2005; Cameron & Trivedi, 2005). Correlations between observations mean that certain non-observed common features of the observations – such as belonging to region *i* – affect the crime rate. Such region-specific time-invariant characteristics (e.g., industrial vs. agrarian economy) may be correlated with the independent variables (e.g., police apprehension rates). Because the non-observed region effect is captured by the error term, not taking into account that region effect would result in correlation between the error term and the independent variable, which is a violation of the OLS assumption that explanatory variables should be independent from the error term.

Instead, the panel models are based on the decomposition of the error term v into two components (Cameron & Trivedi, 2005; Baltagi, 2005): a region-specific error u_i, which is time invariant, and an idiosyncratic error e_{it}, where

$$v_{it} = u_i + e_{it}$$

Thus, Model 13 can be expressed as:

$$y_{it} = \beta_1 x_{it} + u_i + e_{it} \qquad (3.14)$$

where the constant β_0 is omitted because of its collinearity with u_i.

The region-specific error does not vary over time. Every region has a fixed value for this latent variable (fixed effects); therefore, u_j represents region-specific, time-invariant unobserved heterogeneity. In contrast, the idiosyncratic error e_{it} varies across region and time, which should fulfil the assumption for the standard OLS error term.

The panel models overcome the OLS assumption of no correlation between x_{it} and v_{it} through different treatment of u_i. According to which treatment is used, panel models may be classified as fixed effect or random effects.

3.3.2.2 Fixed effect panel models.

The effect of temporal changes in the regional prevalence of security devices on regional burglary rates over the studied period is estimated by employing fixed effect models. This methodological model is reliable, as it does not make any assumption about u_i, which is simply cancelled out. However, because this model does not take into account differences in the prevalence of household protection *between* regions, it requires considerable variation of the prevalence *within regions* to produce a statistically significant effect on burglary rates. If this condition is not met, the standard errors from fixed effect models may be too large.

Fixed effect models “difference out” the region-specific error u_i by assuming that u_i is time invariant. The regression equation of one region at different time points t_1 and t_2 is provided by:

$$y_{i1} = \beta_1 x_{i1} + u_i + e_{i1}$$

$$y_{i2} = \beta_1 x_{i2} + u_i + e_{i2}$$

Subtracting the first equation from the second gives:

$$\Delta y_i = \beta_1 \Delta x_i + \Delta e_i \qquad (3.15)$$

where Δ is the change from t=1 to t=2.

By subtracting year one from year two, the fixed effects are eliminated. Therefore, the assumption that u_i is not correlated with x_{it} is no longer necessary, because time-constant unobserved heterogeneity is no longer a problem. However, given that T>2 in this research, this estimator is not efficient, because it would also be possible to subtract year one from year three (and so on), which is information not used.

An alternative and more efficient way to estimate the effect of changes in the prevalence of household security is the "within transformation". This strategy also starts from the error component model (Equation 14):

$$y_{it} = \beta_1 x_{it} + u_i + e_{it}$$

This equation is then averaged over time for each *i* (between transformation)*:*

$$\bar{y}_i = \beta_1 \bar{x}_i + u_i + \bar{e}_i \qquad (3.16)$$

Subtracting the second equation from the first for each t (within transformation) gives:

$$y_{it} - \bar{y}_i = \beta_1 (x_{it} - \bar{x}_i) + e_{it} - \bar{e}_i \quad (3.17)$$

Similar to Equation 3.15, the u_i effect has disappeared in Equation 3.17; therefore, the time-invariant unobserved heterogeneity is no longer a problem. In addition, because time is demeaned in Equation 3.17, all available information is used for the estimation of the model´s parameters. As such, Equation 3.17 is also more efficient than Equation 3.15.

3.3.2.3 Random effects models

By assuming that regional unobserved effects (u_i) are random variables (i.i.d. random-effects) and that the covariance between those regional variables and security prevalence (and other independent variables) is equal to zero (cov (x_{it}, u_i)=0), a random effects model can be estimated.

Random effects models assume that u_i is Normally distributed and that $Cov(X_{it}, u_i) = 0$. Thus, the equation form of the random model is similar to Equation 14:[10]

$$y_{it} = \beta_0 + \beta_1 x_{it} + u_j + e_{it} \qquad (18)$$

The random-effects estimator is obtained by quasi-demeaning the data and calculating:

$$(y_{it} - \lambda \bar{y}_i) = \beta_0 (1- \lambda) + \beta_1 (\bar{x}_{it} - \lambda x_i) + \{ (1 - \lambda) u_i \bar{+} (e_{it} - \lambda e_i)\}$$

where

$$\lambda = 1 - (\sigma^2_e / T\sigma^2_u + \sigma^2_e)^{1/2}$$

If $\lambda = 1$, the random-effects estimator will be identical to the fixed-effect estimator, that is, the random-effects estimator will be unbiased. The degree of the bias depends on the magnitude of λ. If λ is closer to one, the bias of the random-effects estimator is low. According to the equation, the magnitude of λ depends on the ratio of σ^2_u and σ^2_e. If $\sigma^2_u \gg \sigma^2_e$ then λ will be close to one, and the bias of the random-effects estimator will be low.

This research expects that the variance in burglary rates between regions is significantly greater than the variance within regions. Therefore, a random effects model is chosen because the bias in estimation, if any, would be very low.

The main advantage of the random effects model over the fixed effect model is that the former provides estimates for time-constant variables and mixes within and between estimators, thereby increasing the efficiency of the model.

However, the assumption that unobserved regional variables are not correlated with security prevalence and other control variables (cov (x_{it}, u_i)=0) is difficult to justify. If cov (x_{it}, u_i)≠ 0, the estimation of security prevalence will be biased.

[10] Multilevel models are a type of random model.

To test whether the random effects model is appropriate, specialised literature and manuals of econometrics recommend the use of the Hausman test (Baltagi, 2005; Cameron & Trivedi, 2005) .

3.3.2.4 Hausman test

To decide whether fixed or random effects models are more appropriate for modelling the relationship between changes in the prevalence of security devices and changes in burglary rates, a Hausman test was performed, in which the null hypothesis is that the preferred model is a random effects model, versus the alternative fixed effect model (Green, 2008). The Hausman test ascertains whether regional errors (μ_i) are correlated with the regressors. The null hypothesis is they are not correlated:

$$H_0: \beta_{RE} = \beta_{FE}$$

where β_{RE} and β_{FE} are the estimated coefficients for the time-varying explanatory variables, excluding time variables.

If the null hypothesis is rejected, the random effects model is inconsistent and the fixed effect model is preferred. If the null hypothesis cannot be rejected, the random effects model is preferred because it is a more efficient estimator.

3.4 Summary

This chapter described the main characteristics of the ENUSC and the usefulness of its data for the purposes of analysing changes in burglary rates over time and examining the relationship between those changes and the prevalence of household security protection. The statistical methods used to analyse the data were also presented. Each method was employed in an effort to answer the research question that guides this investigation. Longitudinal analyses, employing both fixed and random effects models, are utilised in Chapter 4 to establish whether the observed burglary trend in the 2005-2013 period is statistically significant or if it is an artefact of aggregating regional averages at the national level. The same techniques are also utilised in Chapter 6 to examine the role the observed burglary trend played by the observed changes in the prevalence of household security protection. Chapter 5 presents the results from multilevel logit and multilevel negative binomial models to ascertain if the prevalence of security protection at the household level and other control variables affect burglary risk and incidence. These methods seek to increase understanding of the changes in burglary victimisation between 2005 and 2013 and to validate or reject the security hypothesis as an explanation of those changes. The following chapter explores the trends in burglary rates over the studied period.

Chapter 4: Trends in burglary victimization

The first step in the analyses presented in this thesis is to explore the trends in burglary victimization rates in Chile to establish whether the observed decrease in burglary rates is statistically significant (H1).

Between 2005 and 2013, the ENUSC demonstrated a clear, but unexplored, decrease in burglary rates. However, the average figures may hide regional or between-group differences, thus making it inaccurate to claim a national decline in burglary rates. This thesis follows Aebi and Linde's advice (2012, p.37) and begins by "establishing the actual evolution of crime trends, and, only after that, on providing explanations for that evolution". The objective of this chapter is therefore to analyze how burglaries are distributed, both over time and across different regions in the sample, in the period in question and thereby determine if it is accurate to claim a national drop in burglary rates.

A decrease in burglary incidence may reflect a decrease in the percentage of households victimised and/or a decrease in the number of burglaries each victimised household suffers (Farrell & Pease, 1993; Britton et al., 2012; Thorpe, 2007). Therefore, this chapter explores the incidence, prevalence and concentration rates to measure crime trends over the studied period (Trickett et al., 1992; Tseloni, 2014).

- Burglary incidence is measured as the number of burglaries per 100 households.
    - Incidence = nº burglaries / N households in sample *100
- Burglary prevalence is measured as the percentage of victimized households in the respective population.
    - Prevalence = nº households burglarized / N households in sample * 100

- Burglary concentration is measured as the number of burglaries per victimized household.
  - Concentration = nº burglaries/ nº households burglarized

Burglary incidence rates are higher than prevalence rates because some victims experience more than one burglary, with the average rate of repeats marked by the concentration rate. The crime rates derived in this research are measures of the annual burglary rates at the national and regional level. The latter are used for the multilevel analyses in Section 4.3 of this chapter.

This chapter begins by presenting the observed frequencies of burglaries reported per household for each round of the ENUSC from 2003 to 2014. The chapter then introduces a longitudinal analysis of regional rates to test the statistical significance of the observed downward trend in burglary rates and assess regional variations in the three crime rate measures. The relative importance of repeat victimisation and prevalence is then considered. Finally, this chapter explores whether there are differences in burglary trends among other groups in the sample.

4.1 The ENUSC data

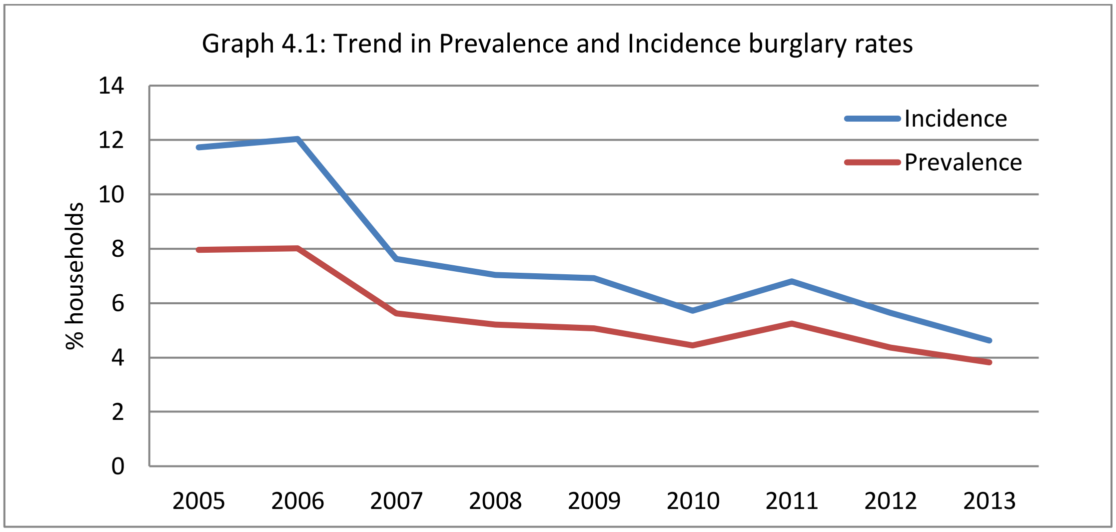
This analysis utilizes the data from each ENUSC annual survey between 2005 and 2013. The Chilean victimization survey data were described in Chapter 3. To analyze burglary trends in this chapter, household data were aggregated at the national and regional level. Data from 13 administrative regions were used to examine whether there was a significant national downward trend or whether the observed national average trend reflects the over-representation of any region (e.g., the metropolitan region accounted for nearly one-third of the sample each year) or sub-set of regions. Although a new administrative division of the country was introduced in 2008 which created two new regions (for a total of 15), this analysis used the old 13-region administrative division in order to maintain a balanced data set. As the analysis aims to examine national trends and cross-regional variation, the ideal situation is to utilize data from each region in each year that the survey was conducted. A total of 117 region-year combinations were ultimately used in the statistical modeling.

The sample size of the ENUSC is typically around 1,000 households per region, with the exception of the metropolitan region (Santiago, capital city), where the sample size is around 9,000 households. This unbalanced representation of the metropolitan region in the ENUSC sample means that the region-level burglary estimates for regions other than the metropolitan region have significantly greater margins of error. As a result, there are sometimes anomalies in the data, such as unusually low or zero crime rates in some administrative regions. However, the greater margins of error should not affect the findings of the present analysis, because it is reasonable to assume that such biases have remained relatively consistent over time, and the focus of the present study is on trends.

4.2 Trend and distribution of burglary over time

Table 4.2 details the full distribution of domestic burglary in Chile and its relatively small prevalence. Across all ENUSC surveys, more than 90% of households were not victims of burglaries. Less than 10% were victimized once, and an even smaller proportion were victimized twice or more.[11] While burglary is a rare event, Table 4.2 demonstrates a clear downward trend in burglary rates over the observed period.

[11] Figures from ENUSC inevitably will undercount repeats in a year, given that the time available for repeat incidents during the recall period will vary from a year to a day. This is the time window problem. The bias, however, will be the same for each sweep



Graph 4.1 illustrates the burglary victimization trend between 2005 and 2013. The blue line indicates the mean number of burglary incidents per 100 households, while the red line indicates the mean number of burglarized households per 100 households. The y-axis represents both the number of incidents and the number of victimized households. The graph demonstrates a clear downward trend in both incidence and prevalence rates.

The burglary incidence rate decreased by 62% between 2005 and 2013. In 2005 and 2006, the mean number of burglary incidents was at its highest: 11.7 and 12 burglaries per 100 households, respectively. The graph demonstrates that, between 2006 and 2007, the burglary incidence rate decreased by 37%, from 12 burglaries per 100 households to 7.6 burglaries per 100 households. This drop between 2006 and 2007 accounts for more than half of the total drop in burglary incidence in Chile between 2005 and 2013. From 2007 onward, burglary incidence rates further decreased, but at a reduced pace. Still, between 2007 and 2013, the burglary incidence rate decreased by 40%.

The burglary prevalence rate also decreased over the studied period, following a very similar curve to the incidence rate. First, there was a steep decrease from 8 to 5.6 households victimized per 100 households (a 30% reduction) between 2006 and 2007. There was subsequently a slighter but steady decline to 3.8 households victimized per 100 households in 2013, with the exception of a slight jump in 2011. Overall, the prevalence rate decreased by 53% between 2005 and 2013.

Graph 4.1 illustrates that the distance between the incidence line and the prevalence line was shorter in 2013 than in 2005. The decreasing distance between the two lines reflects the fact that the decrease in incidence rate (-62%) was larger than the decrease in prevalence rate (-53%), which in turn implies that the concentration rate and repeat victimization rate also decreased.

4.2.1 Repeat victimization and concentration rates

Repeat victimization refers to the multiple criminal victimization of a target (person, property, place of vehicle). Repeat victimization is an important element to be taken into account when describing the distribution of victimization in a given population, as a small proportion of repeatedly victimized targets experience a disproportionately large number of criminal victimization (Farrell, 1995; Pease, 1998). Thus, a decrease in burglary rates may be the result of either a decrease in the number of households victimised or a decrease in the number of burglaries experienced per victimised household. Exploring this dynamic is therefore an important step to understanding the nature of burglary trends and their drivers (Hopkins and Tilley, 2001; Tilley and Hopkins, 1998).

Although there is no research to date on repeat victimization in the Chilean context and very limited literature on repeat victimization in developing countries (Grove and Farrell, 2011), an extensive body of research has demonstrated the presence and importance of repeat victimization across different countries and crime types (Grove et al., 2012). The importance of considering repeat victimisation in crime level analysis has been emphasised since the early 90s (Forrester et al., 1990; Pease, 1991; Farrell and Pease, 1993; Pease, 1998). Research has also found that burglary victimisation is a reliable predictor of future victimisation (Pease, 1998; Farrell and Pease, 2001); therefore, focussing crime prevention initiatives on previously victimised households can improve the efficiency with which resources are allocated (Farrell and Pease, 1993; Farrell, 1995; Pease, 1998; Tseloni et al., 2002).

Explanations of why repeat victimisation occurs generally focus on two mechanisms: a *boost* mechanism and a *flag* mechanism (Tseloni and Pease, 2003; Johnson, 2008). The flag hypothesis holds that burglary risk is heterogeneously distributed over a population due to time-stable attributes of households which flag them as an attractive target for burglars (Spark 1981; Johnson , 1998).

The second hypothesis – the boost mechanism – suggests that an initial burglary increases the likelihood of repeat victimisation (Pease, 1998). The victimisation risk may increase because burglars return to search for valuable items that they were unable to carry the first time or items that were replaced or because the knowledge obtained from the first burglary facilitates the commission of a new burglary against the same target. Research on the optimal foraging approach, which focusses on offenders' target selection process (Johnson and Bowers, 2004), has also found evidence supporting the boost hypothesis. The results confirm that offences of the same type occurring close to each other in space and time are those most likely to be attributed to the same offender(s), as predicted by the boost hypothesis (Johnson, Summer and Pease, 2008).

The distribution of repeat burglary victimisation in Chile

According to the data reported in Table 4.2, 42.5% of reported burglaries in Chile over the examined period were repeat incidents. In other words, nearly half of all burglaries occurred in households that had previously been burgled on at least one occasion in the same year. This proportion of repeat incidents is similar to that reported in England and Wales between 1995 and 2006 (35%), but larger than the proportion found by Farrell, Tseloni and Pease (2005) for the country sample of the International Crime Victimisation Survey (22%).

The data from the Chilean sample confirms the distribution patterns observed in previous studies: a small proportion of households account for a considerable proportion of burglaries committed. Table 4.2 demonstrates that, over the studied period, 5.4% of households reported suffering a burglary in the past 12 months. Households that suffered more than one burglary (repeat victims) accounted for 1.25% of the total sample and suffered 6,970 burglaries over the examined period. In other words, 43.5% of the total number of reported burglaries took place in just 1.25% of the sampled households. Around 15% of the victimised households suffered two burglaries, while 1.3% of the victimised households were victimised five times or more, accounting for over 5% of all reported burglaries.

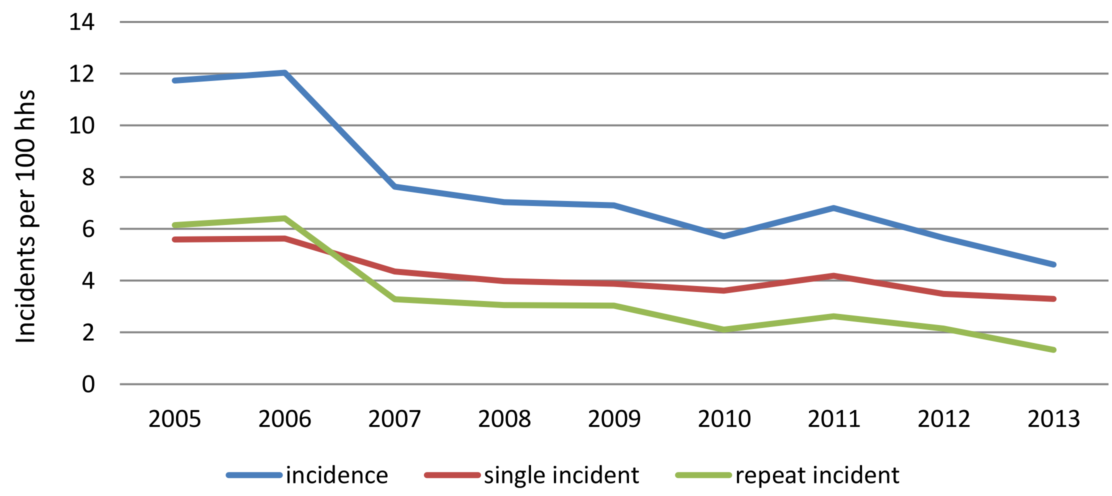
Graph 4.2.1 and Graph 4.2.2 illustrate the proportion of repeat incidents and repeat victims over the studied period. The same data are also depicted indexed to 2005.

Graph 4.2.1 demonstrates that the observed decrease in incident rates over the study period was composed of a decrease in the number of single incidents and a decrease in the number of incidents suffered by previously victimised households. The graph also indicates that the decrease in repeat incidents was larger than the decrease in single incidents. As Graph (b) illustrates, while repeat incidents fell nearly 80%, single incidents decreased by only 40% over the same period. The figures from Graph (b) clearly illustrate that the decrease in burglary incidence rates was due, to a large extent, to the reduction in repeat incidences.

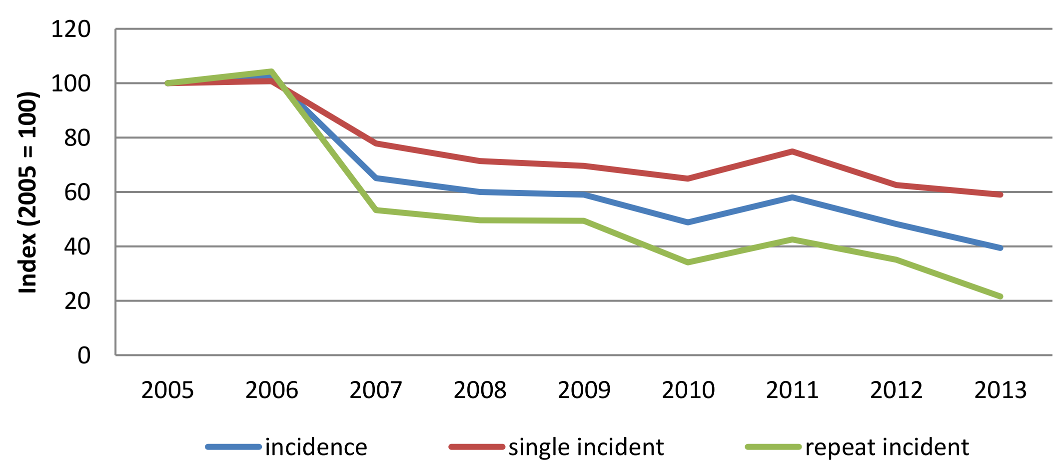
In fact, a more detailed analysis of the figures in Table 4.2 reveals that in 2005, there were 11.7 burglaries per 100 households, of which 5.6 were first burglaries (from the household perspective) and 6.1 were committed against previously victimised households. In 2013, the burglary incidence rate decreased to 4.6 burglaries per 100 households, of which 3.3 were first burglaries and 1.3 were repeat victimisations. Thus, nearly 70% of the reduction in the number of burglaries per 100 households was due to the reduction in the number of burglaries against previously victimised households.

This finding is complemented by the concentration rates reported in Table 4.2. The concentration rate is equal to the expected number of burglaries suffered per victimised households in a population and summarises the intensity of repeat victimisation (or household vulnerability) in the population. As detailed in Table 4.2, between 2005 and 2013, the concentration rates of burglary victimisation in Chile decreased from 1.47 burglaries per victimised household to 1.20 burglaries. Graph 4.2.1 also illustrates that the relative weight of repeat incidents within the total number of burglary incidents changed over time. In 2005, repeat incidents accounted for 52% of the total number of burglary incidents. By 2013, that figure decreased to only 28% of total burglary incidents per 100 households.

Graph 4.2.1 (a): Single and repeat burglary incidence trend



Graph 4.2.1 (b) Indexed single and repeat burglary incident trends

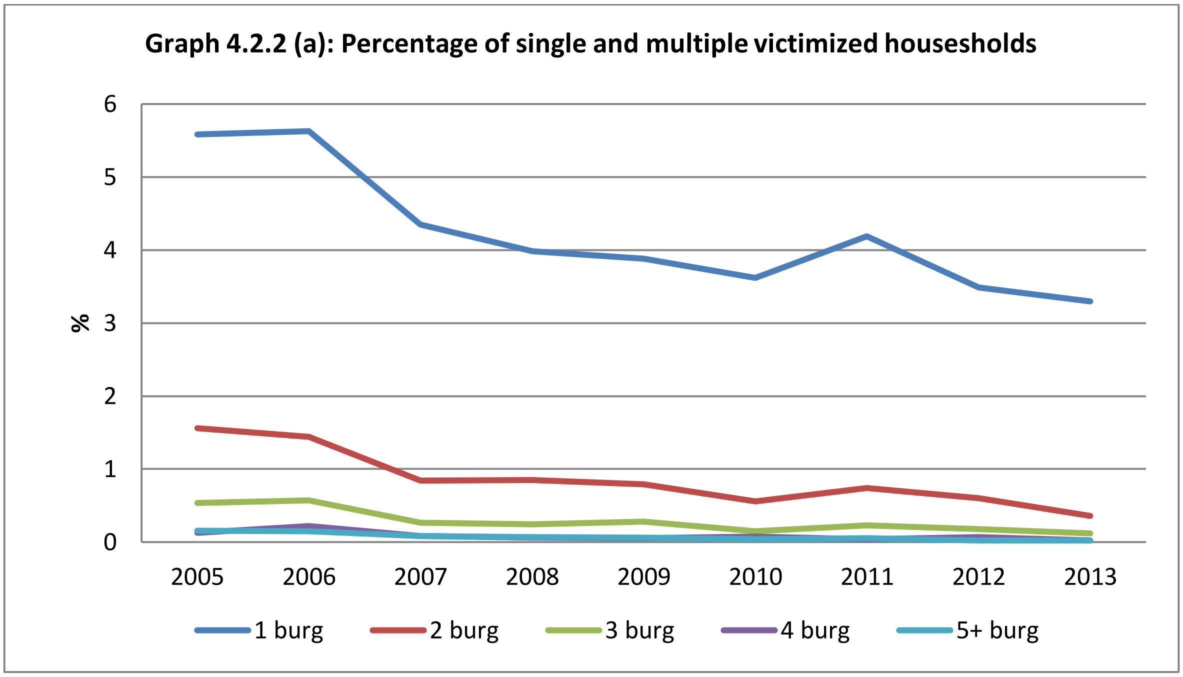


Graphs 4.2.2 (a) and (b) depict the percentage of households that reported having been burglarised one, two, three, four or five or more times over the previous year. The majority of victimised households suffered one burglary in the previous year. In 2005, eight out of 100 households were victims of burglary, of which 5.6 were burglarised once, and 2.4 households were victimised two or more times. Thus, 30% of victimised households suffered two or more burglaries. In 2013, the number of victimised households decreased to

3.8 per 100 households, of which 3.3 were households victimised once in the previous year, and 0.5 households were victimised two or more times. Thus, the proportion of victimised households that suffered two of more burglaries in 2013 was 13%.

Graph 4.2.2 (b) demonstrates that the proportion of households repeatedly victimised decreased faster than the proportion of households victimised once. While the latter fell 40% between 2005 and 2013, the proportion of households victimised two times fell 77%, the proportion of those victimised three times fell 78%, the proportion of those victimised four times fell 82% and the proportion of households victimised five or more times fell 85%. These figures suggest that the decrease in burglary rates over the studied period was especially important among the most vulnerable households.

Overall, the prevalence of burglaries fell 4.2 percentage points, from 8% in 2005 to 3.8% in 2013. This decrease was composed of a 2.3 percentage-point decrease in the percentage of households burglarised once and a 1.9 percentage-point decrease in the percentage of households burglarised twice or more. Thus, unlike its role in the decrease in incidence rates, the decrease in repeat victimisation explains less than half of the decrease in burglary prevalence rates between 2005 and 2013.


Graph 4.2.2 (a): Percentage of single and multiple victimized households
%
0
1
2
3
4
5
6
2005
2006
2007
2008
2009
2010
2011
2012
2013
1 burg
2 burg
3 burg
4 burg
5+ burg

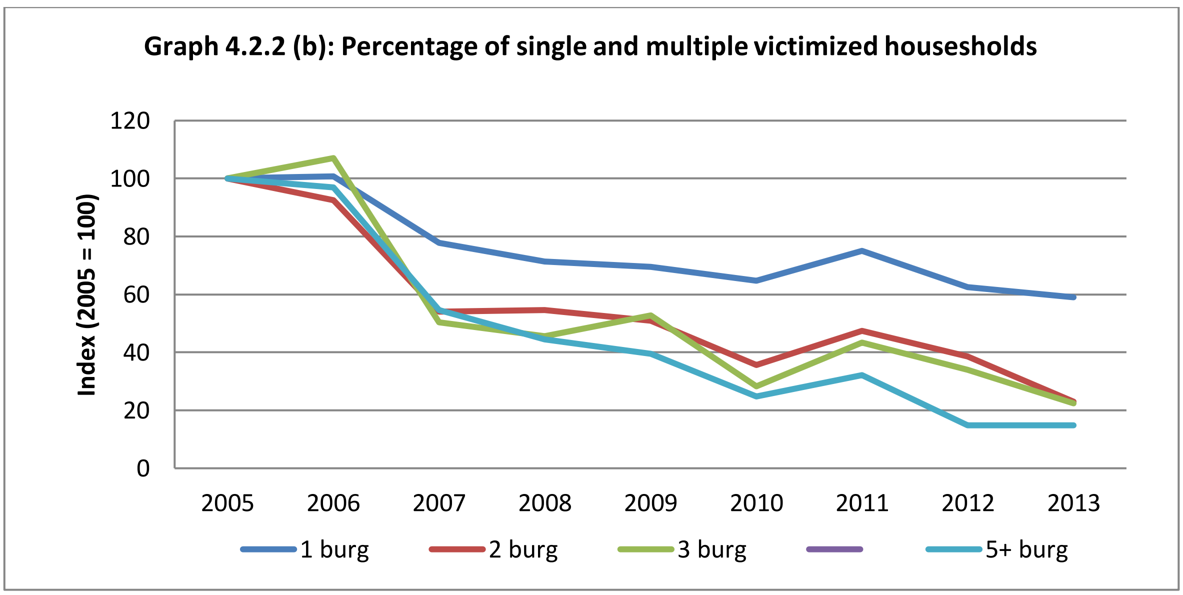

Graph 4.2.2 (b): Percentage of single and multiple victimized households
Index (2005 = 100)
0
20
40
60
80
100
120
2005
2006
2007
2008
2009
2010
2011
2012
2013
1 burg
2 burg
3 burg
5+ burg

Table 4.2: Observed Frequency distribution for Burglary				ENUSC 2005-2013					
n° incidents	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
0	18289	18842	21047	24580	24614	24780	24569	24801	24942
1	1110	1153	970	1033	1007	939	1086	905	855
2	310	296	188	221	206	144	192	156	93
3	106	117	60	63	73	39	60	47	31
4	25	45	18	15	14	19	10	18	6
5	17	16	13	11	8	6	10	5	1
6	7	7	4	4	4	1	1	0	2
7	4	3	1	3	1	0	0	0	2
8	1	1	1	0	1	1	1	0	0
9	0	1	0	0	0	0	0	0	0
10	2	3	0	0	2	2	1	1	1
Total sample	19871	20484	22302	25930	25930	25931	25930	25933	25933
Total n° incident	2331	2466	1702	1824	1793	1484	1764	1465	1199
Total n° vict.	1582	1642	1255	1350	1316	1151	1361	1132	991
Mean n° per 100 hhs	11.73066	12.03866	7.631603	7.034323	6.914771	5.72288	6.802931	5.649173	4.623453
Risk per 100 hhs	7.961351	8.016012	5.627298	5.206325	5.075202	4.438703	5.248747	4.365095	3.821386
Concentr.	1.473451	1.501827	1.356175	1.351111	1.362462	1.289314	1.296106	1.29417	1.209889

4.3 Statistical significance of burglary trends

The analyses in this section focus on establishing whether the observed temporal changes in burglary rates are statistically significant or whether they are the result of aggregating subnational-level data. To examine the statistical trends in burglary rates and determine whether the average decrease in national burglary prevalence could be hiding regional differences in burglary trends, the present analysis uses trend estimates derived from multilevel statistical modeling. As stated by Tseloni et al. (2010), this methodological approach produces more reliable trends than descriptive analysis.

Three main issues are addressed in this analysis. Firstly, the analysis aims to identify the main national burglary trends by drawing on region-level data. Secondly, the analysis seeks to identify the extent of region-level variation from those trends. The analysis then explores whether any significant changes in burglary rates are mostly explained by changes in the number of victims or in repeat victimization of the same victims.

Following the model used by Tseloni et al. (2010) to explore the international crime drop, this study uses multilevel modelling to identify Chilean burglary trends. The multilevel modelling methodology was detailed in Chapter 3. Given that region-level burglary estimates for regions other than metropolitan regions have a considerable margin of error, multilevel modelling is an appropriate methodological approach, as it “disentangles the systematic changes over time, namely the trends, of burglary rates from the more erratic changes” (Tseloni et al., 2010).

As explained in Chapter 3, the annual regional burglary rates can be considered repeated observations within each administrative unit. In other words, the ENUSC data provide a two-level structure, where each measure can be though as level one –measurement occasion level-, and region as level two – subject or individual level. The observations within each region are expected to be correlated over time.

By distinguishing level-one variance from level-two variance, multilevel modelling allows for estimation of the statistical significance of the crime rate trends over the period 2005-2013. Unexplained variance terms at two levels capture the erratic changes due to sampling or measurement error, while a time variable coefficient captures the systematic trend of burglary rates – the mean rate of change in the repeated measures across all respondents in the sample. Because *the time variable* is a level-one variable, its inclusion in the model should reduce the unexplained variance at level one, σ^2_e. The statistical significance of the estimated trend indicates whether the trend is plausible or largely an artefact of the available data.

The following sub-sections in this chapter present analyses of the incidence, prevalence and concentration rate trends for burglary. Each measure of burglary rate is analysed using two models: a null model in which only the intercept is considered and a model that includes a time variable. These models are compared in order to test whether inclusion of the time variable reduces the unexplained variance at level one. This analysis also allows for testing the statistical significance of the observed downward trend and determining how much of the variance in burglary rates is explained by the national downward trend, particularly regarding level-one variance.

The estimated trend in burglary rates derived from the statistical modelling is subsequently presented. The estimated national trend and estimated mean burglary reduction is compared with the observed mean from the ENUSC "raw" data. Finally, a random slope multilevel model is estimated in order to illustrate the regional-level differences around the main national burglary trend.

4.3.1 Trends in incidence rates of burglary.

In order to estimate the trend in incidence rate, two multilevel models were estimated, as summarized in Table 4.3.1. The null model, without explanatory variables, allows for examining the variance of burglary incident rates across administrative regions. The null model was formally defined as follows:

$$y_{it} = \beta_0 + u_i + e_{it}$$

where y_{it} is the incident rate for the t^{th} observation/occasion on the i^{th} individual (administrative region).

In this simple model:

- β_0 is the overall mean incidence rate (across all regions);
- $\beta_0 + u_i$ is the mean incidence rate for region i;
- u_i is the difference between region i´s mean incidence rate and the overall mean and
- e_{it} is the difference between the regional incidence rate for the t^{th} occasion and that region's group mean, $e_{it} = y_{it} - (\beta_0 + u_i)$.

By separating the error term into two components, the null model allows for estimating how much of the variance in incidence rate is due to between-region variance and how much is due to variance within regions.

The second model described in Table 4.3.1 includes a level-one *time* variable, used to measure the trend in burglary incidence over the observed period. The model is expressed as follows:

$$y_{it} = \beta_0 + \beta_1 t_{it} + u_i + e_{it}$$

To facilitate interpretation of the model, the first value for t was defined as zero (year 2005). Thus, the intercept or constant of the model (β_0) can be interpreted as the mean incidence rate at the first measure (2005). In turn, the slope coefficient can be interpreted as the mean rate of change in the repeated measures across all regions in the sample.

Table 4.3.1 details the estimation for these two models. The model parameters are listed in the first column. Both models include a constant term, but *the trend model also* includes explanatory *time variables,* where *time* is the estimation of the linear trend, and squared time *(time2*) and cubed time (*time3*) are estimations of the non-linear components of the trend. The estimations for each parameter are provided in the column under the heading "β". The statistical significance of each estimated parameter is indicated in the *p-value* column. The standard errors of the estimations are also listed. Random parameters of models, (i.e., the unexplained within and between variance) are also estimated and provided in the bottom lines of each model.

The overall extent to which the trend model predicts the individual regional incidence rate of burglary is estimated by comparing the unexplained variance from the trend model with that from the null model. In the *null model,* the unexplained variance is estimated at 12.9 (3.7 + 9.2), while in the *trend model,* it is 8.8. That is, the incorporation of trend variables reduces by 31.7% the unexplained variance in incidence rates. The remaining unexplained variance reflects individual regional variations from the mean national rate that are not explained by the trend.

Table 4.3.1: Incidence`s null and trend model

		Incidence null model			Incidence trend model		
		β	std. error	p-value	β	std. error	p-value
regressors	intercept	7.51	0.6	0.000	12.05	0.79	0.000
	time				-3.22	0.64	0.000
	time2				0.68	0.19	0.000
	time3				-0.05	0.02	0.002
unexplained variance		estimate	std. error		estimate	std. error	
	between	3.7	1.86		4.22	1.85	
	within	9.2	1.28		4.58	0.64	
	log likelihood			-305.76			-269.58

The null model presents the regional dispersion of incidence rates from the mean incidence rate. The constant term (β_0) represents the estimated mean incidence rate over the study period: 7.51 burglary incidents per 100 households. The total variance of regional rates from the average rate is estimated at 12.89, which is decomposed into between-region variance (3.70), and within-region variance (9.19). This balance of within and between variance indicates that most of the variance around the national mean incidence rate is due to variations between measurement occasions rather than between regions.

When a trend variable is incorporated into the model, the constant term must be interpreted as the regional average incidence rate at the first occasion (12.05 incidents per 100 households). The linear trend is estimated by *time*, which in conjunction with *time2* and *time3*, represents the non-linear trend. As expected, the linear trend parameter has a negative sign. On average, the burglary incidence rate decreased by 3.22 burglaries each year. All trend parameters are statistically significant, which confirms the observed downward trend in burglary incidence and dismisses the possibility that the observed trend is an artefact of averaging available data.

Analysing random parameters allows for exploring the nature of unexplained variations. The between variance σ^2_u is the aggregate measure of the extent to which the burglary incidence rate of individual regions varies around the cross-regional incidence rates. The within variance σ^2_e is the aggregate measure of the extent to which the burglary incidence rate of individual regions varies from their respective means over time. Table 4.3.1 clearly demonstrates that including a trend variable reduces the unexplained variance within regions and thereby the total unexplained variance. From an initial 82% of total unexplained variance due to within-region variation, the inclusion of a level-one trend variable reduces the relative importance of unexplained variance to 54% of the total unexplained variance. Thus, after controlling for the cross-regional downward trend, the regional variation from the mean national incidence rates is similar between regions and within regions.[12]

4.3.1.a Variation of incidence trend across regions

To test whether the trend in burglary incidence varied across regions, a random slope model was fitted (see Chapter 3). This model allows the “trend” effect to vary across regions and thus provides an estimation of individual regional variations over the national/cross-regional averaged trend. Table 4.3.1.1 lists the results from fitting a random slope model, allowing the “trend” to vary across regions.

The first step in this analysis was to test whether the effect of the trend actually varied across regions. To do so, a likelihood ratio test was used. This test compared the random slope model to the random intercept model previously estimated. The likelihood ratio was calculated as follows:

$$LR= 2\ (-261.30 - -269.58) = 16.56 \text{ on } 2 \text{ d.f.}$$

The test statistic was compared with a chi-squared distribution with two degrees of freedom (because there are two new parameters). The 1% point of

[12] Magnitude of σ^2_e is further reduced when the effect of time variable is allowed to vary across region in a random slope model.

a chi-squared distribution with two degrees of freedom is 9.21. Therefore, the effect of the trend did indeed vary across regions.

Table 4.3.1.1: Random efects of time accross regions

	β	Std. Err	P-value
intercept	12.05	1.05	0.000
time	-3.22	0.59	0.000
time2	0.68	0.17	0.000
time3	-0.05	0.01	0.001
Unexplained Variance		**Estimate**	**Std. Err.**
Between	var(time)	0.1	0.07
	var(cons.)	11.12	4.93
	cov(time,cons.)	-1.06	0.54
Within		3.82	0.57
log likelihood:			-261.3

As provided in Table 4.3.1.1, the fixed effect of the trend variable is similar to the fixed effects in Table 4.3.1. However, in the random slope model, the effect of trends involves both fixed and random effects; thus, the effect of trends on the estimated incidence rate in region *j* is estimated as - 3.215 + $\hat{u}_{time.ij}$. Regions with an above-average negative relationship between *"time*" and estimated incidence rates therefore exhibit $\hat{u}_{time.i} < 0$, while regions with a below-average negative relationship between "*time"* and estimated incidence rates exhibit $\hat{u}_{time.i} > 0$.

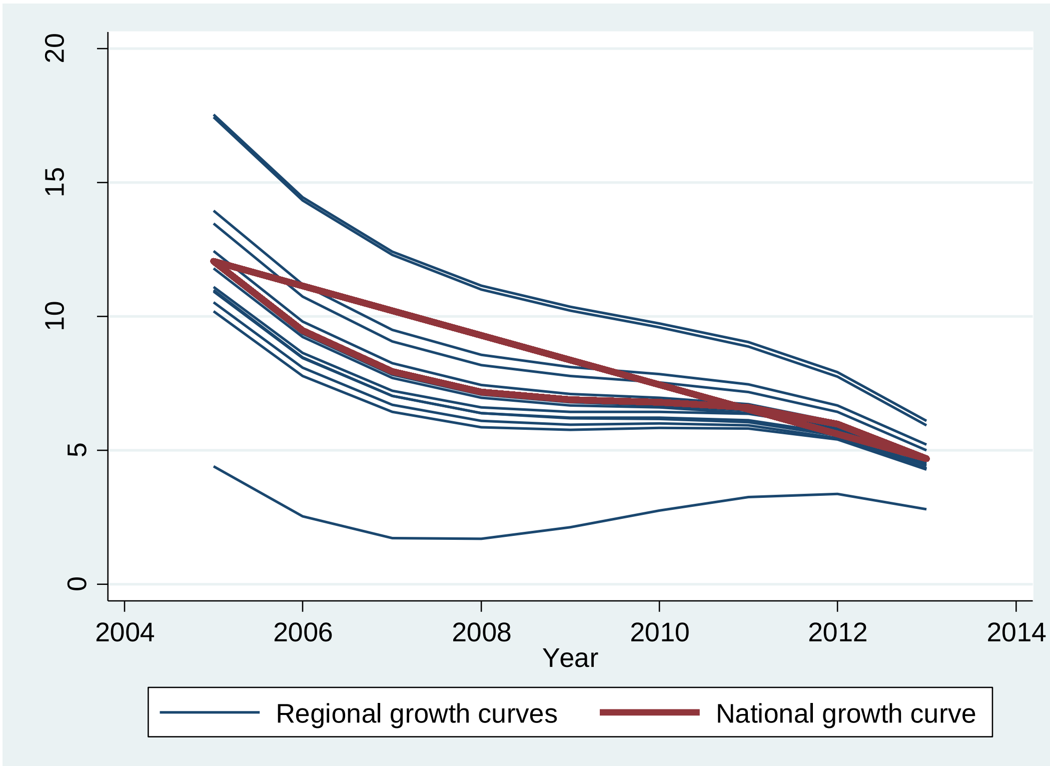
The between-region variance in the effect of "*time*" is estimated as 0.10. The intercept variance $\sigma^2 u_0$ = 11.12 is interpreted as the between-region variance in the estimated incidence rate of burglary at the first wave.

The negative intercept-slope covariance estimate (= -1.06), together with the negative estimate for β_{time}, implies that regions with an above-average incidence rate (higher than the average incidence rate, $u_{oj} > 0$) tend to also have a steep slope (stronger negative relationship between incidence rates and time variable, $u_{time.i} < 0$). In contrast, in regions with lower incidence rates, the negative effect of time is weaker. In other words, during the observed period, the downward trend is steeper in regions with initial higher incidence rates than in regions with lower incidence rates.

The individual regional trends derived from the statistical model are depicted in Graph 4.3.1.1. The graph illustrates the region prediction lines for the relationship between the regional incidence rate of burglary (y-axis) and the time variable (x-axis; “0”=2005; “1” = 2006…; “8”=2013). The graph clearly demonstrates that the burglary incidence rate dropped in every region, but one. The only region that presented a positive trend is Magallanes, the sparsely populated southernmost region of Chile, which also presented unusually low incidence rates. The graph also presents the national cross-regional linear and non-linear trend in burglary incidence, represented by the red curves.

As expected, the negative intercept-slope covariance, in conjunction with the negative fixed effect of time, lead to a “fanning in” pattern in prediction lines. This “fanning in” pattern clearly demonstrates that the negative effect of time was larger in regions with higher incidence rates, while in regions with lower incidence rates, the decline in burglary rates was smoother. The pattern also indicates that the between-region variance in the burglary incidence rate decreased throughout the studied period. Thus, this pattern may reflect an association between regional variations in burglary incidence trends and a “regression to the mean” effect.

Graph 4.3.1.1: Predicted regional trends in burglary incidence



4.3.2 Trends in prevalence rates

As in the previous section, the regional burglary prevalence rates, or burglary victimisation risk, are also analysed by estimating null, random intercept and random slope multilevel models.

The null model is formally defined as:

$y_{it} = \beta_0 + u_i + e_{it}$

where y_{it} is the prevalence rate for the t^{th} observation/occasion on the i^{th} region and

- β_0 is the overall mean prevalence rate (across all regions);
- $\beta_0 + u_i$ is the mean prevalence rate for region i;
- u_i is the difference between region i´s mean prevalence rate and the overall mean; and
- e_{it} is the difference between the regional prevalence rate for the t^{th} occasion and that region's mean over time, $e_{it} = y_{it} - (\beta_0 + u_i)$

By separating the error term into two components, the null model enables estimation of how much of the variance in the prevalence rate is due to between-region variance and how much is due to variance between measurement occasions (within region).

The prevalence trend model also includes a level-one time variable, and time^2 and time^3 variables in order to measure the linear and non-linear trends in burglary prevalence:

$y_{it} = \beta_0 + \beta_1 t_{it} + u_i + e_{it}$

To facilitate interpretation, the first value for t was defined as zero. Thus, the intercept or constant of model (β_0) can be interpreted as the mean prevalence rate in the first wave (2005). In turn, the slope coefficient can be interpreted as the mean rate of change in the repeated measurement occasions across all regions in the sample.

Table 4.3.2 describes the estimation for the two models. The model parameters are listed in the first column of each model. Both models include a constant term, but only the trend model also includes an explanatory *time* variable. The second column in each model provides the estimation for each parameter. The statistical significance of each estimated parameter is indicated in the fifth column. The random parameters of the models (i.e., the within variance and between variance) are also estimated.

Table 4.3.2: Estimations of Prevalence

	Prevalence null model			*Prevalence trend model*		
	β	**Std. Err**	**P-value**	**β**	**Std. Err**	**P-value**
intercept	5.48	0.39	0.000	8.17	0.5	0.000
time				-2.02	0.38	0.000
time2				0.44	0.11	0.000
time3				-0.03	0.01	0.001
Unexplained Variance		**Estimate**	**Std. Err.**		**Estimate**	**Std. Err.**
Between		1.64	0.68		1.81	0.78
Within		3.17	0.44		1.65	0.23
log likelihood:			-244.69			-210.67

The null model demonstrates the regional dispersion of prevalence rates from the mean incidence rate. The constant term (β_0) represents the estimated mean prevalence rate over the period: 5.48% of households were victimised. The total variance in regional rates from the average rate is estimated at 4.81, which is decomposed into between-region variance (1.64) and within-region variance (3.17). Similar to the incidence rates, the null model of burglary prevalence indicates that most of the variance around the cross-regional mean of prevalence is due to dispersion between measurement occasions rather than between regions.

When a trend variable is incorporated into the model, the constant term must be interpreted as the cross-region average prevalence rate at the first ocassion (8.17%). The linear trend is estimated by *time*, which in conjunction with *timesq* and *time3* represents the non-linear trend. As expected, the linear trend parameter has a negative sign. On average, the burglary prevalence rate decreased by 2.0 percentage points each year. Both parameters are statistically significant, which confirms the observed downward trend in burglary incidence and dismisses the possibility that the observed trend is an artefact of averaging available data.

The overall extent to which the trend predicts individual regional incidence rate of burglary is denoted by the percentage of explained variance (1- 3.46/4.80 = 0.28 or 28%). The remaining unexplained variance reflects individual regional variations from the mean national rate which are not explained by the trend.

Table 4.3.2 clearly demonstrates that including a trend variable reduces the unexplained variance within regions and thereby the total unexplained variance. From an initial 66% of total unexplained variance due to within-region variation, the inclusion of a level-one trend variable reduces the relative importance of unexplained within-variance to 48% of total unexplained variance.

4.3.2.a Variation in the prevalence trend across regions

Table 4.3.2.1 presents the results from fitting a random slope model, allowing the "trend" of prevalence to vary across regions. To test whether the effect of the trend varies across regions, a likelihood ratio test is used. This test compares the random slope model to the random intercept model previously estimated. The likelihood ratio is calculated as follows:

$$LR= 2(-207.02 – 210.67) = 7.2 \text{ on 2 d.f.}$$

The test statistic is compared with a chi-squared distribution with two d.f. The 5% point of a chi-squared distribution with 2 d.f. is 5.99. Therefore, the effect of the trend did indeed vary across regions.

Table 4.3.2.1: Random efects of time accross regions

	β	Std. Err	P-value
intercept	8.17	0.61	0.000
time	-2.02	0.36	0.000
time2	0.44	0.11	0.000
time3	-0.03	0.01	0.000

Unexplained Variance		**Estimate**	**Std. Err.**
Between	var(time)	0.02	0.02
	var(cons.)	3.51	1.6
	cov(time,cons.)	-0.26	0.16
Within		1.47	0.22
log likelihood:			-207.02

As provided in Table 4.3.2.1, the fixed effect of the trend variable is similar to the fixed effect in Table 4.3.2. However, in the random slope model, the effect of trends involves both fixed and random effects; thus, the effect of trends on the estimated prevalence rate in region *i* is estimated as – 2.01 + $u_{time.oi}$. Regions with an above-average negative relationship between *"time"* and estimated incidence rate therefore exhibit $\hat{u}_{time.i} < 0$, while regions with a below-average negative relationship between "*time"* and estimated incidence rates exhibit $\hat{u}_{time.i} > 0$.

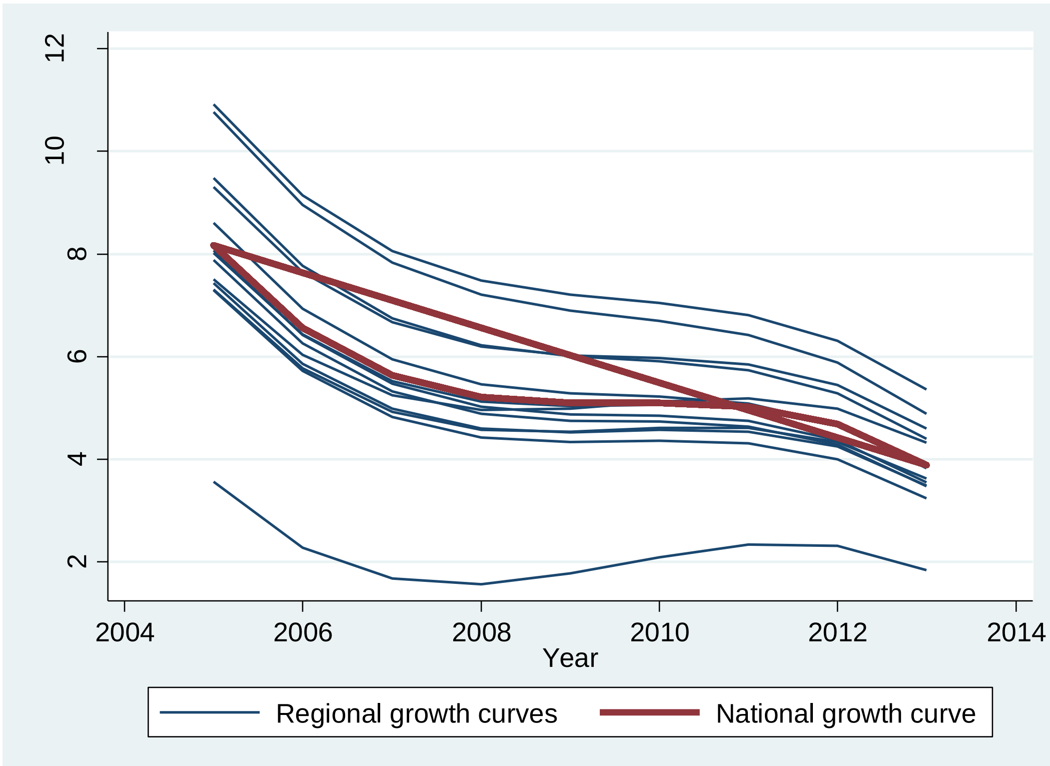
The between-region variance in the effect of "*time*" is estimated as 0.02. The intercept variance $\sigma^2 u_0$ = 3.51 is interpreted as the between-region variance in the estimated prevalence rate of burglary at the first occasion (year 2005).

The negative intercept-slope covariance estimate (-0.26), together with the negative estimate for β_{time}, implies that regions with an above-average prevalence rate ($u_{oi} > 0$) tend to also have a steep slope (stronger negative relationship between prevalence rates and time variable, $u_{time.i} < 0$). In contrast, in regions with lower prevalence rates, the negative effect of time is weaker. In other words, during the observed period, the downward trend in prevalence rates is steeper in regions with initially higher prevalence rates than in regions with lower prevalence rates.

The individual regional trends in prevalence derived from the statistical model are illustrated in Graph 4.3.2.1. The graph depicts the region prediction lines for the relationship between the regional prevalence rate of burglary (y-axis) and the time variable. The graph clearly demonstrates that the burglary prevalence rate dropped in every region, even though some regions exhibited a pattern of growth. The graph also presents the national cross-regional linear and non-linear trends in burglary incidence, represented by the red curves.

Similar to the case of the incidence rate, the negative intercept-slope covariance, in conjunction with the negative fixed effect of time, lead to a “fanning in” pattern in the prevalence prediction lines. However, compared to the incidence pattern, the reduction in between-region variance is lower, which may indicate that the intensity of the regression-to-the-mean effect is also weaker.

Graph 4.3.2.1: Predicted regional trends in burglary prevalence



4.3.3 Trends in burglary concentration rates

The analysis of burglary concentration rates examined the role of repeat victimisation in the burglary trends over the observed period. Table 4.2 demonstrates that the burglary concentration rate decreased by 55%, from 1.47 to 1.21, between 2005 and 2013. However, between 2007 and 2012, the concentration rate decreased by only 17%. To examine whether the decrease in concentration rate is statistically significant across Chilean regions, the same procedures used to examine the other crime rates were employed. A null model, a random intercept model, and random slope models were estimated.

Table 4.3.3 presents the results from the null model on concentration and the model including the trend variables. The explained variance of the trend model is 23%, which, as expected, is mainly due to a reduction in unexplained variance between measurement rounds. This reduction in unexplained within variance, however, is less than the same measure for the incidence and prevalence rates, and the proportion of unexplained within variance barely changed from 85% to 80%. Furthermore, the estimated coefficients of the trend variables have the expected signs, but are not statistically significant.

Table 4.3.3: Concentration null and trend models

		Concentration null model			***Concentration trend model***		
		β	**Std. Err.**	**p-value**	**β**	**Std. Err.**	**p-value**
Regressors	**Intercept**	1.34	0.02	0.00	1.44	0.038	0.00
	Time				-0.061	0.038	0.11
	Time2				0.02	0.01	0.16
	Time3				-0.002	0.001	0.10
Unexplained variance		**Estimate**	**Std. Err.**		**Estimate**	**Std. Err.**	
	Between	0.004	0.002		0.004	0.002	
	Within	0.022	0.003		0.016	0.002	
	Log likelihood	51.08			66.06		

The statistical significance of the trend coefficients improves when the effect of time is allowed to vary across regions. Table 4.3.3.1 presents the results from the random slope model. The estimated coefficient of time has the expected negative sign and is statistically significant at the 10% level. Thus, the results on the (downward) trend effect of concentration rates must be interpreted cautiously because they are statiscally significant only when trend effect is allowed to vary across regions (which may indicate regions where the trend is upward) and because the probability of finding those estimations even if there actually is no effect of the trend variable on concentration rates is not sufficiently low.

Table 4.3.3.1: Random effects of time on concentration

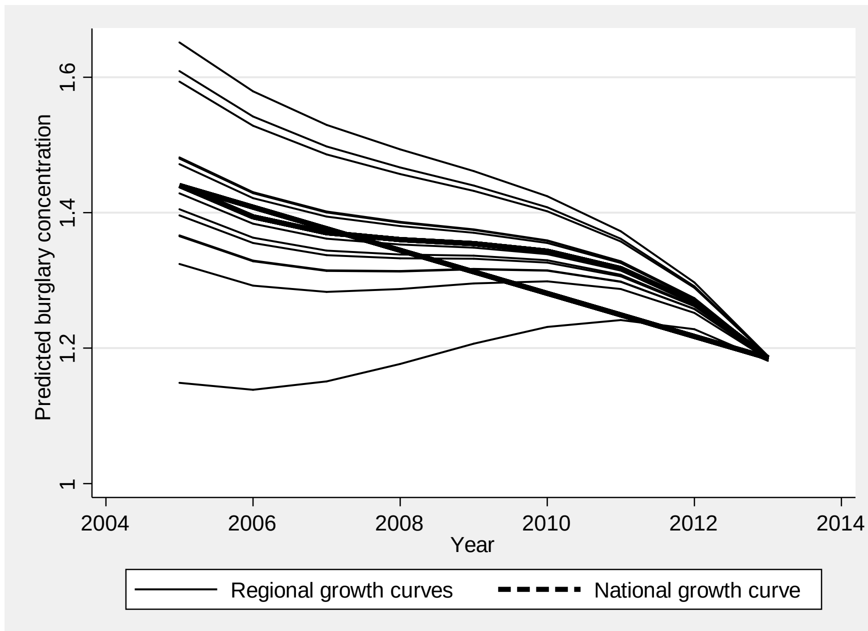
	β	*Std. Err.*	*p-value*
Intercept	1.44	0.05	0.00
Time	-0.06	0.035	0.08
Time2	0.016	0.01	0.13
Time3	-0.002	0.0008	0.07
Random-effect parameter			
	estimate	*std. err.*	
Var(time)	0.0003	0.0001	
Var (_cons)	0.02	0.009	
Cov(time, cons)	-0.002	0.001	
Var. within	0.014	0.002	
Log likelihood	72.99		

Similar to the case of the incidence and prevalence models, the negative intercept-slope covariance estimate (-0.002), together with the negative estimate for β_{time}, implies that the downward trend in concentration rates was steeper in regions with initially higher concentration rates than in regions with lower concentration rates.

Graph 4.3.3 illustrates the individual regional trends derived from the statistical model. The graph clearly demonstrates that the burglary concentration rate dropped in most regions. The *Magallanes* region again exhibited a unique upward trend in concentration rates, which may be related to its very low overall rates of burgary.

Graph 4.3.3 also demonstrates that the negative effect of time was larger in regions with higher concentration rates, while in regions with lower concentration rates, the decline was smoother, as anticipated by the negative intercept-slope covariance. In addition, the between-region variance in concentration rate decreased throughout the studied period. This fanning-in pattern may reflect an association between regional variation in burglary concentration trends and a “regression to the mean” effect.

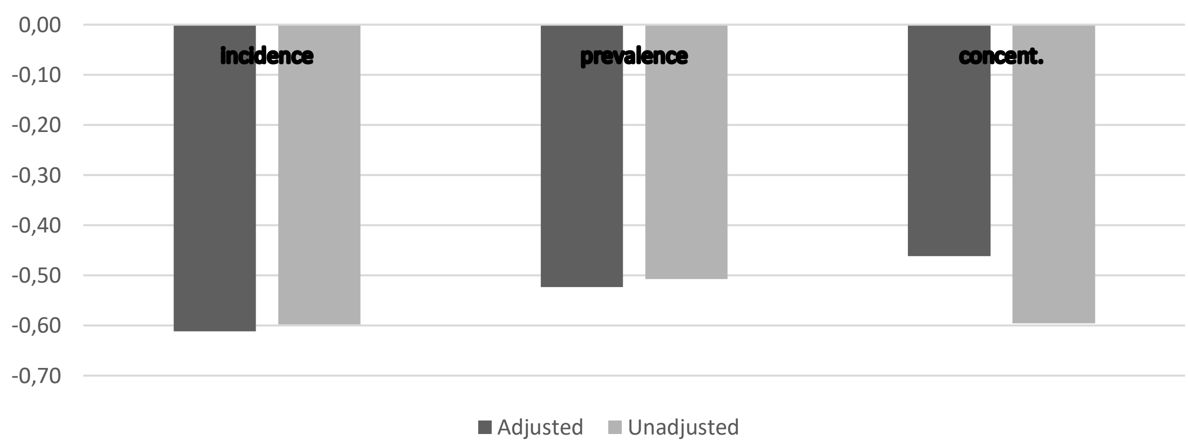
Graph 4.3.3: Predicted regional trends in burglary concentration



4.4 The main national trends in burglary rates

The first finding in this research is the statistical validation of the observed downward trend in the Chilean burglary rate. Despite some regional variations in the slope of the trend, it is appropriate to claim a "national" (or cross-regional) downward trend. Figure 4.4 depicts the variation in burglary rates between 2005 and 2013 and compares the predicted means (based on the statistical modelling) with the observed national mean from the ENUSC "raw" data listed in Table 4.2.

Figure 4.4: Cross-regional Burglary Decrease 2005-2013 (unadjusted and adjusted)



The adjusted data confirms the observed downward trend in the three measures of burglary rate. The incidence and prevalence rates were predicted to decrease by 60% and 50%, respectively, which is quite similar to the figures from the "raw" data. The concentration rates also decreased, but this downward trend was statically significant only after its effect was allowed to vary across regions; the estimated decrease was lower than the decrease estimated from the raw data, at 45% and 60%, respectively.

The magnitude of the fall in burglary rates is similar to that reported (58%) in England and Wales between 1995 and 2008/09 (Tilley et al., 2011) and larger than that estimated by Tseloni et al. (2010) for Europe and North America (a decrease of 26%).[13] National data from industrialised countries also confirm that the decrease in the burglary rate in Chile between 2005 and 2013 is relatively large compared to the decrease experienced by developed countries during the “crime drop”. Given the magnitude of the fall in burglary rates in Chile, research on this topic and on the observed reduction in other offences as well can importantly contribute to understanding the international crime drop, as the existing research has primarily focussed on Europe and North America.

The statistical modelling of burglary rates found that the national or cross-regional downward trend predicted around 30% of the variation in individual regional burglary rates over the studied period. That is, the national (or cross-regional) trend captured around 30% of over-time and between-region differences in burglary rates. Thus, despite regional differences, it is appropriate to claim a significant downward trend in Chilean burglary rates at the national level.

The remaining unexplained variance in the regional burglary rates entails two components: the between-region variance, which measures the extent to which the burglary rates of individual regions varied around the cross-regional rate, and the within-region variance, which measures the extent to which the burglary rates of individual regions varied around the trend over time. The estimated values of these two statistics, reported in Section 4.3, suggest that, despite the common trend, the regional burglary incidence and prevalence rates varied more between regions than over time.

The regional analysis of burglary rates demonstrated that, over time, the decrease in burglary rates was more pronounced in regions with initially higher rates, presenting a “fanning in” pattern in the regional negative slopes of

[13] Even though they recognize that the fall was even larger in the devoloping countries that participated in the International Crime Victimisation Survey

burglary. Therefore, it is possible that alongside the national downward trend, the regional trend was also driven by a “regression to the mean” effect.

Between 2005 and 2013, the incidence rates of burglary decreased faster than the prevalence rates. That is, for the most part, the decrease in burglary rates was composed of a reduction in both households targeted and the victimization frequency. Along with a reduction in prevalence rates by 50%, the average number of burglaries per victimized household also decreased by 45% between 2005 and 2013.

The significant reduction in concentration rate is another important finding of this research, as it contradicts previous studies that have questioned the role of repeat victimization in the decrease in burglary rates. In the case of England and Wales, Thorpe (2007) concluded that trends in burglary concentration rates “had no clear relationship to overall levels of burglary”. Tseloni et al. (2010) similarly found that while the concentration rates for theft from cars and theft from persons decreased significantly across the ICVS sample, the burglary concentration rate did not fall internationally during their period of study (1995-2004).

Reduction in both the prevalence and concentration rates implies that the decrease in burglary rates between 2005 and 2013 was driven by a reduction in general risk, but especially by a decrease in the vulnerability of those more vulnerable (i.e., those expected to suffer the highest number of burglaries, whose risk of being a repeat victim and risk of being victim at all decreased).

4.7 Summary and conclusions

The main aim of this study was to examine temporal changes in burglary rates in order to establish whether there was a decline in Chilean burglary rates similar to that observed in industrialized countries. To this end, this chapter examined national and cross-regional trends in the incidence, prevalence and concentration rates of burglary in Chile between 2005 and 2013.

The results provided in this chapter confirm that there was a statistically significant downward trend in Chilean burglary rates between 2005 and 2013. This study also reveals the national (or cross-regional) nature of the downward trend, allowing for region- specific singularities. The burglary incidence rates in Chile decreased by about 60%, and the prevalence rates decreased by about 50%. Furthermore, the magnitude of the decline in burglary was similar to that observed in countries that are often analyzed in the crime drop literature.

Through analyzing the case of Chilean burglary rates, this study provides evidence about the international character of the crime drop. The crime drop has been called “the most important criminological phenomenon of modern times” (Farrel et. al, 2014). Research on why crime fell, and when and where it did, is important in order to yield lessons on how best to sustain the observed reductions and replicate them elsewhere. However, research on the extent, nature and causes of the crime drop has largely been limited to North America, Australia and Western Europe, while little is known about whether the same type and levels of crime reduction have been observed in developing countries. This research therefore contributes to bridging this gap in knowledge by documenting the decrease in Chilean burglary victimization rates.

The composition of the drop in Chilean burglary rates indicates several differences from the findings in other countries, which should be taken into account in explanations about the international crime drop. The importance of the decrease in repeat victimization in explaining the Chilean drop in burglary is an important finding of this research, which differs from the role that repeat victimization has played in the burglary drop in countries such as England and

Wales (Thorpe, 2007). In Chile, around 70% of the reduction in the burglary incidence rate was due to reduction in repeat incidents, which means that any hypothesis about the burglary decline in Chile should take into consideration that the reduction was particularly significant for the most vulnerable households.

Chapter 5: Are security devices effective for preventing burglary in Chile?

According to the *security hypothesis* (outlined in Chapter 2), the crime drop observed in several Western countries may be (partially) due to the increasing prevalence and quality of security protections. This hypothesis may be feasible to explain the burglary trends in Chile if the prevalence of household protection increased along with the decrease in burglary rates.

This chapter aims to establish if household protection actually reduced the burglary victimisation of Chilean households (at the individual level). This analysis is the first step toward testing the causal relationship between the increasing prevalence of household security devices and the observed downward trend in burglary rates. If the increasing prevalence of security devices (partially) explains burglary trends at the aggregate (national) level, security devices should be effective for reducing burglary victimisation at the individual level.

Advanced statistical modelling, in the form of multilevel negative binomial regression for modelling burglary incidence (or the number of burglaries per household) and multilevel logistic regression, for modelling burglary prevalence (or the probability of being a victim of burglary), were utilised to address the following questions:

- What is the distribution of burglary rates across Chilean households and boroughs?
- Are the security protection measures taken by Chilean households (negatively) correlated to burglary victimisation?
- Do the preventive effects, if any, of security configurations vary by household socio-economic status?
- Do the preventive effects of security configurations vary across boroughs?

The following section provides an overview of the relevant literature on guardianship and burglary victimization as justification for the selection of explanatory variables in this research. The results of the statistical modelling are then presented. Firstly, this chapter presents the results from the null models of burglary rates and the analyses of burglary distribution across boroughs. The results of multilevel models of burglary incidence and burglary risk are then presented. These models include a number of covariates which, according to the relevant literature, affect burglary rates, including household-level variables and borough-level variables. The results on the effect of several specific configurations of household protection devices are subsequently analyzed, including the interactions between security devices and households characteristics, such as socio-economic status, and the interactions between security devices and borough-level characteristics. Finally, this chapter closes with a discussion of the findings.

5.1 Previous research

In the exploration of burglary risk, a solid body of research has established that there are a number of individual and area characteristics associated with burglary victimization. In particular, age, marital status, household composition, household socio-economic status and income, dwelling occupancy, frequency of activities out of home and measures of area characteristics such as poverty or population are significantly correlated to burglary victimization.

According to the opportunity theory framework, these characteristics are associated with four factors explaining burglary risk: target exposure, absence of capable guardianship, attractiveness and proximity to potential offenders (Tseloni et al., 2004). Demographic variables have often been used as proxy measures, as demographic variables may be "… associated with differences in expectation, constraints, opportunities, and preferences which influence the type of activities in which people engage" (Cohen and Cantor, 1981). Variables such as poverty at both the individual and area level may be considered as proxies of proximity to potential offenders and are thereby associated with higher burglary risk. In the same line, the fact that flats are consistently less burglarized than houses is explained by target exposure.

Despite the significant contributions of previous studies to understanding the preventive mechanisms activated by household security devices, most studies have assumed that the preventive effects of household security devices are similar across different contexts (Wilcox et al., 2007). The evidence from those studies has been built from multivariate analyses, mainly regression models, which estimate the preventive effect of security devices while controlling for other individual household features. This technique, although appropriate for controlling for covariates, estimates the "average" value of the dependent variable when the independent variables are fixed. Thus, this technique assumes that the preventive effect of security devices is the same regardless of the contexts in which they are placed.

However, during the last several decades, many researchers have highlighted the role of context in victimization risk analysis and examined how contextual effects interact with individual household characteristics (Trickett et al., 1992; Sampson & Woolredge, 1987; Trickett et al., 1995; Ellinworth et. al., 1997; Osborn & Tseloni, 1998). A number of studies have specifically questioned the "assumption of cross-context generalizability in the effect of guardianship indicators" (Wicox et al., 2007. See also Miethe & McDowall, 1993; Outlaw, et. al., 2002; Wilcox & Land, 1996; Wilcox et. al., 1994; Tseloni, 2006). From this research, one of the main lessons is that both individual variables (such as household composition and activities) and contextual variables (such as neighbourhood characteristics) are required to explain and predict crime (Kennedy & Forde, 1990; Tseloni, 2006). Furthermore, the interaction of individual and contextual variables yields effects on victimization risk which are different from simply adding the effects of each variable at different levels.

Considering contextual variables and their interaction with individual variables is theoretically important because offenders' target-selection process is a multilevel process (Brantingham & Brantingham 1978; Brown & Altman 1981;

Cornish & Clarke 1986). The different levels in the selection process would be areas within cities, streets within areas, blocks and places within blocks. Thus, Taylor and Gottfredson (1986) posited that “particular areas are identified as affording an abundance of targets, and particular blocks or houses within those areas are selected as targets”. This idea has been echoed by other authors (Coupe & Blake, 2006; Grof & La Vigne, 2001; Johnson et al., 2008; Johnson & Bowers, 2004) and supported by findings from ethnographic studies, which have found that, in situations with restricted information about the potential rewards from one specific dwelling, thieves assess area features such as target attractiveness and guardianship (Wright & Decker, 1994). In addition to considering the characteristics of the target and surrounding area, the analyses of Wim Bernasco and his colleagues on burglars’ target-selection decisions included offender characteristics, particularly address and distance to the target. The discrete choice model of offenders’ decisions on target selection developed by Bernasco and Nieuwbeerta (2005) integrated evidence regarding the importance of the target and the absence/presence of guardianship (Cohen and Felson, 1979) and evidence that crimes tend to occur close to where the offender lives (Baldwin & Bottoms, 1976; Wiles & Costello, 2000; Ratcliffe, 2003). The results from discrete choice modelling of how burglars select their targets reinforce the importance of considering the relationships between households and contextual-area characteristics.

Several studies have explicitly incorporated individual and contextual variables into empirical analyses of burglary (Miethe & McDowall, 1993; Miethe & Meier, 1994; Outlaw et, al., 2002; Wilcox &Land, 1996; Wilcox et. al., 1994; Wilcox et. al., 2007; Tseloni, 2005). The findings from these studies have found that burglary victimization risk is affected by both individual and contextual factors. In addition, previous studies that have assessed the interaction effect[14] of

---

[14] An interaction effect exists when the effect of an independent variable on a dependent variable changes, depending on the value(s) of one or more other independent variables. In this case, authors estimated the interaction effects between the independent variable ”security protection” and an independent contextual neighbourhood-level variable, to asses whether the effect of security protection changes when features of neighbourhood change,

household protection devices with area features have found that the preventive effects of security devices are lower in disadvantaged areas (Wilcox, et. al., 1994) and in areas with a smaller prevalence of household security devices (Wilcox et. al., 2007). These studies have demonstrated that the individual effects of security devices interact with the socio-economic features of the surrounding neighborhood. Wilcox, Land and Miethe (1994) further found that the preventive effect of household security protection is moderated by the socio-economic characteristics of disadvantaged areas. Although the authors did not pose hypotheses to explain why installing security devices in poor areas would be less effective for preventing burglary than in more affluent areas, it could be hypothesized that, in more disadvantaged areas, the presence of security devices may be seen as an indicator of a household's wealth and thereby the attractiveness of that particular household.

An important aspect and limitation of the existing research on guardianship is that security devices are often grouped together and analysis of a particular device is often conducted without consideration of whether other devices are also in place. As a consequence, it is difficult to precisely measure the individual effect of particular combinations of security devices (Tseloni et al., 2014).

More detailed analyses of the relative protective effect of different configurations of security devices are presented by studies that use the four analytical combinations of security devices to classify each possible configuration of household protection: *no security*, *less than basic security*, *basic security* and *enhanced security*[15] (Murphy, 2004). Such studies have found that the risk of burglary victimization is greater for households with no security compared to households with basic or enhanced security (Tilley, 2009; Flatley et al., 2010). Households with less than basic security have also been found to face a greater risk of burglary victimization than households with basic

[15] Less than basic: any device except the concurrence of those in basic; Basic: window locks and door double locks; enhanced : basic plus at least one other device

and enhanced security (Flatley et al., 2010). In these studies, the interactions between demographic and security configuration variables were significant. Tilley et al. (2011) reported that the preventive effect of enhanced security was greater in the poorest households in the Crime Survey of England and Wales (CSEW) sample (income less than £5,000) than in households in other income categories and that basic security "conferred effectively no protection for £20,000 - £29,000 income households in 1997" (Tilley et al., 2011).

Further analysis of particular configurations of security devices was provided by Tseloni et al. (2014), who analyzed a significant number of the 128 potential combinations of seven security devices reported in the CSEW. Their findings reinforce the hypothesis about the differences in the preventive effect of different configurations of household protection.

5.2 Variable selection

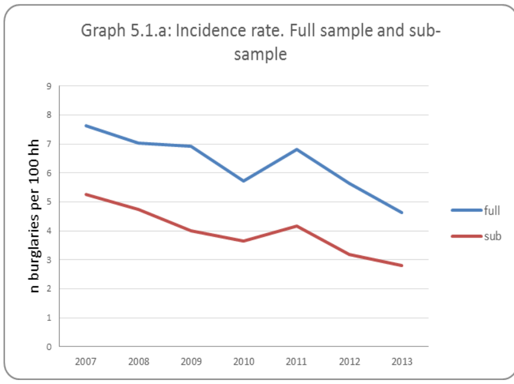
Informed by previous research, this analysis considered several demographic, routine, and area characteristic variables which were identified within the ENUSC dataset. These variables were cross-checked and recoded (where necessary) across each round of the ENUSC to ensure consistency. Variable harmonization was conducted in order to foster comparability to the greatest extent possible over the entire period of study.

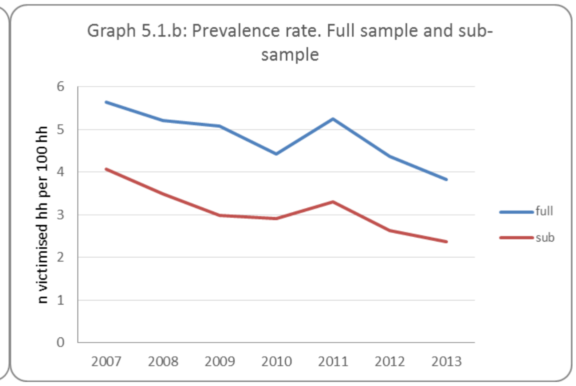
As explained in Chapter 3, one of the main methodological issues in analyzing the ENUSC data is the fact that it is not possible to identify whether a security device was fitted as a response to an instance of burglary victimization in the reference period. This double-causality aspect of security devices can lead to a biased estimation of the effect of such devices or configurations of devices (including "*any_protection*") which would likely underestimate the actual preventive effect. To overcome this difficulty, the analysis described in this chapter utilized a sub-sample of households that did not take any security measures during the reference period. Graph 5.1 in the next section depicts the victimization rates for both the full ENUSC sample and the sub-sample used in the analysis. Although the victimization rates are higher in the full ENUSC sample than in the sub-sample, the overall trends in both samples are very similar. The following section presents descriptive information about the sub-sample used in the analysis; data from the full is presented in Annexes 1.

5.2.1 Dependent variables

Burglary victimization was measured by two indicators. Firstly, burglary incidence was measured as the number of burglaries per households. Secondly, burglary prevalence, or individual risk, was measured as the proportion of victimized households in the population. Burglary incidence is generally more accurate than burglary prevalence for modelling burglary victimization, as it considers the full distribution of burglaries and not only the victim/not-victim dichotomy. As a result, incidence models can account for the fact that burglaries are not randomly distributed, but rather concentrated in certain households and areas (Tseloni, 2006). Thus, the remaining analyses presented in this thesis are guided by results from incidence models, while models of burglary risk are presented for comparative purposes.

The burglary rates were overall lower in the sub-sample of households that did not install security devices during the victimization reference year than in the full ENUSC sample. During the studied period (2007-2013), the average burglary incidence was 3.97 burglaries per 100 households (0.0397 per household) in the sub-sample, compared to 6.34 per 100 households in the full sample (see Table 4.2). The prevalence was 3.1% in the sub-sample, and 4.8% in the full sample. However, as illustrated by Graph 5.1, the differences between the sub-sample and full sample are consistent over time, and the temporal change (trends) in burglary rates is similar between the two samples.





Graph 5.1 shows that households at higher risk of (repeat) victimisation were excluded from the analysis. Therefore, the coefficients for the relationship between the independent variables included in the models and burglary rates should be interpreted cautiously, as the coefficients estimated for households at lower risk may be different in higher risk contexts.

5.2.2 Prevalence of security devices

Since 2007, the ENUSC has included questions about the prevalence of seven security devices in respondents' homes:

- Burglar **A**larm
- **C**CTV
- **G**rills on windows or doors
- **E**lectric protection on fence
- Non-electric **P**rotection on fence
- **D**oor double-lock or deadlock
- Internal or external light on a timer or **S**ensor

For economy of space the enlarged capital bold letters in the previous list will denote the respective security device in the remainder of this chapter. Availability of those security devices and its more popular combinations are presented in Table 5.2.2.

Questions about the presence of a dog for protective purposes and about changes made to improve dwelling security are also asked, but these questions were not considered in this analysis.

5.2.2.1 Prevalence of any security device

From this list of security devices, the prevalence of household protection was first measured by creating a dummy variable indicating whether any of the security devices were present in the respondent´s home. Therefore, the first analysis estimated the effect of having any security at home compared to no security at all. As indicated above, this measure of physical guardianship is the most frequent indicator of security prevalence at home.

Table 5.2.2 demonstrates that the figures from the sub-sample used in this analysis did not differ from the general trend observed in the full sample (see Appendix 5.1). The percentage of households with any security device in the sub-sample increased by 18% between 2007 and 2013[16] , from 64% to 76%, with an average prevalence of 71.4% over the studied period. The prevalence of any security device was around 5% lower in the sub-sample than in the full ENUSC sample, in which the prevalence averaged 75.7% (see Appendix 1).

5.2.2.2 Prevalence of each security device

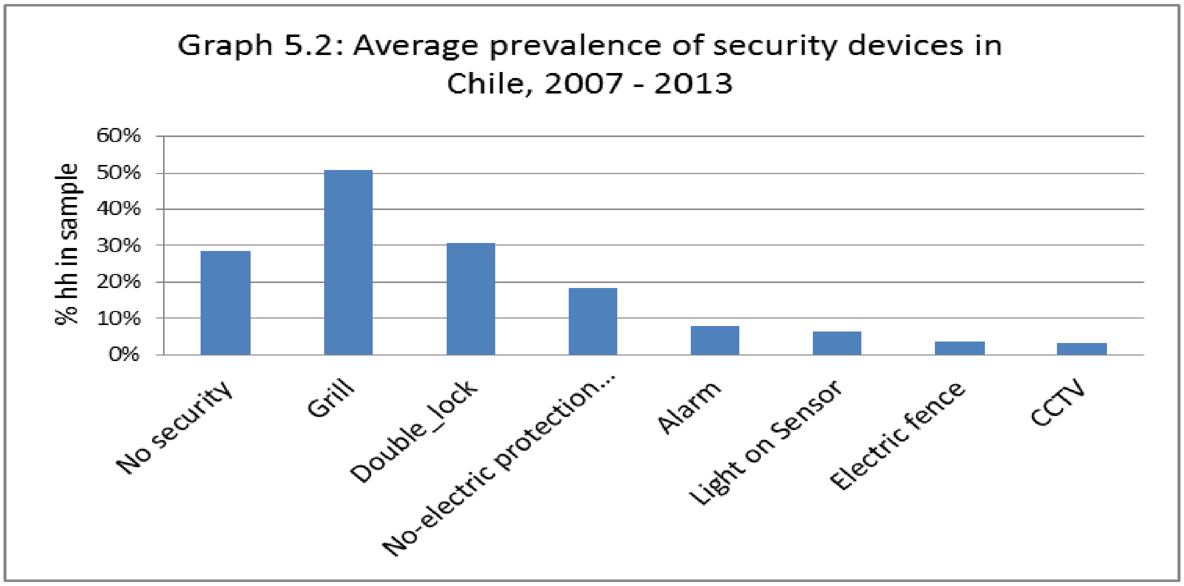
The prevalence of each security device was also measured in order to differentially test their preventive effects. Dummy variables were created indicating whether a particular security device (e.g., burglar alarm) was present at the respondents' homes. Although this dummy cannot distinguish the pure effects of individual security devices from their interaction effects, the variable captures significant effects of devices with low prevalence more effectively than a more restrictive operationalisation of security configurations.

[16] That figure was 17% in the full sample

The prevalence and trends in prevalence of each security device are detailed in Table 5.2.2. The most prevalent household security device in the sub-sample was ***grills on windows or doors***, which were present in 50.78% of households.[17] Similarly to what was observed in the full sample (see Appendix 1), the prevalence of grills on windows or doors slightly increased from 49% in 2007 to 53% in 2012, but then decreased to 50% in 2013.

Double-locks on doors, the second most prevalent security device in the sub-sample (30.53% prevalence over the study period), increased in prevalence by 73.6% between 2001 and 2013, from 21% to 37%. In comparison, faster growth in prevalence (80%) was experienced by ***CCTV**,* but this was also the most rare security device, present in only 3.38% of households. In addition, the growth rate of CCTV is only 16% if 2008 (and not 2007) is considered as the reference year. ***Non-electric protection on fences*** was present in 18% of sampled households over the study period, with a growth rate of 36%. The prevalence of both ***burglar alarms*** and ***light sensors*** increased by around 60% between 2007 and 2013: from 6% to 10% and 5% to 8%, respectively. Finally, the very low ***electric fence*** prevalence increased from 3.26% to 4.25% in the same period. Overall, these figures are very similar to those observed in the full ENUSC sample, as presented in Appendix 1.

[17] Grills on windows was also the most prevalent security device in the full sample, though it was slightly higher (54%).



5.2.2.3 Prevalence of different configurations of security devices

In order to estimate the pure effects of security devices and their interactions, two kinds of configurations were considered in this chapter's analysis. The first, a theoretically led classification, used opportunity theory not only as a theoretical framework to explain the preventive effects of physical protection, but also as a conceptual tool to classify different kinds of protection according to the preventive mechanism triggered by the specific protection. Security devices were classified into two categories: those aimed to prevent burglary, such as double-locks, grills on windows and fence protections, and those aimed to increase detection risk, such as alarms, CCTV or light sensors. Four dummy variables were created to indicate which of the following exclusive conditions was satisfied by each individual household:

- ***No security*** at all. This variable remained the same as recorded in the first row in Table 5.2.2

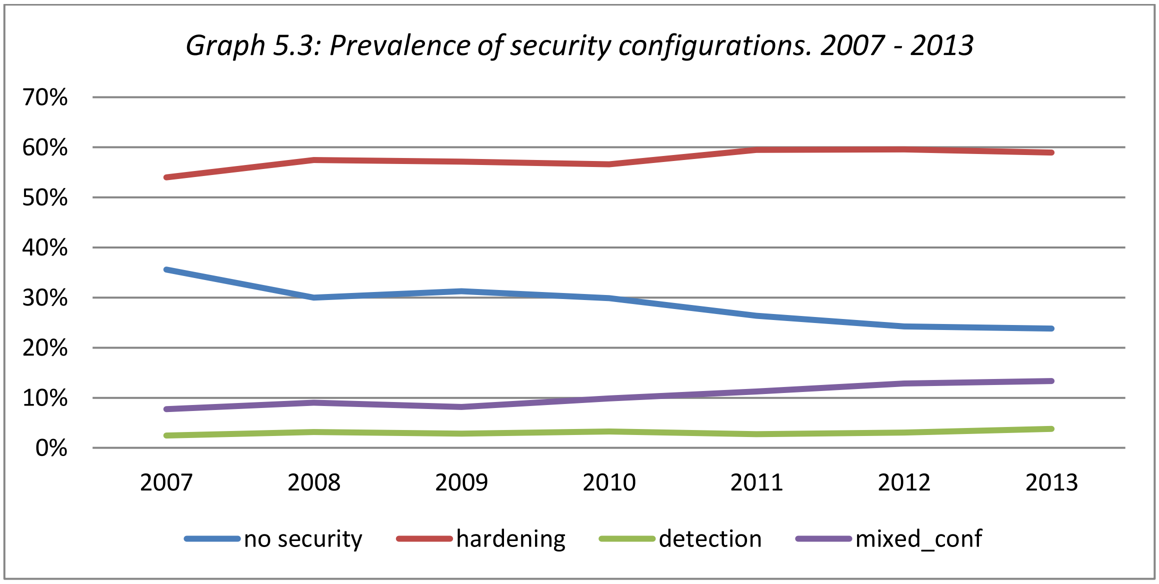
- Any ***hardening*** device, but no detection device. This category grouped households with grills, double-locks, electric fences or non-electric protection on fences and without burglar alarms, CCTV or light sensors.
- Any ***detection*** device, but no hardening device. This category grouped households with a burglar alarm, CCTV or light sensor and without grills, double-locks, electric fences or non-electric protection on fences.
- A ***mixed configuration*** of any hardening and any detection device. This category was used as a control variable.

The prevalence of hardening configurations across ENUSC sweeps is recorded in row nine of Table 5.2.2. The percentage of households with one or more hardening device was 57.64% over the period of study. This figure increased by 9%, from 54% to 58%, between 2007 and 2013.

The percentage of households with only detection devices was notably low during the studied period, at only 3.1%. However, the growth in detection configurations was also notably faster than that observed for hardening configurations. The prevalence of detection configurations rose by 54%, from 2.45% to 3.78%, between 2007 and 2013.

Finally, mixed configurations were more popular (10% prevalence) over the study period, and grew in prevalence even faster than detection devices, growing by 73% from 7.7% prevalence in 2007 to 13.3% in 2013. Both figures demonstrate that the largest component of the increase in security device prevalence is explained by an increase in detection devices.

Graph 5.3 depicts the distribution of these categories across annual sweeps rounds of the ENUSC.



Another kind of configuration of security devices was derived from all potential combinations of each security device. This method was used by Tseloni et al. (2014) in their analysis of household protection in England and Wales. Combinations of security devices may be a single device or all possible combinations of a single device with the other security devices included in the ENUSC survey (e.g., alarm combinations include alarm as a single device, alarm and double-locks, alarm and double-locks and CCTV , alarm and CCTV , alarm and protection on fence and so on). The seven security devices generate 128 possible configurations (including no security at all), whose distribution in the full sample is detailed in Appendix 1.

For analytical purposes, a cut-off for the sample prevalence of each security device combination was utilised. Of the 128 combinations of security devices, only 52 were present in at least 100 households in the sub-sample and 21 were present in at least 500 households. The latter configurations accounted for 93% of sample households. Table 5.2.2 records the distribution of the 21 most popular configurations across ENUSC rounds.

As listed in Table 5.2.2, the most popular security configurations over the study period were “grills on windows”, “double-lock on doors”, “non-electric protection on fence", and combinations of these devices. As single devices, grills were present in 23% of households, double-locks in 7.5% of households and non-electric protection on fences in 3.5% of sampled households. These single configurations and combinations of them accounted for 55% of total households in the sample (including households with no security) and 77% of households that had at least one security device.

While the percentage of households that exclusively used grills on windows decreased by 25% over the study period, the prevalence of the single double-lock configuration increased by 88%. The second most popular security configuration over the study period was the combination of grills on windows and double-lock on doors, which also increased in prevalence by 39% between 2007 and 2013. Additional combinations of double-locks and other devices experienced even larger increases in prevalence. For example, the prevalence of the combination of double-lock and non-electric protection on fence increased by 250%, from 1% in 2007 to 2.47% in 2013. Furthermore, the fastest growth during the study period was exhibited by the double-lock and burglar alarm configuration. The prevalence of this combination quadrupled over the studied period, although its prevalence was still very low in 2013.

Graph 5.4: Prevalence of most popular security configurations in Chile. 2007-2013

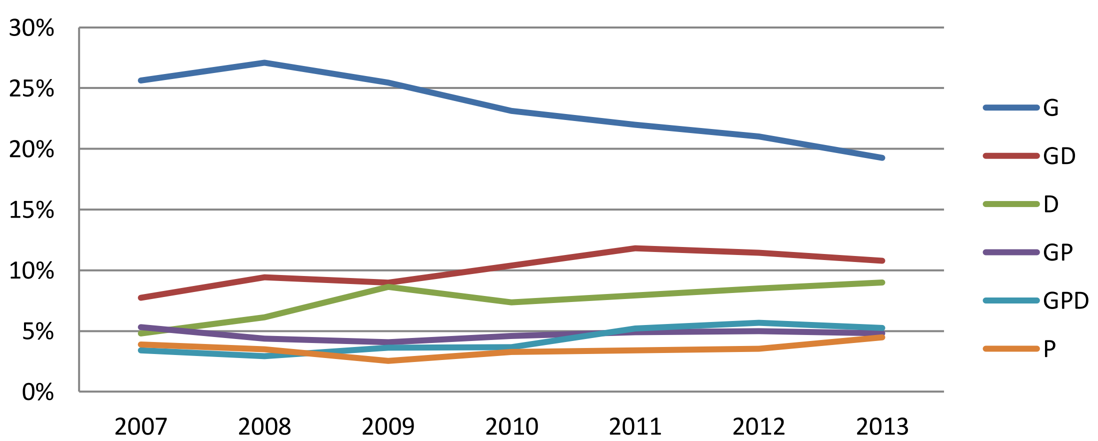


Table 5.2.2: Prevalence of different security configurations by year

Security configuration	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
No security	35.6	30.0	31.3	29.9	26.4	24.2	23.9
Grill	49.0	51.6	49.1	50.0	52.6	53.3	50.0
Double-lock	21.3	25.5	28.4	29.4	34.5	36.6	37.0
Non-electric **P**rotection on fence	17.0	15.6	14.7	16.7	20.2	22.2	23.2
Alarm	6.3	7.2	6.4	7.7	8.1	9.7	10.2
Light **S**ensor	5.0	5.6	5.4	6.3	7.1	7.5	8.2
Electric fence	3.3	3.6	3.2	4.0	3.9	3.8	4.3
CCTV	2.2	3.4	2.6	3.5	3.8	4.0	4.0
Hardening	54.0	57.5	57.1	56.6	59.5	59.6	58.92
Detection	2.5	3.2	2.8	3.3	2.7	3.1	3.8
Mixed configuration	7.7	9.0	8.2	9.9	11.3	12.9	13.3
G	25.6	27.1	25.5	23.2	22.0	21.0	19.3
GD	7.7	9.4	9.0	10.4	11.8	11.4	10.8
D	4.8	6.1	8.6	7.4	7.9	8.5	9.0
GP	5.3	4.4	4.1	4.6	4.9	5.0	4.8
GPD	3.4	2.9	3.6	3.7	5.2	5.7	5.2
P	3.9	3.5	2.5	3.3	4.0	3.5	4.5
PD	1.0	1.4	1.4	1.3	1.8	2.2	2.4
AG	1.0	1.2	1.0	1.1	1.0	1.3	1.5
A	0.8	1.0	1.0	1.3	1.0	1.3	1.5
E	0.8	0.9	0.7	1.0	0.9	0.7	1.0
AGD	0.5	0.7	0.5	0.7	0.7	0.9	0.7
GS	0.6	0.7	0.6	0.7	0.7	0.6	0.7
S	0.5	0.5	0.7	0.7	0.6	0.7	0.8

C	0.5	1.0	0.7	0.5	0.5	0.5	0.5
GDS	0.3	0.4	0.4	0.5	0.6	0.8	0.8
GE	0.5	0.4	0.4	0.5	0.4	0.5	0.4
AGPD	0.3	0.2	0.3	0.3	0.4	0.7	0.7
GPDS	0.2	0.3	0.3	0.4	0.5	0.6	0.7
ED	0.2	0.5	0.5	0.4	0.5	0.4	0.5
AD	0.2	0.3	0.3	0.4	0.4	0.5	0.7
DS	0.1	0.3	0.4	0.3	0.3	0.3	0.5

G: bars or grilles on windows; **D**: double-locks; **P**: no-electric protection on fence; **E**: electric protection on fence; **A**: burglar alarm; **C**: CCTV; **S**: light on sensor

5.2.3 Demographic variables

The following 11 demographic characteristics of households were included in the models:

- Age of the head of household
- Sex of the head of household
- Number of children in household
- Highest qualification achieved by the head of household
- Employment status of the head of household
- Number of adults in household
- Whether the household is a single-parent household
- Whether there is a housekeeper or pensioner in the household (as proxy of dwelling occupancy)
- Socio-economic status of household
- Length of residence in area
- Type of accommodation

In addition to their relevance according to opportunity theories and related empirical research, these variables were selected because they were recorded in every ENUSC survey round between 2008 and 2013.

These demographic characteristics may also act as proxy measures of a household´s exposure and attractiveness to a potential burglar. Demographic characteristics may affect households' exposure to burglary victimisation through either guardianship or proximity mechanisms. Regarding guardianship, the core principle is that the longer a household is unoccupied, the more likely it is that the household experiences a high risk of burglary. Thus, demographic variables related to the amount of time spent outside of the home may be used as proxies of a household's guardianship level.

Age, for example, is hypothesised to affect victimisation risk because younger individuals generally spend more time outside of the home than their older counterparts (Tseloni et al., 2002). The number of children was similarly included because having children increases the activities and time spent outside of the home, including taking children to school/home and extra time on shopping. Single-parent households also tend to leave the home unattended for significant time periods.

In contrast, both the number of adults in the respondent´s household and the presence of a pensioned household member or full-time housekeeper were used to measure the probability that properties are regularly occupied. The unemployment status of the head of household is negatively related to victimization risk because of the greater time spent at home by the head of household.

Proximity refers to the physical distance between potential targets and potential offenders (Meier & Miethe, 1993). Because burglars (and other offenders) usually live in relatively deprived areas and less-affluent households, measures of household affluence were used as a proxy of proximity to potential burglars.[18] A dummy variable for "female-headed" households was also used to indicate additional vulnerability.

The ENUSC data also contains a measure of household socio-economic status which is determined and collected by the INE[19] following the standard methodology applied in the market research industry. Households in the ENUSC sample are classified into five categories: ABC1, C2, C3, D and E. Each category classifies respondents' households as upper class, upper-middle class, middle class, working class or the most deprived precariat class. As recorded in Appendix 5.3, more than 80% of households in the ENUSC sample are classified as middle or working class, while roughly 10% are classified as part of the upper class and only 5% as precariat class.[20] The

18 Pertinence of this proxy is also reinforced by the well-documented segregation in Chilean cities (Sabatini, 2001; Agostini, 2010), which means that less-affluent households tend to group in more deprived areas, and by contrary, the more affluent households tend to group in better-off areas.

19 Responsible for the ENUSC survey.

20 ENUSC´s distribution of SEG differs from distributions established by Market Researcher Association for Chile. According to official figures published by that association 7% Chilean households belong to

distribution of socio-economic groups in the sub-sample modeled in this chapter is not significantly different from the full ENUSC sample.

Socio-economic status was used as a proxy for proximity to potential offenders; however, it can also be used as proxy of attractiveness, as it is reasonable to assume that more affluent households own more valuable and desirable items. It may also be the case that more affluent households are more likely to have greater and better quality household protection because they are better able to afford them. However this effect of wealth on reducing vulnerability was isolated by including specific variables for household protection in the model (see Sub-section 5.2.2).

The type of accommodation indicates the exposure of households to burglary victimization. Opportunity theory predicts that flats are less frequently burglarized than houses because the former are less exposed. In the ENUSC survey, respondent' dwellings are classified into flats, houses on streets, houses on culs-de-sac and houses in gated neighbourhoods.[21] Finally, the length of residence is related to social ties at the neighbourhood level and informal guardianship of properties.

The demographic variable values in the sub-sample of households that did not install a security device over the last 12 months (Table 5.2.3) are very similar to those for the full sample (Appendix 2). The mean age of heads of household remained constant at about 52 years-old over the studied period. With regards to the sex of the head of household, the percentage of female-headed households increased from 33.16% in 2008 to 38.7% in 2013. The percentage of households without children (up to 17 years-old) increased from 44% to 50%, while the percentage of households with more than one child decreased from 30% to 24.5% between 2008 and 2013. The percentage of single-parent households slightly increased from 12% to 14%. There was also a slight

SEG "abc1"; 15% to SEG "c2"; 21% to SEG "c3", 37% to SEG "d", and 20% to SEG "e". See http://www.aimchile.cl/publicaciones/niveles-socio-economicos/.

[21] ENUSC data also split the houses categories into detached or terraced house, but that classification was not considered in this analysis.

increase in the proportion of one-adult households and a decrease in the proportion of households with three or more adults. These changes in sampled households' structure over time appear to be a reflection of wider trends in Chilean society in terms of a general reduction in household size and a growing number of "female-headed" households in the population.

The increasing participation of women in the labour market might also explain the reduction in the proportion of households with at least one member classified as a housekeeper ("looking after the home or the family") or whose employment status is "pensioner". The prevalence of these measures of occupancy declined from 61% to 54% between 2008 and 2013. The proportion of heads of household with qualifications at the higher or further education level slightly increased from 19% in 2008 to 23% in 2013, while variations in the employment status of heads of household were even smaller.

There were some changes in the socio-economic distribution of households in the ENUSC sample over time. The proportion of middle-class households rose from 36% in 2007 to 42% of the sample in 2013. More affluent households were also more prominent in 2013 than in 2007 (11% and 7%, respectively), while the proportion of poorest households declined by 70%, from 8.9% in 2007 to 2.8% in 2013.

Regarding the type of accommodation, Table 5.2.3 presents a general trend of a slight increase in the proportion of flats and houses on culs-de sac in the sample and a decrease in the prominence of houses on streets. These figures again appear to reflect wider changes in the residence preferences of Chilean households.

5.2.4 Borough-level variables

The following five characteristics of respondents' boroughs were incorporated in the models:

- Metropolitan borough (dummy variable)
- Proportion of working and precariat households

- Proportion of flats
- Proportion of households with any anti-burglar protection
- Proportion of households associated with NWS

The metropolitan borough and proportion of poor households variables were employed to indicate proximity to potential offenders. Metropolitan indicates whether the respondent´s borough is in one of the three metropolitan areas in Chile (Greater Santiago=1, Greater Valparaíso=2, Greater Concepción=3). These areas are the most populated areas in the country; therefore, the likelihood of contact between a motivated burglar and a potential target is higher in these areas than in areas with a lower population density. The proportion of poor households in the respondent´s borough also indicates proximity to potential offenders, as burglars tend to live in relatively deprived areas. These areas may also be characterised as having fewer resources for effective collective action, leading to higher levels of victimisation.

The other three area measures serve as proxies for borough attractiveness. According to empirical research, one of the first steps in burglars' target-selection process is identifying areas with attractive and available targets. A larger prevalence of household protection devices or NWSs reduces borough attractiveness because these factors make finding an available target more difficult. However, a larger prevalence of household protection may also be interpreted by burglars as indicating more households able to afford security devices and more valuable items to be protected. Both mechanisms may be activated by the increased prevalence of security devices; thus, estimations of the effects of these variables should be carefully interpreted. Moreover, as Wilcox et al. (2007) found in their analysis of the interactive effects of protection measures, the proportion of security devices in the area may alter the protective effect of security protection at the individual level.

Finally, the proportion of flats in the respective borough was used to measure the accessibility and exposure of households in that borough. Boroughs with a larger proportion of flats are generally less attractive to burglars.

Over half of respondents lived in non-metropolitan boroughs. Nearly one-third of the sampled households were located in a Greater Santiago metropolitan borough, while around 5% and 6% of respondents lived in Greater Valparaíso and Greater Concepción areas, respectively. These figures remained consistent over the studied period.

The mean proportion of households belonging to the two poorest socio-economic groups remained constant over the studied period at around 51%, with a standard deviation of 0.17 (a Normal distribution across boroughs). That proportion ranges from less than 1% in borough "Vitacura" to 85% in borough "Lota" and borough "La Pintana".

The mean proportion of households with security devices at the borough level was 75% over the entire study period, while the mean proportion of households associated with a NWS was 15%. Finally, the mean proportion of flats across boroughs remained stable at around 14% in the period 2007-2013.

All demographic, lifestyle and area characteristics included in the models are listed in Table 5.2.3 by ENUSC round. The proportion (percent) of the total sample (victims and non-victims) for each sweep is provided. The total number of cases included in each round is recorded in the last row. Most variables (apart from age and borough-level variables) are binary or categorical and their effect on burglary victimisation is interpreted relative to a reference or base category. The respective reference category is provided in brackets next to each variable in the table.

TABLE 5.2.3: DESCRIPTION OF HOUSEHOLD BURGLARY COVARIATES

CHARACTERISTICS	2007	2008	2009	2010	2011	2012	2013	Average
AGE	n/a	51.8	51.4	51.7	53.3	52.5	52.3	
FEMALE_HH	n/a	33.16	34.29	35.67	36.82	38.29	38.69	36.18
N° CHILDREN	n/a	56.22	56.46	53.92	51.32	50.68	49.73	53.03
LONE PARENT	n/a	11.77	12.71	12.98	13.4	13.66	13.79	13.06
N° ADULTS								
1	n/a	15.45	15.82	17.42	17.04	18.22	19.53	17.27
2	n/a	41.72	42.87	42.64	41.36	42.34	41.94	42.15
3	n/a	42.83	41.31	39.94	41.6	39.44	38.53	40.59
OCCUPANCY	n/a	61.1	59.81	58.48	59.48	57.01	54.21	58.31
EMPLOY. STATUS								
EMPLOYED	n/a	69.91	69.81	69.44	66.76	68.6	70.22	69.13
UNEMPLOYED	n/a	3.43	4.25	3.36	3.1	3.22	2.99	3.39
INACTIVE	n/a	26.67	25.93	27.2	30.15	28.18	26.79	27.48
QUALIFICATIONS								
NONE	n/a	2.2	2.12	2.09	2.49	2.07	2.27	2.21
PRIMARY	n/a	31.07	29.39	28.27	30	28.43	26.42	28.9
SECONDARY	n/a	47.51	47.57	47.13	46.24	45.49	45.29	46.53
TECHNICAL EDUCATION	n/a	5.51	6.32	6.94	6.21	6.99	8.39	6.74
UNIVERSITY EDUCATION	n/a	13.7	13.84	14.98	14.32	16.43	17.18	15.1
SOCIO-ECONOMIC GROUP								
ABC1	1.28	2.28	1.66	1.35	2.28	2.38	2.42	1.96
C2	6.01	6.92	6.26	7.17	7.26	6.85	8.45	7.01
C3	35.55	39.99	37.2	35.06	35.92	38.78	41.96	37.83
D	48.29	45.34	48.9	52.6	47.18	47.33	44.35	47.69
E	8.88	5.47	5.99	3.81	7.36	4.65	2.82	5.51
TYPE OF ACCOMMODATION								
FLAT	10.46	12.57	15.77	14.65	10.37	17.59	17.79	14.25
HOUSE	68.54	62.55	53.37	56.81	60.13	54.88	53.54	58.38
HOUSE ON CUL DE SAC	20.49	24.28	29.76	28.12	28.88	26.74	27.87	26.67

HOUSE IN GATED COMMUNITY	0.51	0.6	1.1	0.42	0.63	0.79	0.8	0.7
LENGTH OF RESIDENCE (YEARS)								
1	6.82	7.36	6.95	7.51	6.31	6.7	7.07	6.96
2	13.84	17.41	17.18	16.86	15.05	16.56	15.88	16.14
3	14.84	14.38	16.38	15.09	14.15	15.25	16.19	15.2
4	12.8	11.91	12.63	12.3	11.23	12.18	12.72	12.25
5 OR MORE	51.7	48.94	46.86	48.25	53.26	49.32	48.14	49.45
METROPOLITAN AREA								
NON-METRO AREA	57.87	57.95	57.4	57.05	57.86	57.28	57.25	57.52
GREATER SANTIAGO	32.32	31.36	32.48	32.3	32.13	32.46	31.9	32.13
GREATER VALPARAÍSO	4.06	5.05	4.86	4.86	4.65	4.92	4.91	4.77
GREATER CONCEPCIÓN	5.74	5.64	5.26	5.78	5.35	5.34	5.94	5.58
% POOR HOUSEHOLDS	0.52	0.51	0.51	0.51	0.51	0.51	0.51	0.51
% FLATS	0.13	0.14	0.14	0.14	0.14	0.14	0.14	0.14
% HH WITH SECURITY PROTECTION	0.75	0.75	0.76	0.76	0.75	0.76	0.75	0.75
% HH IN NW SCHEMES	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15

5.3 Modelling strategy

The data were cleaned and merged, and dummy variables were created for each explanatory variable. Statistical modelling was then conducted using STATA 13 software (StataCorp, 2013). Seven ENUSC rounds (2007 to 2013) were merged in order to increase the potential number of homes with any possible security configuration. Given that the data were combined across rounds, all results presented within this chapter are unweighted. The ENUSC weight variables are not comparable across sweeps, because there were changes in the regional division in Chile during the study period which altered the expansion factors used in the ENUSC. Thus, all findings should be interpreted as estimates related to the sample and not the wider population.

Multilevel negative binomial regression was used to model the number of burglaries per household, while multilevel logit regression was used to model the risk of burglary victimisation. Several models were estimated for both the expected number of burglaries and burglary risk. First, a baseline model was run. This model was followed by a model that included all individual variables and a dummy for the prevalence of any security protection. A second model that retained all significant variables in the previous model plus borough-level variables was subsequently run.[22] The effectiveness of security devices was assessed through the second model. The effect of the prevalence of each security device on the expected number of burglaries and the burglary risk was estimated, creating a total of 14 models. To evaluate whether the effect of the devices' prevalence varied across socio-economic groups, each model was run separately by household SEG thus, 56 (14 x 4) models were estimated. Models including interactions between the devices' prevalence and borough characteristics were also estimated. Particular security configurations were analysed to isolate the effect of security devices. As detailed in Sub-section 5.2.2, the effectiveness of the 21 most popular security configurations was analysed by separately replacing the security dummy in previous models with a dummy for each of those 21 configurations, producing a total of 42 models. Each model was also run separately by household SEG. Furthermore, additional models including interaction effects between security-configuration dummies and borough characteristics were also estimated.

[22] Removal of non-significant variables was done just to simplify the second model, which includes new borough-level variables. (also, the remotion do not affect coefficients nor p-values of remained variables)

5.4 Results

Table 5.4.1 presents the results from fitting multilevel null models for both the mean number of burglaries per household and the probability of being burglary victimised. These null models, which include borough random effects, but not explanatory variables, were estimated in order to analyse the variance in burglary victimisation across boroughs and thereby the pertinence of using multilevel modelling instead of a simple one-level model. The appropriateness of multilevel models was tested by using the likelihood ratio test (LR test).

Table 5.4.1 Baseline models

	Incidence			Risk		
	Coef .	*Std. Err.*	*p-value*	*Coef.*	*Std. Err.*	*p-value*
β_0	-3.29	0.042	0.000	-3.49	0.038	
α	2.54	0.038	0.000			
$\sigma^2_{\mu 0}$	0.14	0.025		0.12	0.021	
log likelihood			-2045.131			-17782.574

An LR test compares the log likelihood of the null model (reported in the last row of Table 5.4.1) and the log likelihood of simple one-level models (not shown) and tests whether this difference is statistically significant. An LR test is calculated as follows:

LR= -2(-log likelihood multilevel model -log likelihood one-level model)

The test statistics for incidence and for the risk model were found to be 302.84 and 312.72, which were compared to a chi-square distribution with two and one degrees of freedom, respectively, equal to the difference in the number of degrees of freedom between multilevel and one-level models (i.e., the number of variables added to the model). The associated p-values from the chi-square distribution for both LR statistics were less than 0.000, indicating that the between-borough variance is not zero.[23] Therefore, there was significant variation between boroughs in the risk of being burglarised, which supports the use of multilevel models for estimating burglary rates.

From the null model, $\boldsymbol{\beta_0}$ is the estimated intercept of the model when no additional information is known about the household and borough effects are equal to zero (μ=0). When the number of burglaries is modelled (incident model), the exponent of the estimated intercept (exp(-3.29) = 0.037) represents *the expected mean number* of burglaries per household in an average borough. When burglary risk is modelled, the exponent of the estimated intercept (exp(-*3.49)* = 0.031) represents the odds of being burglarised in an average borough, which allows for estimation of the probability of being burglarised in an average borough (0.031/1 + 0.031 = 0.03). Thus, in an average borough, the risk of being burglarised is 3%, and the expected number of burglaries per household is 0.04 (or four burglaries per 100 households)

The incidence model reveals two random parameters. The random parameter α = 2.54 represents the unexplained heterogeneity between households, while the random parameter $\sigma^2_{\mu 0}$ = 0.14 represents the unexplained heterogeneity between boroughs. The fact that the between-household unexplained variance α is considerably higher than the unexplained variance at the borough level implies that the heterogeneity in the expected number of burglaries is higher between households than between boroughs.

The risk model reveals only one random parameter $\sigma^2_{\mu 0}$ = 0.12, which also represents the between-borough unexplained variance. There is no between-household variance parameter in the risk model because individual risk is equal

[23] Significance of σ^z_u might be also tested by using a Wald test. The Wald test statistic is the square of the Z ratio, i. e. $(0.120/0.021)^2$ = 32.65, which is compared with a chi-square distribution on 1 degree of freedom, giving a p-value less than 0. It is therefore concluded that there is significant variation between boroughs in the proportion of burglary-victimised households.

to the proportion of victimised households among all households in the borough. In other words, individual risk is the same for all households with similar characteristics living in the same borough.

The between-borough random parameter can be used to calculate the difference in the burglary rate between "high" crime boroughs and "low" crime boroughs. By assuming that μ_0 follows a Normal distribution, it is expected that 95% of boroughs have a value of μ_0 within two standard deviations from the mean zero. Thus, a borough that is two standard deviations above the mean represents a high-burglary-rate borough, while a borough that is two standard deviations below the mean represents a low-burglary-rate borough. The coefficients from Table 5.4.1 were used to estimate that total household burglaries were more than four times (calculated as $\exp(2*1.96*\sqrt{0.14}) = 4.33$) higher in a high-burglary-rate borough compared with a low-burglary-rate borough. The variation in burglary rate across boroughs is illustrated in the following analyses of victimisation risk.

5.4.1 Probability of being a victim of burglary across boroughs

The fact that the between-borough variance was different from zero indicates that, all other individual variables being equal among boroughs, there are still differences in victimisation risk due to borough-contextual non-observed variables. To estimate the size of these borough effects, the predicted mean number of burglary incidents and the probabilities of being burglary victimised were calculated, assuming different values for the borough effect $\boldsymbol{\mu_j}$.

The estimated probability of being a victim of burglary in an average borough with $\mathbf{u_j} = 0$ is:

$exp(-3.49) / [1 + exp(-3.49)] = 0.029$ or **2.9%.**

Assuming that $\boldsymbol{u_j}$ follows a Normal distribution, 95% of boroughs should have a value of $\boldsymbol{u_j}$ within two standards deviations of the mean of zero (i.e., between approximately $\pm 2\, \boldsymbol{\sigma_u} = \pm 2\sqrt{0.120} = -0.69$ and $+0.69$). Substituting these values for u_j and the estimate for $\boldsymbol{\beta_0}$ from Table 2 produces the following predictions:

For a borough two standard deviations below the mean, the probability of being a victim of burglary is

= exp (-3.49 - 0.69) / (1 + exp(-3.49- 0.69) = 0.015 or 1.5%.

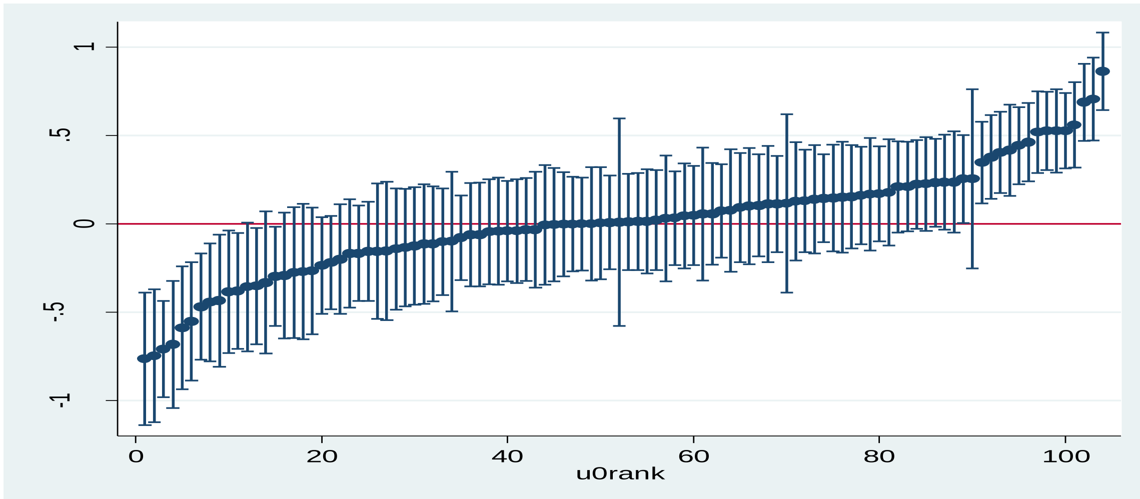
For a borough two standard deviations above the mean, the probability of being a victim of burglary is

= exp(-3.49+ 0.69) / (1+ exp(-3.49 + 0.69) = 0.057 or 5.7%.

Therefore, the expected proportion of burglary-victimised households is between 1.5% and 6% in the middle 95% of boroughs. This is a very large range, as the probability of being burglary victimised may be nearly four times higher in some boroughs than in others.

The differences in burglary risk across boroughs is illustrated in Graph 5.4.1, which depicts the estimates of the borough effect, $\mathbf{\hat{u}_j}$, obtained from the null model. The graph is a "caterpillar" plot with the borough effects presented in rank order together with 95% confidence intervals. A borough for which the confidence interval does not overlap with the line at zero (representing the mean log-odds (-3.49) of being burglary victimised across all boroughs) differs significantly from the average at the 95% level of confidence. The graph demonstrates that many of the confidence intervals include zero, but also that a considerable number of boroughs significantly differ from the estimated mean.

Graph 5.4.1



5.4.2 Effects of the prevalence of any security device and covariates

This section examines the effect of having any security device on household burglary rates, controlling for non-observed differences between boroughs. Two multilevel models were estimated for incidence estimations and risk estimations. *Model 1* included the any-security variable and all level-one explanatory variables described in Sub-section 3.2.3. *Model 2* included each level-one variable group in which at least one dummy variable was statistically significant at the 10% level and added the borough-level variables described in Sub-section 3.2.4.

Table 5.4.2a presents the results from Model 1 for estimations of the number of burglary incidents and household burglary risk, respectively. The log likelihood functions of models (=-16840.438 and -14673.66) were used to evaluate whether the models fit the data better than the null model. The likelihood ratio test compared the log likelihood of the null model and the less restrictive model (the one with explanatory variables) and tested whether this difference is statistically significant.

The LR statistics for the incidence and risk models were compared to a chi square distribution with 26 degrees of freedom. The associated p-value for both statistics was < 0.001, indicating that, in both cases, Model 1 fit significantly better than the null model.

The overall significance of the model was evaluated by a Wald test equal to 279 and 294 for the incidence and risk models, respectively, which were compared with a chi-square distribution with 26 degrees of freedom. The associated p-values, p>0.0001, in each case, indicate that Model 1 is highly significant in both estimations. The significance of each set of covariates, with their respective degrees of freedom, included in *Model 1* was tested by using a Wald test. The results from that test demonstrate that most sets of covariates were highly statistically significant in comparison with a chi-square distribution with the respective degrees of freedom, which means that these explanatory variables are important for the prediction of burglary risk. The exceptions were "educational qualifications of household head" (Wald statistic = 3.83) and "employment status of household head" (Wald statistic = 2.06).

The effects of each variable on the burglary victimisation rate are presented by the estimated coefficient (*b*). When the number of burglary incidents is estimated, the exponent of estimated coefficients, exp(*b*), reflects changes in the expected number of burglaries. When burglary risk is estimated, the exponent of estimated coefficients, exp(*b*), reflects changes in the odds of being burglary victimised when the respective variable changes.

The statistical significance of each estimated coefficient was evaluated by calculating the Z-ratio[24] to test the null hypothesis that a particular coefficient is equal to zero. Table 5.4.2a reports the Z-ratio in the column labelled z. The associated p-values are presented in the column labelled P>|z|. A p-value less than 0.1 is statistically different from zero at a 90% level of confidence, while

---

[24] The Z test compares the estimated regression coefficient and its standard error; the z test is thus the parameter estimate divided by its standard error ($Z = \beta / s_\beta$), which is compared to a normal distribution.

p-values less than 0.05 and 0.01 are significantly different from zero at a 95% and 99% level of confidence, respectively.

The random parameter α of the incidence model indicates considerable unexplained between-household heterogeneity after accounting for household characteristics. As Tseloni (2006) stated, this heterogeneity implies that the number of burglaries per household is affected by a greater range of variables than those measured in the ENUSC and included in the empirical models. Such unmeasured characteristics may include lifestyle activities and dwellings' exterior conditions or physical characteristics. In addition, previous victimisation, which is not measured in the ENUSC, might capture some between-household unexplained heterogeneity (Tseloni and Peace, 2003).

The statistic recorded at the bottom of Table 5.4.2a indicates the unexplained variance of borough effects. Comparing the unexplained level-two variance in incidence (σ^2_μ= 0.10) and prevalence (σ^2_μ= 0.09) to that from the respective null model (σ^2_μ= 0.14 and 0.12, respectively) reveals that inclusion of individual-level explanatory variables reduced the unexplained between-borough variance in victimisation rates by around 25%. This reduction implies that some of the individual variables incorporated in Model 1 are unevenly distributed across boroughs; thus, borough-level burglary rates partially depend on the distribution of these individual variables.

The majority of estimated coefficients in *Model 1* are statistically significant and support the hypothesis of opportunity theories. As expected, the prevalence of any security protection significantly reduced burglary rates compared to households without anti-burglar protection. The preventive effect of any household protection accounted for a 10% reduction in the expected number of burglaries (exp(-0.*1058*)= 0.90) an 8% reduction in the probability of being burglarised (exp(*-0.0837*)=0.92). Tests of significance indicate that these estimations are significant at a 95% level of confidence. These results affirmatively answer the first question in this research: whether the prevalence of anti-burglar protection reduces the probability of being burglary victimised.

The subsequent sections of this chapter provide detailed analyses which attempt to differentially measure the effect of several configurations in order to better model the effect of the prevalence of security devices on burglary rate trends.

The age of the head of household was found to be negatively correlated to burglary rates. Burglary incidence increases/decreases by 6% and burglary risk increases/decreases by for a household whose "head" is 10 years older/younger than the mean age (52). Furthermore, households with two adults experienced 20% less burglary victimisation than otherwise identical one-adult households. The fact that the burglary risk of households of three or more adults was higher than the burglary risk of two-adult households may be explained by the former variable capturing "households of many cohabiting, usually young, adults rather than extended families" (Tseloni, 2006). The expected number of burglaries was 15% lower for households of three or more adults than for one-adult households.

While the sex of the head of household was not statistically significant, lone-parent households suffered 15% more burglaries than households of otherwise identical characteristics. These results indicate that the sex variable affects burglary victimisation through the strong association between lone-parent households and female-headed households, rather than through the increased vulnerability of female-headed households.

Occupancy (i.e., presence of a housekeeper or retired household member) also had an expected negative effect on burglary risk. This variable reduced the odds of being burglarised by 9%, possibly because of greater guardianship in the household. Regarding the incidence model, occupancy was also negatively correlated with the number of burglaries, but its statistical significance (p-value = 0.102) was slightly lower than standard.

The socio-economic status of households seems to affect burglary rate through a proximity mechanism. The results from *Model 1* demonstrate that less-affluent households suffered more burglaries. Compared to the poorest households, the expected number of burglaries was 26% less for working-class households and 36% less for middle-class households. Similar results were found regarding burglary risk. The estimated effect of belonging to the more affluent socio-economic group indicates that burglary risk is higher for affluent households than for middle-class households, which may reflect the attractiveness of the former. However, significance tests indicate that the effect of belonging to SEG abc1 is not statistically significant.

The type of accommodation was found to be significantly associated to burglary risk. Compared to flats, the number of burglaries per house in gated neighbourhoods was 72% higher and double among houses on culs-de-sac. In addition, houses on roads/streets suffered 250% more burglaries than flats. Exposure to risk is the obvious explanation for these estimated effects.

The number of children in households also appears to be positively related to burglary victimisation. However, the correlation between the number of children and burglary risk is not statistically significant. Regarding the number of burglaries, each additional child increases the expected number of burglaries by 8%.

The qualifications and employment status of heads of household were found to be not statistically significant, possibly because the socio-economic status variable better captures the higher burglary risk of relatively poor households.

Table 5.4.2a Model 1: Household-level covariates

Covariates	Incidence	Prevalence (Risk)
Any Security	**-0.11****	**-0.08****
Age (cent.)	**-0.01*****	**-0.01*****
Female_hh	**0.02**	**0.02**
N° children	**0.08***	**0.06**
Lone parent	**0.14****	**0.10***

N° adults		
1(base)		
2	**-0.24*** **	**-0.23*** **
3 or more	**-0.16*** **	**-0.15*** **
Occupancy	**-0.08***	**-0.1** **
Employ. status		
Unemployed (base)		
Inactive	**-0.16**	**-0.13**
Employed	**-0.13**	**-0.13**
Qualifications		
None (base)		
Primary	**-0.18**	**-0.13**
Secondary	**-0.15**	**-0.10**
Technical education	**-0.13**	**-0.09**
Universitary Education	**-0.27***	**-0.19**
Socio-economic group		
e (base)		
d	**-0.31*** **	**-0.21*** **
c3	**-0.44*** **	**-0.35*** **
c2	**-0.45*** **	**-0.45*** **
abc1	**-0.30**	**-0.30**
Type of accommodation		
Flat (base)		
House	**0.89*** **	**0.87*** **
House on cul de sac	**0.70*** **	**0.69*** **
House in gated community	**0.54** **	**0.44***
Length of residence (years)		
1 (base)		
2	**0.13**	**0.08**
3	**0.09**	**0.04**
4	**0.002**	**-0.1**
5 or more	**0.05**	**-0.04**
Intercept	**-3.28*** **	**-3.53** **
Random effects		
lnα (standard error)	**2.51 (0.04)**	
$\sigma^2_{\mu 0}$	**0.10 (0.02)**	**0.09(0.02)**
Log likelihood	**-16840.5**	**-14673.67**

Table 5.4.2b presents the results from *Model 2* for both incidence and risk estimation. In this model, all statistically insignificant variables from *Model 1* were removed and a set of borough-level variables were included. The Wald statistic was used to test whether the metropolitan condition of boroughs and a set of borough-level aggregated variables were simultaneously equal to zero. The statistic for the set of aggregated variables, with four degrees of freedom, was 15.97 with a p-value < 0.01, which means that including this set of variables resulted in a statistically significant improvement in the fit of the model. In contrast, the Wald test for the metropolitan dummies (χ^2 =4. 38, p-value=0.22) indicates that removing the metropolitan set of variables does not substantially harm the fit of the model.

The likelihood ratio test was used to compare the fit of Model 2 to the fit of Model 1. The estimated statistics were compared to a chi-squared distribution with five degrees of freedom (the number of variables removed in Model 2) and their values (χ^2 = 50.98, and 44.59; p-value < 0.01) indicated that *Model 2* fit significantly better than *Model 1* for both estimations.

The random-effect parameters of *Model 2* demonstrate a reduction in unexplained between-borough variance compared to both *Model 1* and the *null model*. By including borough-level variables in Model 2, between-borough variance was reduced by 25% compared to *Model 1* and by 44% compared to the *null model*.

The magnitudes of the estimated coefficients of borough-level variables should be carefully interpreted because they represent a comparison of a borough with 100% of households meeting the measured condition with a borough with 0% of households meeting the measured condition. For instance, the results suggest that living in a borough with a larger proportion of poor households significantly increased the victimisation risk. In fact, the results specifically indicate that a household in a borough where 100% of households are classified as belonging to socio-economic groups “d” or “e” was 68% - exp *(0.52)* - more likely to be victimised than a household in a borough with no households are classified into those socio-economic groups. However, there is no borough with 100% or 0% poor households in the sample. A one-unit increase in a borough's proportion of poor households is associated with a 0.68% increase in burglary rates.

The prevalence of security devices in a borough was also positively related to both the number of burglaries and household burglary risk. The coefficients for these parameters indicate that an one-unit increase in a borough´s proportion of households with any security protection increased the number of burglaries per household by 0.82% and the odds of burglary victimisation by 0.86% (p-value = 0.07 for both number of burglaries and risk estimation). In addition, a one-unit increase in the prevalence of NWSs increased the expected number of burglaries per household by 4% and increased the odds of being burglarised at all by 3.2% (p-value = 0.01 for number of burglaries and p-value = 0.02 for burglary risk).The significant positive correlation between borough-level security measures and burglary rates may indicate that the prevalence of security measures at the borough level captures part of the unexplained variance of burglary risk across boroughs. These estimations are statistically significant at the 10% level and 5% level, respectively.

The coefficient for the proportion of flats in boroughs indicates a negative relationship with burglary risk, which aligns with the hypothesis that borough attractiveness is associated with the proportion of accessible properties. However, this estimation is not statistically significant.

Finally, the metropolitan dummy coefficients indicate that households located in the Greater Concepción metropolitan area were significantly more burglarised than households located in non-metropolitan boroughs. The coefficients were not significant for the Greater Santiago and Greater Valparaíso metropolitan dummies.

Table 5.4.2b Model 2: Household- and borough-level covariates

Covariates	Incidence	Prevalence (Risk)
Household covariates		
Any Security	-0.12***	-0.09**
Age (cent.)	-0.01***	-0.01***
N° children	0.08*	0.06
Lone parent	0.15***	0.11**
N° adults		
1(base)		
2	-0.25***	-0.24***
3	-0.18***	-0.18***
Occupancy	-0.08**	-0.09**
Socio-economic group		
e(base)		
d	-0.31***	-0.21***
c3	-0.45***	-0.35***
c2	-0.44***	-0.43***
abc1	-0.29	-0.29
Type of accommodation		
Flat(base)		
House	0.87***	0.84***
House on cul de sac	0.67***	0.66***
House in gated community	0.47*	0.38
Borough covariates		
Metropolitan area		
Non-metro area (base)		
Greater Santiago	-0.05	-0.05
Greater Valparaíso	0.5	-0.02
Greater Concepción	0.29**	0.24*
% Poor households	0.52**	0.51**
% Flats	-0.39	-0.21
% Hh with security protection	0.62*	0.60*
% Hh in NW schemes	1.39**	1.19**
Intercept	-4.38***	-4.60***

Random efects

lnα (standard error)	2.51 (0.04)	
$\sigma^2_{\mu 0}$	0.08 (0.02)	0.07(0.01)
Log likelihood	-16863.8	-14695.9

5.4.2.a Random effects of security protection across boroughs

To evaluate whether there was significant variation in household protection effects across boroughs, random effect models were fitted for both incidence and risk estimations. Table 5.4.2c present the random parameters of those models. The negative sign of the estimated coefficient for the covariance between protection prevalence and the mean number of burglaries across boroughs indicates that the protective effects of security devices were larger in boroughs with a higher mean number of burglaries; however, the Z test indicates that the covariance is not statistically significant (p-value = 0.164). Furthermore, the log likelihood functions of the random effect models were similar to those for Model 2; thus the log-likelihood ratio test also indicates that there was no significant model improvement when the preventive effect of security device prevalence was allowed to vary across boroughs. Similar results were found regarding burglary risk. Therefore, the effect of the prevalence of any security protection on burglary rates did not significantly vary across boroughs.

Table 5.4.2c

Random effects	***Incidence***		***Risk***	
lnα (standard error)	2.51 (0.04)			
Var_Intercept (standard error)	0.11 (0.03)**		0.07 (0.02)**	
Var_Security (standard error)	0.031 (0.029)		4.69e06(0.0002)	
	Estimate (S.E.)	*p-value*	*Estimate (S.E.)*	*p-value*
CoVar (Intercept, security)	-0.04 (0.03)	0.164	-0.0006 (0.012)	
Log likelihood	-16862.4		-14695.9	

5.4.3 Effectiveness of security configurations

This section aims to differentially test the preventive effect of each security protection configuration considered in this study. Each security device may be used as a single device or in combination with other devices. Some security devices may potentially be available only in combination with other devices. Thus, in order to comprehensively analyse the effect of security devices on burglary rates, three types of configuration were analysed:

a) configurations that included each device, either as a single device or combined with others: for example, the prevalence of "*alarm*" (either as a single device or combined with any other), or prevalence prevalence of "*grills on windows*" (either as a single device or combined with any other);

b) configurations based on the associated preventive mechanism (i.e., to increase difficulty of burglary or to increase risk of detection) and

c) actual security configurations observed in the sample.

5.4.3.1 Prevalence of each security device

To estimate the effect of the presence of each security device, regardless of potential interactive effects when combined with others, seven models were fitted. Each model included the same control variables included in *Model 2*, at both the household and borough level; however, the "any security" dummy was replaced by the following set of dummy variables:

- 0 : no security at all,
- 1 : presence of a security configuration that included the examined security device (including single-device configuration) and
- 2 : presence of any security configuration that did not include the examined security device

Table 5.4.3 and Table 5.4.4 present the estimated coefficients for the presence of each security device considered in the ENUSC. These results were obtained by estimating random intercept models with household- and borough-level variables. Additional models that included interactions between the examined security devices and level-two variables (not shown here) were found to be not significantly better fitted than models without interaction terms. The results from fitting random effect models also demonstrate that the effect of security devices on burglary rates did not significantly vary across boroughs.

The second row in Tables 5.4.3 and 5.4.4 presents the estimated coefficients for the presence of security devices, regardless of the presence of other security protection, that is, the effect on burglary rates of any security configuration that included the examined security devices. The third row presents the effect on burglary rates of any other security configuration that did not include the examined security device. The reference base is no security at all; therefore, the coefficients of security configurations with and without the examined device must be interpreted as changes in the log odds of burglary victimisation compared to having no security device at all.

The estimated coefficients of other covariates included in the models at the household and borough levels are not presented here as they were similar to those from *Model 2*. Thus, the interpretation of the security coefficients must be made assuming that all covariates are held constant.

Table 5.4.3: Multilevel negative binomial estimation of the effects of each security device

	Alarm	CCTV	Grill	Elect. Adds	Protection	Double -lock	Light
$\beta_{sec.\ device}$	-0.12	-0.05	*****-0.13**	-0.03	***-0.11**	-0.07	0.04
$\beta_{other\_sec\_config}$	***-0.12	***-0.12	*-0.11	***-0.12	***-0.12	**-0.16	***-0.13

Table 5.4.4:Multilevel logistic estimation of the effects of each security device

	Alarm	CCTV	Grill	Elect. Adds	Protection	Double -lock	Light
$\beta_{sec.\ device}$	-0.1	-0.04	****-0.11**	-0.04	***-0.10**	-0.05	0.04
$\beta_{other\_sec\_config}$	**-0.10	**-0.10	-0.08	**-0.10	**-0.10	***-0.14	***-011

The tables indicate that configurations that include "*grills on windows*" and "*non-electric protection on fences*" had significant negative effects on burglary rates. The presence of grills on windows reduced the expected number of burglaries by 12% [exp(-0.13)= 0.878]. The presence of non-electric protection on fence reduced the number of burglaries by 10% [exp(-0.11)=0.895]. Similar results were also found regarding burglary risk.

To further examine whether these effects were the same across different households' socio-economic groups, models were separately fitted for each socio-economic group. Table 5.4.5 and Table 5.4.6 present the results from these estimations.

Table 5.4.5: Multilevel negative binomial estimation of the effects on incidence, by SEG

	Alarm	CCTV	Grill	Electr	Protection	Double-lock	Light sensor
c2	***-0.51**	-0.55	***-0.41**	-0.46	-0.28	***-0.40**	*****-0.87**
c3	-0.13	0.11	-0.12	-0.18	-0.07	-0.06	0.06
d	0.04	0.2	****-0.14**	-0.03	****-0.20**	-0.09	0.23
e	-0.32		-0.06	0.23	-0.16	0.12	0.17

Table 5.4.6: Multilevel logistic estimation of the effects on prevalence, by SEG

	Alarm	CCTV	Grill	Electr	Protection	Double-lock	Light sensor
c2	-0.34	-0.4	-0.33	-0.26	-0.19	-0.3	****-0.6**
c3	-0.11	0.15	-0.05	-0.22	0.01	-0.01	0.11
d	-0.8	-0.01	*****-0.16**	-0.01	*****-0.23**	-0.09	0.09
e	-0.16	-15.5	0.03	0.29	-0.04	0.15	0.14

Table 5.4.5 indicates that grills on windows and non-electric protection on fence had a negative effect in every socio-economic group, but this result is only statistically significant among households belonging to the socio-economic groups *c2* and *d* (i.e., upper-middle class and working class). In addition, grills had a larger preventive effect among upper-middle-class households than among working-class households. Compared to households without security protection, security configurations that included grills reduced the number of burglaries by 44% [exp(-0.41)=0.663] among upper-middle class households, and by only 13% [exp(-0.14)=0.869] in working-class households. The preventive effect of configurations with non-electric protection is significant only

among working-class households, with a reduction by 18% in the number of burglaries in this socio-economic group [exp(-0.2)=0.818].

Configurations that included burglar alarms reduced the number of burglaries among upper-middle-class households by 40%, but the preventive effect was not significant in other socio-economic groups. Configurations with double-locks and light sensors were also significantly correlated to the number of burglaries among upper-middle-class households. The effect of double-locks in this socio-economic group was a reduction in the number of burglaries by 13%, while the presence of light sensors decreased the number of burglaries by 58% in the same group.

5.4.3.1.1 Estimated between-borough random coefficients

Multilevel random effect models were fitted to examine whether the preventive effect of security devices varied across boroughs. The results from the random effect models indicate that only the effect of "grills on windows" (χ^2=5.86, p-value < 0.10) and "non-electric protection on fence" (χ^2=5.39, p-value < 0.10) varied across boroughs.

Table 5.4.7 presents the fixed coefficients for the effect of grills and non-electric protection on the number of burglaries and the random parameters of the models.

Table 5.4.7: Random effect of grills on windows

	Grills		***Non-electric protection***	
No security (base)				
Observed security (standard error)	-0.11 (0.05)**		-0.11 (0.07)*	
Other security (standard error)	-0.10 (0.06)*		-0.13 (0.05)***	
Intercept	-4.67 (0.33)***		-4.72 (0.32)***	
Random efects				
lnα (standard error)	2.51 (0.04)		2.51 (0.04)	
Var_Intercept (standard error)	0.11 (0.03)		0.09 (0.02)	
Var_ obs. security (standard error)	0.04 (0.03)			
	Estimate (S.E.)	*p-value*	*Estimate (S.E.)*	*p-value*
CoVar (Intercept, Obs. Security)	-0.05 (0.02)**	0.049	-0.05 (0.02)	0.044
Log likelihood	-16866.3		-16866.7	

Compared to previous random intercept models, allowing the effect of the security devices to vary randomly across borough adds two new parameters to the model: the between-borough variance of the effect of security device ($\sigma^2 u1$) and the covariance of the effect security devices and the random intercept (σu_{01}). Thus, in these models, the effect of security devices in borough j is β_1 (= -0.11 for both "*grills on windows*" and "*non-electric protection added to fence*") + u_{1j}, where the random (security) effect u_{1j} is assumed to follow a Normal distribution with a mean of zero and variance $\sigma^2 u1$*.* The covariance σu_{01} is the covariance between the borough intercepts and the effect of security devices. The negative sign of the effect of security devices and the negative value of its covariance with the borough intercept implies that, in boroughs where the reference house experienced an above-average number of burglaries, the negative effect of security devices was larger than in boroughs with lower incident rates.

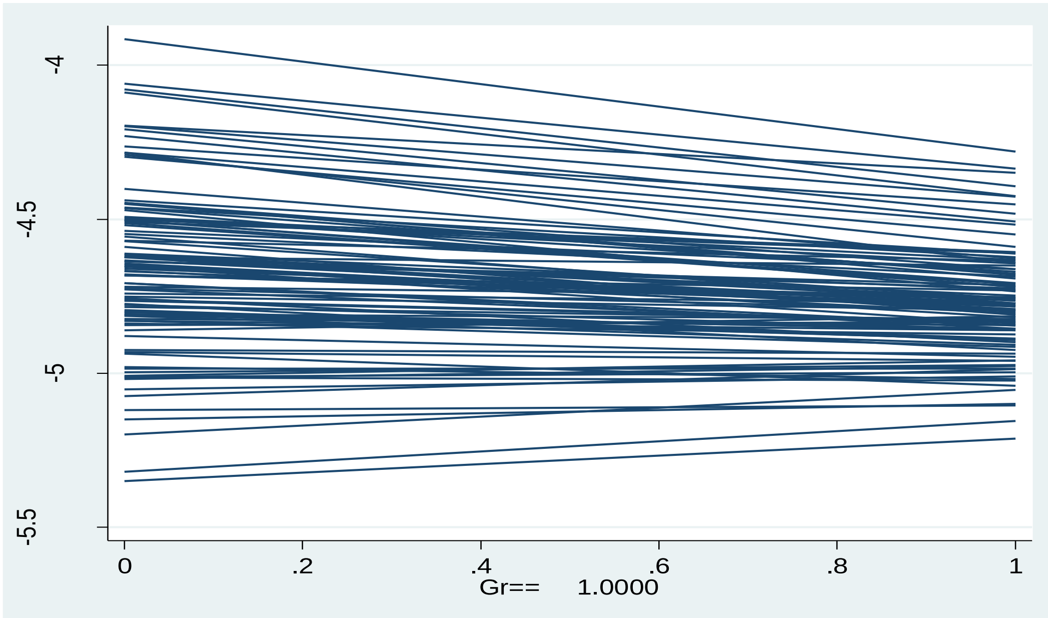
The between-borough variance of the effect of security devices was used to estimate the lower and upper limits of the estimated mean effect, which are provided in the fixed sections of Table 5.4.7. The preventive effect of security configurations with grills on windows on the number of burglaries, estimated at exp(-0.11) in an “average” borough, actually varied from a reduction of 40% (calculated as $\exp[-0.11 - 2\sqrt{0.04}] - 1$) to an increase of 33% (calculated as $\exp[-0.11 + 2\sqrt{0.04}] - 1$) for 95% of boroughs.

Graph 5.4.2 depicts the mean effect of the presence of grills on windows in each borough. The y-axis represents the mean number of burglaries. The x-axis represents households without any security at all and households with grills on windows. Each line represents a borough. Thus, the left end of each line represents the mean number of burglaries among households without security protection, and the opposite end represents the mean number of burglaries among households with grills on windows. The difference between the right end and the left end of each line is the expected effect of grills on the burglary incidence rate in the respective borough.

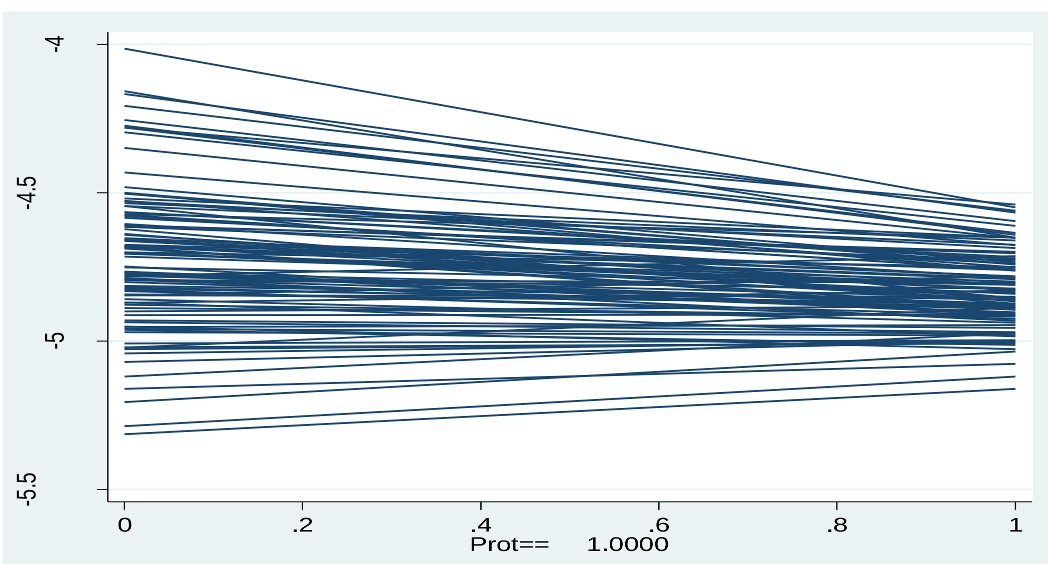
The borough lines follow a “fanning in” pattern, which indicates that the preventive effect of grills on windows was larger in boroughs with a higher incidence rate of burglary. In contrast, in “safer” boroughs, the preventive effect of grills was significantly less, or even counter-productive, for preventing burglary.

Similar patterns were found regarding non-electric protection on fences. The effect of this device varied by a factor from 0.57 to 1.4 in 95% of boroughs. The coefficient for covariance was also negative, indicating that the preventive effect of non-electric protection on fences was larger in boroughs with higher rates of burglary. Graph 5.4.3 illustrates the “fanning in” pattern in the relationship between non-electric protection on fences and borough risk.

Graph 5.4.2: Predicted borough lines for the relationship between log number of burglaries and prevalence of grills on windows



Graph 5.4.3: Predicted borough lines for the relationship between log number of burglaries and prevalence of non-electric protection on property fence



5.4.3.2 Hardening and detection configurations

As described in Sub-section 5.2.2.3 in this chapter, security devices are classified into two categories: those aimed to block burglary, such as double-locks, grills on windows and fence protections, and those aimed to increase detection risk, such as alarms, CCTV or light sensors. Four dummy variables were created to indicate which of the following exclusive conditions was satisfied by an individual household:

- ***No security*** at all;
- Any ***hardening*** device, but no detection device. This category grouped households with "grills on windows", "double-locks", "electric protection on fence" or "non-electric protection on fence" but without a "burglar alarm", CCTV or "light sensor".
- Any ***detection*** device, but no hardening device. This category grouped households with a burglar alarm, CCTV, or light sensor, but without grills, double-locks, electric fences or non-electric protection on fence.
- A ***mixed configuration*** of any hardening and any detection device. This category was used as a control variable.

The first group, which includes grills on windows, double-locks on doors and fence protections, was more prevalent than the "detection" group (burglar alarm, CCTV and light sensor), possibly because the latter is considerably more expensive for the average family budget.[25]

Table 5.4.8 presents the results from fitting the same random intercept model for number of burglaries that was fitted above, but replacing the security

[25] Typically, the installation of an alarm with photodetector has a cost of 165 pounds, plus 44 pounds monthly maintenance. In Chile, 50% of the workforce earns less than 420 pounds per month, and 70% earns less than 547 pounds per month (as a reference, the poverty line for a family of 4 is 460 pounds per month)
On the other hand, only 15% of the workforce earns more than 930 pounds per month. That is, for a large proportion of families in Chile, the use of more advanced anti-burglar security technologies (such as alarms, CTVs, or light sensors) is too expensive.

variable with dummy variables indicating the presence of a “hardening”, “detection”, or “mixed” configuration. The reference category was no security at all.

The coefficients for each covariate included in the model are similar to those presented in Table 5.4.2b. The coefficient for the effect of hardening configurations is estimated at -0.13 at 99.5% confidence. The coefficient for detection configurations is similar in magnitude, but not statistically significant. The coefficient for mixed configurations is also not significant.

To evaluate whether the effects of hardening and detection configurations varied across boroughs, two random effect models were estimated. The results from those models (not presented) indicate that there were not significant variations in the effect of security configurations across boroughs.

However, when the random intercept model was estimated separately for each socio-economic group, the results indicated that the preventive effects of both detection and mixed configurations were large and statistically significant for upper-middle-class households, while the preventive effect of hardening configurations was significant among working-class households. These results were found in estimations of the number of burglaries and burglary risk.

Table 5.4.9 details the effects of different security configurations on the odds of burglary rates. For households belonging to socio-economic group “c2”, the presence of detection configurations reduced the risk of burglaries by 50% and the expected number of burglaries by nearly 60%. The preventive effect of mixed configurations was also statistically significant for this socio-economic group. In contrast, the preventive effect of hardening configurations was not statistically significant for upper-middle class households, but significantly reduced the expected number of burglaries in households belonging to socio-economic group “d” by 15%.

Table 5.4.8:

Estimated effect of "hardening" and "detection" configurations on incidence rate

Covariates	Incidence
Hardening conf.	-0.13***
Detection conf.	-0.12
Mixed config.	-0.08
Age (cent.)	-0.01***
N° children	0.08*
Lone parent	0.15***
N° adults	
1(base)	
2	-0.25***
3	-0.18***
Occupancy	-0.08**
Socio-economic group	
SEG (cent)	0.13***
Type of accommodation	
Flat(base)	
House	0.85***
House on cul de sac	0.66***
House in gated community	0.50*
Metropolitan area	
Non-metro area (base)	
Greater Santiago	-0.03
Greater Valparaíso	-0.05
Greater Concepción	0.29**
% Poor households	0.45*
% Flats	-0.35
% Hh with security protection	0.60*
% Hh in NW schemes	1.45***
Intercept	-4.67***

Random effects

lnα (standard error)	2.52 (0.04)
$\sigma^2_{\mu 0}$	0.07 (0.02)
Log likelihood	-16831.6

Table 5.4.9: Estimated effects of "hardening" and "detection" configurations on incidence rate, by household socio-economic group

		c2	c3	D	E
Incidence rate	Hardening	0.73	0.9	***0.85**	1.11
	Detection	****0.42**	0.92	1.02	0.64
	Mixed	****0.54**	0.97	0.98	0.86
Risk	Hardening	0.75	0.95	***0.86**	1.07
	Detection	***0.50**	0.97	0.99	0.92
	Mixed	***0.67**	0.99	0.89	0.84

5.4.3.3 Estimated effect of the (21) most popular security configurations

This sub-section analyses the effects of the most prevalent configurations of security devices in the sample. The seven devices examined in this chapter produce 128 possible combinations of protection devices, but only 21 of those potential combinations were observed in at least 500 households in the sample. These 21 configurations and the "no security" configuration accounted for 94% of the sample households. Table 5.2.2 presents figures for each of those configurations. The devices that compound each configuration are identified by a single capital letter, in the following way:

- **G**: bars or grilles on windows;
- **D**: double-locks;
- **P**: no-electric protection on fence;
- **E**: electric protection on fence;
- **A**: burglar alarm;
- **C**: CCTV;
- **S**: light on sensor

To estimate the effect of each configuration on burglary rates, the original model with household- and borough-level variables was utilised, but the security variable was replaced by a dummy variable indicating “no security” (the base reference), the examined configuration and any other configuration. Thus, 21 models were estimated, one for each of the 21 configurations observed.

Table 5.4.10 presents the estimated coefficients for the effect of each security configuration on burglary rates. The coefficients for the control covariates are not presented, as they are similar to those reported in Table 5.4.2b.

Table 5.4.10 is divided into two sections: the first presents the estimation results of the individual incident rate, while the second presents the estimation results of individual burglary risk. The first row in each section reports the overall effect of the associated security configuration. The second to fifth row in each section records the effect of the associated configuration when models are estimated separately for each socio-economic group.

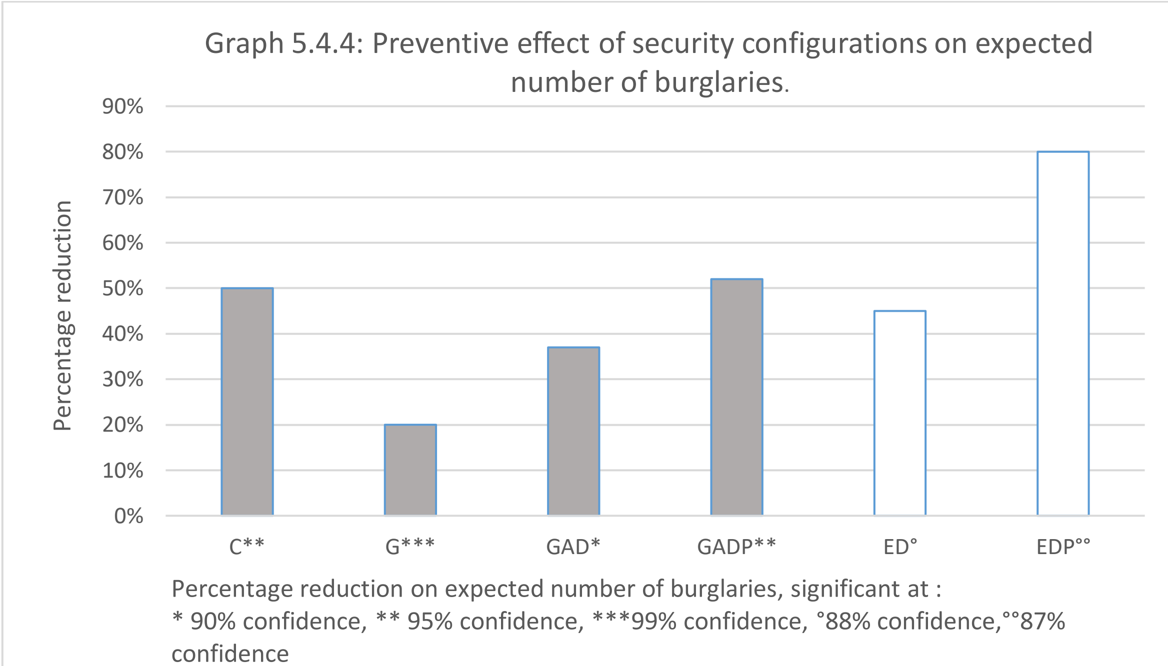
The results indicate that most security configurations used by Chilean households were actually ineffective for preventing burglary, after controlled for other individual and area characteristics. Only four of 21 examined configurations had a significant effect on burglary rates. Thus, for most households, the resources invested in protection were wasted. The ineffectiveness of most security configurations may be due to the poor quality of protection available (which can easily be overcome) or to the poor allocation of resources or selection of devices (devices inappropriate for the context). Further analysis is needed to clarify why most security configurations were ineffective and how to improve their effectiveness. From a practical perspective, information about the security needed in a particular context is crucial for assisting households’ decisions in security investment and for supporting improvement actions by the security industry.

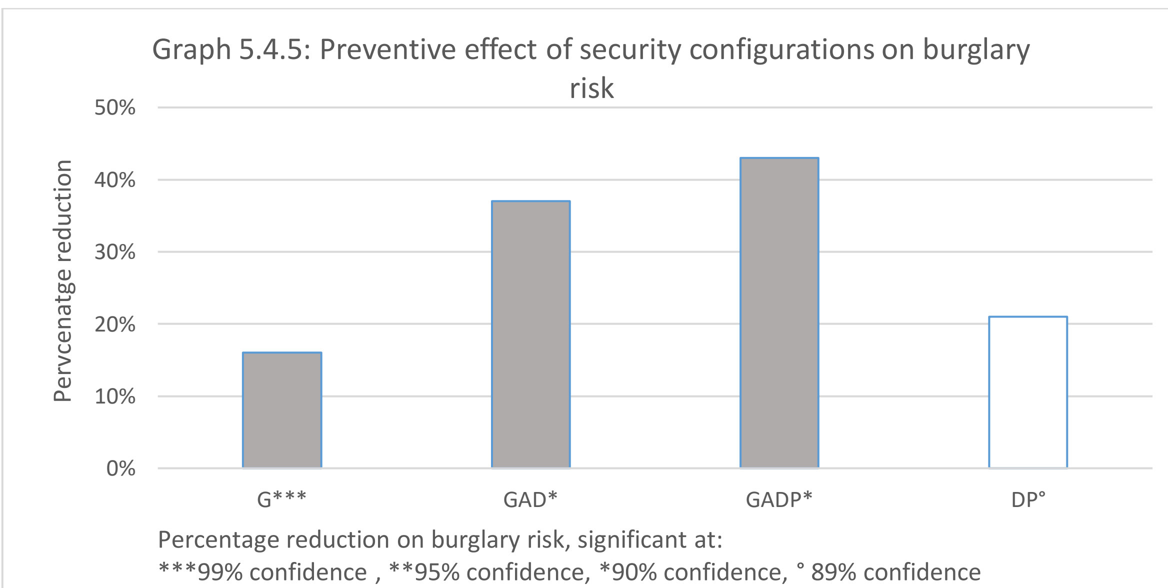
Table 5.4.10: Effect of popular security configurations for full sample and for each socio-economic group												
		G	**GD**	**D**	**GP**	**GDP**	**P**	**DP**	**GA**	**A**	**E**	**GAD**
Prevalence rate	**Sample**	***-0.18	-0.03	0.00	-0.13	-0.05	-0.09	-0.24	-0.03	-0.08	0.14	*-0.47
	c2	**-0.70	-0.15	*-0.64	0.07	0.18	0.09	0.12	0.22	-0.82	0.08	-1.23
	c3	-0.10	-0.02	-0.04	-0.09	0.02	0.11	0.11	-0.11	-0.26	-0.20	-0.05
	d	***-0.20	-0.05	0.02	-0.19	-0.15	**-0.29	***-0.79	-0.13	0.10	0.33	*-0.84
	e	-0.08	0.23	0.27	-0.09	-0.19	0.10	0.19	-14.79	0.66	-0.24	-15.3
		G	**GD**	**D**	**GP**	**GDP**	**P**	**DP**	**GA**	**A**	**E**	**GAD**
Incidence rate	**Sample**	***-0.22	-0.05	-0.02	-0.13	-0.12	-0.14	-0.15	-0.07	-0.15	-0.02	*-0.46
	c2	**-0.71	-0.30	**-0.85	-0.04	0.23	-0.32	0.61	-0.13	-1.07	-0.30	-0.60
	c3	*-0.16	-0.04	-0.05	-0.23	-0.09	0.13	0.11	-0.20	-0.40	-0.45	-0.08
	d	**-0.21	-0.06	-0.00	-0.08	-0.22	**-0.34	***-0.78	-0.14	0.22	0.28	*-0.86
	e	-0.18	0.16	0.35	-0.09	-0.70	-0.04	0.32	-16.00	0.27	-0.67	-20.06
cont.												
		GDS	**GS**	**S**	**C**	**GE**	**GADP**	**GDPS**	**ED**	**DS**	**AD**	**EDP**
Prevalence rate	**Sample**	0.41	0.11	0.04	-0.38	0.06	*-0.56	0.18	*-0.48*	-0.21	-0.02	*-1.28*
	c2	-0.37	-1.01	-0.75	0.40	-0.07	-0.97	-0.87	-0.46	-16.36	0.27	-14.9
	c3	0.10	0.09	*0.51	-0.52	-0.100	-0.3	0.03	-0.37	0.21	-0.47	-15.6
	d	-0.10	0.28	-0.36	-0.44	-0.16	-1.0	0.41	-0.56	-0.74	0.38	-0.38
	e	-1.20	1.29	-14.58	-14.96	**2.03	-0.14	1.43	-14.38	-14.31	-16.6	
		GDS	**GS**	**S**	**C**	**GE**	**GADP**	**GDPS**	**ED**	**DS**	**AD**	**EDP**
Incidence rate	**Sample**	-0.02	0.07	0.06	**-0.70	0.38	**-0.73	0.18	-0.59	-0.18	0.03	-1.61
	c2	-0.76	-1.31	-0.7	-0.22	0.95	-1.54	-1.34	-0.52	-15.02	0.24	-16.52
	c3	-0.05	-0.06	0.38	-0.70	0.49	-0.39	-0.18	-0.24	0.23	-0.14	-16.66
	d	-0.13	0.30	-0.31	-0.68	-0.10	*-1.27	0.64	-0.79	-0.53	0.43	-0.70
	e	0.47	1.93	-17.00	-15.08	0.97	-0.28	1.54	-15.39	-16.46	-22.0	-21.20

G: bars or grilles on windows; **D**: double-locks; **P**: no-electric protection on fence; **E**: electric protection on fence; **A**: burglar alarm; **C**: CCTV; **S**: light on sensor

Regarding the expected number of burglaries, the only single-device configurations that significantly prevented burglary incidents were "***g****rills on window*" and "***C****CTV"*. The presence of ***C****CTV*, as a single device, reduced the expected number of burglaries by 50% (calculated as 1- exp(-0.7)), while the presence of *window* ***g****rills* reduced the incident rate by 20%. The preventive effect of window grills significantly increased when this device was combined with burglar alarm and double-lock on doors (though neither burglar alarm nor double-lock, as single devices, were found to significantly affect burglar victimisation rates), and the preventive effect was even larger when non-electric protection was added. The expected number of burglaries for households with a GAD configuration was 37% (1 – exp(-0.46)) lower than for households with no security at all; for households with a GADP configuration, the expected number of burglaries was 52% (1- exp(-0.73)) lower. Other configurations also exhibited large preventive effects with statistical significance very close to the standard p-value=0.1. For example, the configuration of electric fence and double-lock on doors (ED) reduced the expected number of burglaries by 45% (=1- exp(-0.59)) at 88% confidence. The configuration of electric fence, double-lock and non-electric protection on fence (EDP) was the most effective combination of security devices. At 87% confidence (p-value=0.13), households with this security configuration experienced five times less burglaries than households with no security (exp (-1.61)).

Similar results were found regarding burglary risk. Window grills as a single-device configuration reduced the probability of being burglarised by 16% (1-exp(-0.18)). Households with a GAD configuration experienced 37% (1- exp(-0.47)) lower risk than households with no protection, while those with a GADP configuration experienced 43% lower risk (1 – exp(-0.56)). The combination of double-lock on doors and non-electric protection on fence was also effective for preventing burglary. At 89% confidence (p-value =0.11), this configuration reduced the risk of being burglarised by 21%. These results are illustrated in Graphs 5.4.4 and 5.4.5.





The effects of security configurations were also examined separately for each socio-economic group. The results indicate that certain security configurations were more effective for some groups than others. Table 5.4.11 reports that grills on windows were more effective for upper-middle-class households than for households belonging to other socio-economic groups, even though the effect was significantly negative for middle- and working-class households as well. Grills on windows reduced the expected number of burglaries in upper-middle-class households by 50%, in middle-class households by 15% and in working-class households by 19%.

The estimated coefficients for *GAD* and *GADP* configurations were negative in each socio-economic group, but statistically significant only among working-class households. The presence of a *GAD* configuration was associated with a reduction in the expected number of burglaries by 58% in working-class households, while the presence of a *GADP* configuration was associated with a reduction in the expected number of burglaries by 72% in working-class households. In other words, working-class households with no security protection experienced more than double the number of burglaries compared to working-class households with a *GAD* security configuration and more than three times the number of burglaries than similar working-class households with *GADP* security configurations. Although *CCTV* had the expected negative effect for each socio-economic group, this effect was not statistically significant in any group.

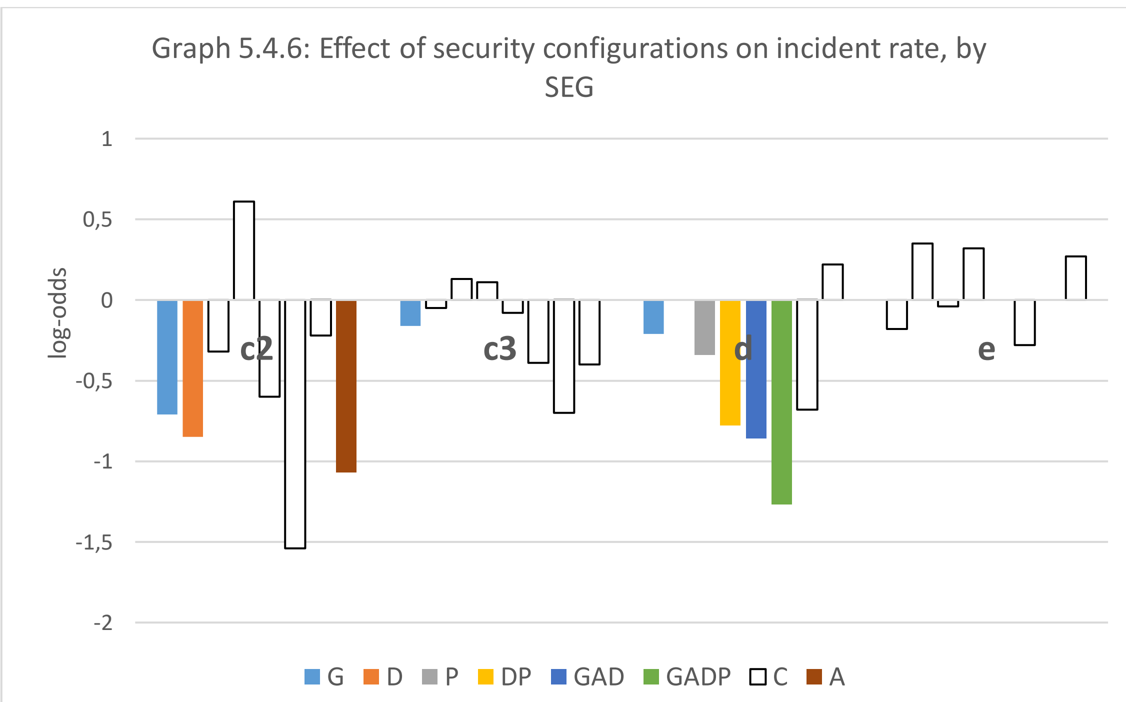
Although the effect of double-locks on door (as a single device) was not significant at the aggregate level, the preventive effect of this configuration (*D*) was significant at 95% confidence in upper-middle-class households. The expected number of burglaries for a “c2” household without security protection was more than double the expected number for a “c2” household with a *D* security configuration (= exp(-0.85)=0.43).

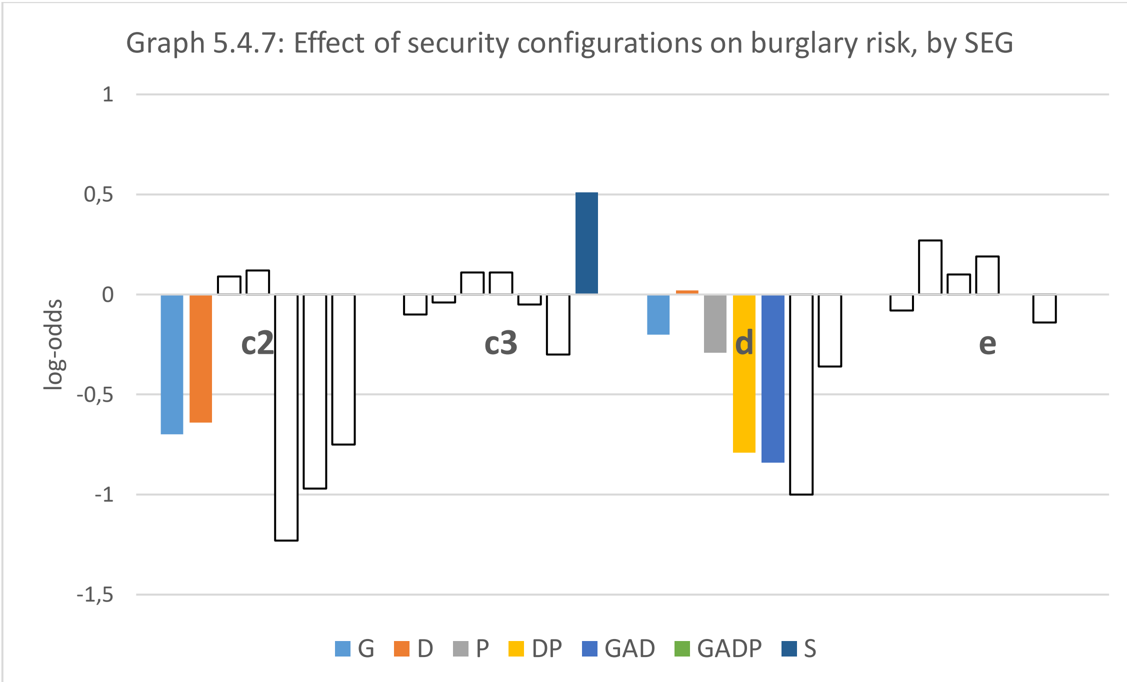
Non-electric protection as single device (*P*) and non-electric protection in combination with double-lock on doors (*DP*) were found to have significant negative effects on burglary rates among households belonging to socio-economic group “d”, at 95% confidence and 99% confidence respectively. Thus, compared to a working-class household without security protection, a working-class household with non-electric protection on fence experienced

29% fewer burglaries (exp(-0.34)=0.71), and a similar working-class household with a *DP* configuration experienced 54% fewer burglaries (exp(-0.78)=0.46)

Finally, burglar alarms in socio-economic group “c2” reduced the expected number of burglaries by 66% compared to a similar households without security protection. Although this result was not statistically significant (p-value= 0.12), it indicates that at 88% confidence (that results are not an “artefact” of available data), an upper-middle-class household suffered three times more burglaries than a similar “c2” household with a burglar alarm for preventing burglary.

The estimated effects of security configurations on burglary risk exhibited similar patterns. In socio-economic group “c2”, window grills and double-lock on doors, as single devices, significantly reduced burglary risk. However, the double-lock as a single device was not effective in socio-economic group “d”. In this socio-economic group, window grills and non-electric protection on fence were the only single devices effective for reducing burglary risk. The combination of non-electric protection and double-lock the and combination of grills, double-lock and alarm were even more effective.





5.5 Discussion

The analysis of the models presented above produced many significant findings. This research examined whether the following conditions were met in the sample:

- Particular demographic and area characteristics that affected burglary rates at the household level
- Differences in burglary rates between households with security protection and households without security protection
- Differences in the preventive effects of particular security devices and combinations of security devices
- Interaction effects between the preventive effect of security configurations and household and borough characteristics

The following discussion is structured around these research questions.

5.5.1 Effect of household and borough characteristics on burglary rates

The first finding in this research is the plausibility of opportunity theories for explaining burglary victimisation rates among Chilean households. To the researcher's knowledge, this research marks the first study to model burglary rates using data from Chile. The results indicate that most covariates affected burglary rates as expected by opportunity theories, which have been rarely tested in developing countries (De Souza and Miller, 2012; Kruger and Landman, 2008; Lemieux and Clarke, 2010; Pires and Clarke, 2011; Zhang, Messner and Liu, 2007). Thus, the ability of opportunities theories to partially explain burglary rates in Chile is a valuable finding of this research.

The analysis suggests that there a several variables that consistently affect both the probability of being burglarised and the expected numbers of burglaries. These variables are household socio-economic status, age of head of household, presence of children in household, number of adults in household, lone-parent condition and occupancy (measured via the presence of a housekeeper or pensioner). As expected, the type of accommodation also significantly affected burglary victimisation rates. With regards to borough characteristics, the percentage of poor households, the prevalence of any security protection and percentage of households involved in a NW scheme significantly increased the predicted mean number of buglaries. In addition, living in the Greater Concepción metropolitan area increased victimisation rates in comparison to living in a non-metropolitan area.

In line with previous literature (Sampson and Wooldredge 1987; Trickett et al. 1995; Osborn et al. 1996; Ellingworth et al. 1997; Osborn and Tseloni, 1998; Tseloni et al.2002), the results indicate that the age of the head of household negatively affected burglary victimisation in Chilean households. A number of factors may explain the reduction in predicted victimisation as the age of the head of household increases. From an opportunity theory perspective, an increase in the age of the head of household may increase the level of home-centred activities (Cohen et al, 1981) and thereby the level of guardianship at home. It may also be that the attractiveness of a dwelling decreases as the age of the head of household increases, because older individuals are less likely to own valuable items, such as the latest popular gadgets.

The positive effect of having children on predicted burglary incidence may similarly be explained by a corresponding increase in routine activities out of the home, such as taking children to/from school, shopping and outdoor activities. The results reveal that having children affected burglary incidence, but not burglary prevalence estimations. These results may indicate a relationship with repeat victimisation that is not captured by the prevalence model. Routine activities related to children are not easily modifiable or avoidable; therefore children may be associated with a pattern of dwelling emptiness that is attractive to burglars.

Contrary to the results from the British Crime Survey estimated by Tseloni (2006), but similar to the effect found by Tseloni et al. (2004) in the Netherlands, the presence of two or more adults in a household reduced the predicted number of burglary incidents compared to one-adult households. The negative effect of the presence of two adults was greater than the preventive effect of three or more adults. The respective reductions in burglary incidence were estimated as -22% (exp*(-0.25)*) and -16% (exp*(-0.18)*) at 99.5% confidence. This finding contradicts the routine activity theory, according to which more adults increase the level of guardianship over a household. However, is is possible that the third-adult dummy variable captured households with adult children (for example, university students living with parents) who spend less time at home such that their effect on guardianship level is less than that of a second adult, who is usually the partner of the head of household. It may be even possible, as proposed by Tseloni (2006), that this variable captured households with many cohabiting adults, such as university students sharing accommodation. As the Tseloni (2006) argued, “such households may have more goods that are attractive to burglars, be less security conscious, subsequently, be a more attractive and profitable target”.

In line with the results estimated by Tseloni (2006) and Tseloni et al. (2004) for the UK, the US and the Netherlands, lone-parent Chilean households suffered exp(0.15)% more burglaries than similar households. Further analysis found that the lone-parent effect varied across socio-economic groups. The lone-parent effect was significantly large among upper-middle-class and middle-class households, resulting in around exp(0.85)% and exp(0.20)% increases in burglary incidence, respectively.

As expected, the presence of a household member whose occupational status was housekeeper or pensioner significantly reduced the predicted number of burglaries by exp(-0.08). The effect of this variable likely acts through an increase in guardianship and thereby the risk of detection.

Respondents living in a flat also experienced fewer burglaries than otherwise identical respondents living in houses. Compared to flats, houses on through-roads experienced 2.4 times more burglaries (calculated as exp(0.87)). In line with opportunity theories, the expected number of burglaries in houses decreased with a reduction in levels of exposure and accessibility. Thus, houses on culs-de-sac experienced two times more burglaries than flats, while houses in gated communities experienced 60% more burglaries than flats.

The effects of households' socio-economic status indicate that burglary victimisation is higher among relatively poor households, which is in line with previous European research (Tseloni & Farrell, 2002; Tseloni et al., 2004). However, it is unclear how socio-economic status affects burglaries rates,. The effect of socio-economic status on burglary rates is independent from households' ability to afford security protection, which was also included in the models and is detailed in next section. Furthermore, the effect of socio-economic status is independent from the effect of the percentage of poor households in a borough, which was also included in the models. Therefore, proximity to potential burglars, used by Tseloni et al. (2004) to explain differences in the effect of socio-economic status between the UK and the US, is not sufficient to explain burglary victimisation differences across socio-economic groups in Chile. Further research is needed to clarify the causal mechanisms that link socio-economic status and burglary rates. Potential hypotheses should considerer unmeasured factors at the individual level, such as the presence of domestic workers, and unmeasured variables at the neighbourhood level that are not captured by borough-level variables, such as informal social control or neighbourhood situational features.

Regarding borough-level variables, the percentage of poor households in boroughs was significantly related to burglary rates. An increase by 10 percentage points in a borough's percentage of poor households increased the expected number of burglaries per household by 6.8%. As burglars tend to live in poor households, it is reasonable to assume that a relative increase in the percentage of poor households would increase a borough's population of potential burglars, thereby increasing the proximity to potential burglars. Previous research has found that burglars choose their targets within familiar areas in the course of everyday activities (Cromwell et al., 1991; Hope, 1999); thus, it is logical that a borough with a larger population of burglars would have higher rates of burglary victimisation. An alternative explanation is that the percentage of poor households serves as a proxy for other manifestations of deprivation and borough vulnerability, such as lack of informal social control or urban decay. These explanations may also explain the significant positive relationship between household burglary rates and the percentage of poor households at the borough level.

The prevalence of security protection and the percentage of households involved in NW schemes at the borough level were positively related to burglary rates. Nevertheless, these results should not be interpreted as disproving the value of such preventive measures. It is more likely that these variables serve as proxies for perceived borough risk from the household perspective, capturing part of the variation in burglary rates across boroughs.

In sum, the estimated effects of most variables included in the models of burglaries rates in this research suggest that opportunity theory is an appropriate theoretical framework to explain and model burglary victimisation in Chile. Accessibility, guardianship, and proximity to offenders appear to be significant factors determining the burglary rates among Chilean households. However, these results should be interpreted cautiously, as there was a large unexplained variance between households.

5.5.2 Effect of household security protection on burglary rates

The presence of at least one security device of any kind significantly reduced the probability of being a victim of burglary and the expected number of burglaries experienced. The results indicate at 99% confidence that a household with any security protection suffers 11% fewer burglaries than an otherwise identical household. At 95% confidence, the results indicate that the risk of being burglarised among households with any security protection is 9% less than the risk among households with no protection.

These effects were similar in magnitude to those found by Miethe and MacDowall (1993) and Wilcox et al. (2007) using data from Seattle, US. In contrast, Tseloni (2006) and Tseloni et al. (2004) found a positive (counter-productive) effect of household protection on burglary rates in three countries: the USA, the UK and The Netherlands. These differences in the estimated sign of the protection effect may be explained, as Tseloni (2006) suggested, by the fact that the data used by Tseloni and colleagues did not identify whether security protections were introduced as a response to burglary, while the Seattle data analysed by Wilcox, Miethe and colleagues explicitly examined only security measures introduced before the victimisation reference period of the survey. This research similarly ensured that all security measures examined were introduced before the victimisation reference period. This methodological issue may also explain the differences between this thesis's results and the positive effect of security devices found by Tseloni and colleagues.

5.5.3 Are security devices similarly effective for preventing burglary?

As expected, some devices were more effective than others for preventing burglary. The presence of grills or bars on windows, either as a single device or combined with other devices, significantly reduced both the risk of victimisation and the expected number of burglaries. As a single device, grills or bars reduced the expected number of burglaries by 20%. In addition, the results indicate that the preventive effect significantly increased to nearly 40% reduction in the expected number of burglaries when grills were combined with burglar alarm and double-lock on doors (GAD configuration). A further increase in the preventive effect was achieved when non-electric protection on fence was added: households without security protection suffered two times more burglaries than otherwise identical households with GADP security configurations.

Non-electric protection on fence was also significantly associated with a reduction in burglary rates. The presence of this protection device was associated with a 10% reduction in the expected number of burglaries. However, as a single device, non-electric protection was not significantly related to burglary rates; rather, its preventive effect was achieved when combined with other devices. Along with the GADP configuration mentioned above, the combination of non-electric and electric protection on fence and double-lock on doors was particularly effective for preventing burglary. The results indicate that a household with an EDP security configuration suffered five times fewer (calculated as exp(-1.61)=0.19) burglaries than an otherwise identical household without security protection. Furthermore, the additional effect of adding non-electric protection to the ED configuration was a 45% reduction in burglary incidence.

CCTV used as single device was also significantly related to burglary rates. A household with CCTV and no other security devices suffered half (50%) the number of burglaries as an otherwise identical household without security protection. That is, CCTV used as a single device was similarly effective in preventing burglary as the four-device configuration GADP. Other security configurations with CCTV were not significantly correlated to burglary rates, although some demonstrated the expected negative effect on burglary rates.

CCTV was the only “detection-aimed” device that clearly affected burglary rates, but this effect was significant only for CCTV as a single device. Burglar alarms exhibited an insignificant effect on burglary rates across the population, except when combined with grills on windows and double-lock on doors. Light sensors were also not significantly effective for preventing burglary across the population.

Most effective security configurations for preventing burglary in Chile were combinations of devices aimed to increase the difficulty of breaking in. Basic security was obtained by reinforcing windows, and further gains in protection were yielded by reinforcing door-locks and fences (electric and non-electric reinforcements). However, for an average household without security, the first security device should be CCTV, as CCTV as a single device offered similar protection to the four-device GADP security configuration.

5.5.4 Are security devices similarly effective in different contexts?

The results from the estimated models indicate that the effects of security devices and combinations of devices significantly vary across households and boroughs. Relevant variations in the effects of security configurations across households were determined by household socio-economic status. For example, grills on windows and non-electric protection on fences, both found to be significantly preventive in the full sample, were more effective among upper-middle-class households than in other socio-economic groups.

Separate estimations of the effects of security protection by socio-economic group reveal that the presence of burglar alarms, double-locks on doors and light sensors was significantly effective for preventing burglary among upper-middle-class households, but not for other socio-economic groups. In these households, burglar alarms reduced the expected number of burglaries by 40%, while light sensors reduced the expected number of burglaries by 60%.

Regarding the interaction effect between security devices and borough characteristics, non-electric protection was more effective in boroughs with a low prevalence of NW schemes (exp(-0.36) + exp(1.5) x %NW). In contrast, burglar alarms were significantly more effective in boroughs with a high prevalence of NW schemes. In addition, CCTVs were more effective in boroughs with a high proportion of flats, which may be related to the fact that more affluent households tends to live in boroughs with a larger proportion of flats. Thus, it is possible that CCTVs were more effective in boroughs with more affluent households.

The coefficients of significant security configurations reveal that several configurations significantly prevented burglaries in one socio-economic group and not in others. Graph 6.4.5 illustrates that that, in ascending order, P, DP, GAD and GADP security configurations were significantly effective for preventing burglaries among working-class households, but not among upper-middle-class households. In addition, double-locks on doors (single device) and burglar alarms (single device) were significantly associated with reductions in burglary rates among upper-middle-class households, but not among working-class households. Thus, while burglar alarms did not significantly prevent burglary among poor households, upper-middle-class households with burglar alarms suffered one-third the number of burglaries compared to otherwise identical “c2” households without security protection.

5.6 Theoretical implications

Several theoretical implications may be drawn from the results in this chapter. Firstly, opportunity theory seems to be an adequate theoretical framework for analysing and modelling burglary rates, and likely other crime rates, in Chile. To the researcher’s knowledge, this research is the first analysis of individual burglary rates in Chile and also the first study to model crime victimisation using the conceptual tools of opportunity theory to analyse Chilean data. The results presented in this chapter demonstrate that each measure of guardianship included in the models significantly affected burglary rates at the household level in the period of study. The signs/directions of the effects of guardianship measures were in line with predictions from opportunity theory. Measures that involved leaving the residence unoccupied were positively associated with increases in burglary rates, while measures that involved an increasing presence of capable guardians were associated with reductions in burglary rates. Accessibility, measured via the type of accommodation, also seems to offer a reasonable justification for why flats were significantly less burglarised than houses and why houses on culs-de-sac were significantly less burglarised than houses on through-streets.

The characteristics of boroughs were also important according to the results. Proximity to potential offenders is a likely explanation for why living in a borough with a higher proportion of poor households significantly increased the predicted incidence of burglary in the sample period. This finding aligns with findings from Reyes (2014) and Tocornal et al. (2014), who found that location of offenders' residence is positively associated to the borough level of segregation and the prevalence of social housing. Proximity to potential offenders is also a reasonable explanation for the significantly higher victimisation of households living in metropolitan areas, such as Greater Concepción, compared to households living in non-metropolitan boroughs.

Effects of borough prevalence of household security protection and involvement in NW schemes on individual burglary rates were counterintuitive from opportunity theory perspective. It is expected that boroughs with more individual and collective security measures are less attractive to burglars and therefore individual burglary rates are lower in those boroughs. However, a possible explanation for these counterintuitive findings is that those variables serve as proxies for perceived borough risk from the household perspective, thus capturing part of the variation in burglary rates across boroughs. The reduction in between-borough unexplained variance in models including those variables would support this hypothesis.

As expected by opportunity theory, the prevalence of household security protection significantly reduced burglary victimisation. The models examined in this research contribute to distinguishing guardianship variables from security protections which are linked to a hardening target mechanism (Holls et al., 2011). This distinction between guardianship and dwelling-hardening devices is important, as they involve different preventive mechanisms. Across Chilean households, the prevalence of household protection significantly reduced the expected number of burglaries by 11%, but this preventive effect varied for different kinds of security devices.

Most popular physical protection devices used by Chilean households can be classified as aiming to increase the difficulty of breaking into a property or aiming to increase burglars' risk of being detected. The results from the models in this research demonstrate that devices aimed to harden the target were effective across Chilean households, but devices aimed to increase the risk of detection were effective only among upper-middle-class households. Furthermore, light sensors, and to a lesser degree, burglar alarms, were counterproductive in the poorest "d" and "e" groups. These results contradict the findings from Tilley et al. (2011) in England and Wales, where more elaborate security devices were more effective for relatively poorer households.

In the case of Chile, a reasonable explanation for why "detection" devices were more effective in more affluent households may be that these devices work in contexts of higher informal control and social cohesion, but their preventive mechanism fails where no capable guardian is inclined to intervene. Physical security protections, as argued by Hollis et al. (2013), are not capable guardians. Nothing happens if alarms sound or lights turn on and nobody notices or intervenes (e.g., disrupting, calling police). In contrast, detection devices are effective in contexts of high collective efficacy (Sampson et al., 1997), where the willingness of potential guardians to intervene activates the “increasing risk of detection” preventive mechanism. As the factors that shape the level of collective efficacy are differentially distributed across socio-economic groups, detection devices may have been more effective among more affluent households because, from the offender´s perspective, intervention was more likely in such households. In the context of the poorest socio-economic group, the willingness to intervene may be diminished by apathy/resignation, fear or distrust of police. This argumentation is aligned with previous research which found a positive relationship between household socio-economic status and informal social control and neighbourhood collective efficacy in Greater Santiago (Tocornal et al., 2014).

A related hypothesis is that the police’s response may be perceived as more effective when calling from affluent households than when calling from poorer households. Offenders may expect that the likelihood of police intervening is lower for poorer households; therefore concerns about activating an alarm or light sensor are also lower. Alternatively, it may be that in the context of poorer households, the presence of elaborate security devices indicates more valuable goods to be protected, thereby increasing the attractiveness of the dwelling.

CCTVs may activate two different preventive mechanisms: On the one hand, CCTVs may increase offenders’ perceived risk of detection, as an offender will think that someone is watching. A kind of panoptical effect. On the other hand, CCTVs potentially store images that can lead to the identification and thereby the prosecution of burglars, even if a burglary has been successfully committed. Thus, the preventive effect of CCTVs does not rely on the immediate availability and intervention of capable guardians. This may be the reason why CCTV as a single-device configuration demonstratd a large preventive effect.

The results from this research highlight the important role of contextual variables in analysing individual burglary victimisation. As argued above, household socio-economic status may be serve as a proxy for characteristics of the surrounding area of a dwelling, which are related to household income, but not fully captured by this variable. The relationship between the effectiveness of security protection and social cohesion in the area illustrates the importance of contextual characteristics for analysing burglary rates. Other relevant characteristics of the areas surrounding dwellings, which tend to be concentrated by socio-economic status, may be the layout of streets, signs of disorder, street lighting and the visibility of dwellings.

Using multilevel analysis for modelling individual burglary rates improved the accuracy of the estimated effects and demonstrated that there were significant differences in the mean burglary rate across Chilean boroughs. This between-borough variance was partially explained by the borough-level variables included in the models, but around 50% of the initial between-borough variance remained unexplained after controlling for the percentage of poor househousds, prevalence of flats and prevalence of security measures (physical protection and NW schemes) in boroughs.

Proximity to potential burglars seems to be the most likely explanation for the significant positive relationship between burglary rates and the percentage of poor households in a borough. However, the observed significant positive effect of the prevalence of security protection, and particularly the prevalence of NW schemes, is hardly explained by opportunity or environmental theory. Indeed, it is expected that boroughs with a higher prevalence of security measures would exhibit lower burglary rates. A possible reason for this unexpected relationship is that the percentage of households with security protection and participation in NW schemes captures the perceived risk of the borough and thereby the positive relationship with burglary rates. Further analysis is required to clarify this counter-intuitive finding.

The analysis of the interactions between security and borough-level variables resulted in few significant effects. It is possible that the borough-level characteristics were too broad to impact the effectiveness of security protection, which is affected by more specific environmental characteristics captured by household socio-economic status. However, two significant interactions are worth noting.

First, the estimated covariance between the effects of security devices and the unexplained between-borough variance in burglary rates (after fitting the models) indicates significant negative relationships. These results imply that the effectiveness of the two protection devices which effectively prevented burglary across the sample (grills on windows and non-electric protection on fence) varied across boroughs such that they were more effective in more risky boroughs (i.e., boroughs with higher burglary rates). The fact that hardening protections, which are basic compared to more elaborate alarms or light sensors, were more effective in boroughs with a higher mean number of burglaries might indicate that a large portion of the burglaries that occurred in those borough are opportunistic and thereby easily deterred or blocked by basic security protection.

Second, a significant negative interaction was found between the prevalence of burglar alarms and a borough's percentage of households involved in NW schemes. This finding indicates that burglar alarms were more effective for preventing burglary in boroughs where relatively more households were involved in NW schemes. This finding supports the argument that burglar alarms work most effectively in contexts of higher social cohesion and informal control.

5. 7 Limitations

Despite this chapter's contributions to understanding the burglary rates in Chile and the role played by security protection in preventing burglaries, several considerations must be noted for further analysis of the results discussed here.

First, the results presented in this chapter came from a sub-sample of households that did not install any security protection during the victimisation reference year (N= 130,000). Thus, all households that installed any security protection in the 12 months prior to the survey were excluded from analysis

(N= 47,416). The purpose of this approach was to ensure that security devices were not installed as a response to burglary. The resulting estimations found a negative relationship between the prevalence of security protection and burglary rates. In contrast, when analyses were made including the households that installed a security device during the reference year, the resulting estimations found a positive relationship between the prevalence of household security protection and burglary rates, likely due to the endogeneity problem previously noted.

The cost of this methodological strategy was the exclusion from analysis of households at higher risk of burglary, which is evidenced by differences in the burglary rates between households that installed security protection during the survey reference year and those that did not: while the prevalence of burglary was 4.8% among the former group, it was just 3.1% among households that had not installed security protection during the survey reference year. Therefore, the estimated effects of security protection might be different for households at higher risk of burglary. Second, as mentioned previously, the available data from the ENUSC survey lack measures of the characteristics of surrounding areas. Therefore, theoretically relevant variables for explaining individual burglary victimisation could not be included in this chapter´s models. It may be that area characteristics such lighting, street layout, intensity of use, familiarity among neighbours and/or other measures of social cohesion and collective efficacy explain a portion of the relatively large unexplained variance in burglary rates between households in same boroughs. The models' estimation of between-household variance demonstrates that the incorporation of individual-level variables slightly affected it. In other words, the individual demographic and lifestyle measures employed in this research were not detailed enough to capture subtle differences in burglary rates between households. Therefore, further efforts to include more detailed information about lifestyle and neighbourhood characteristics are required in order to improve the quality of data and the accuracy of burglary models for Chilean households.

5.8 Summary

From the analysis presented in this chapter, the following conclusions were reached:

1) The prevalence of security protection significantly reduced both the risk of burglary victimisation and the expected number of burglaries.
2) The preventive effects differed between security devices, with grills on windows, non-electric protection on property fence and CCTV the most effective single devices. Greater protective effects were achieved by combining grills on windows, non-electric protection, double-locks and burglar alarms.
3) The effectiveness of security devices vared across socio-economic groups. Most “hardening” configurations significantly reduced burglary rates in working-class households, but not among upper-middle-class households. In contrast, more elaborate security devices (such as burglar alarms and light sensors) were effective only for upper-middle-class households.
4) The effectiveness of grills on windows and non-electric protection on fences was significantly greater in boroughs with higher rates of burglary. The relationship between the prevalence of effective security configurations and the percentage of poor households in a borough was not significant. The prevalence of burglar alarms was significant for preventing burglary in boroughs with a larger percentage of households involved in NW schemes, while CCTVs were significantly more effective in boroughs with a higher prevalence of flats.

Those findings affirm that the increasing prevalence of security protection significantly reduced burglary rates at the household level. The results outlined in this chapter inform the subsequent analysis of the relationship between the prevalence of security devices at the regional level and burglary trends.

Chapter 6: Is the burglary trend in Chile associated with temporal changes in the prevalence of household protection?

As explored in Chapter 5, the prevalence of security protection, particularly certain security configurations, significantly decreased the risk and incidence of burglary in a sub-sample of households that did not install security protections over the victimisation reference period. The analysis in Chapter 5 aimed to establish whether households' security protections were effective for preventing burglary at the household level.

This chapter examines the role that the increasing prevalence of security protection plays in explaining burglary rates in Chile using pseudo-panel data at the regional level for the period 2007-2013. The literature has identified various factors that affect burglary rates at area levels, such as the incarceration rate, detection rates and other demographic and economic variables. The effects of the prevalence of household protection were estimated in this research by controlling for such factors.

In contrast to Chapter 5, this chapter analyses burglary rates at the regional level in order to test whether changes in regional burglary rates can be partially explained by changes in the prevalence of security devices and/or by changes in the prevalence of particular security configurations. Chapter 5 established that security protection significantly contributed to reducing households' victimisation risk. Chapter 6 subsequently explores the effect at the aggregate level. The ENUSC data were aggregated at the regional level due to the availability of data on the control variables. In addition, aggregation at this level should avoid potential biases in estimates due to the potential displacement of burglary from neighbourhoods or boroughs with a higher prevalence of security devices to those with a lower prevalence of security devices.

Random effects and fixed effect models were estimated in order to answer the following questions:

- Has the increasing prevalence of household security protection negatively affected burglary rates in Chile?
    - Did the prevalence of household security protection affect regional burglary rates?
    - Did changes in the prevalence of security devices affect burglary rates within regions?
    - Did changes in the prevalence of security devices affect burglary rates at the average (national) level?

6.1 Previous research

As outlined in Chapter 2, there are several hypotheses to explain the observed decline in crime victimisation rates across industrialised Western countries (Tonry and Farrington, 2005; van Dijk et al., 2005; Tseloni et al., 2010; van Dijk and Tseloni, 2012). The key hypotheses concern demographic changes (Blumstein 2000; Fox 2000; Levitt 2004); increasing prison populations (Langan and Farrington 1998; Levitt 2004); changes in policing strategies (Eck and Maguire 2000); the increasing number of police officers (Marvell and Moody 1996; Levitt 2004), gun control policy (Rosenfeld 1996; Levitt 2004); changing crack markets (Levitt, 2004); the legalisation of abortion (Donohue and Levitt 2001) and changes in the economy, which is derived from Becker's classical model of crime (Becker, 1968).

However, several of these hypotheses are clearly not relevant to the Chilean case. For example, abortion law in Chile has not changed in many years and marks one of the toughest, most prohibitive policies in the world (even therapeutic abortion is not allowed). Changes in crack or drug markets are also not relevant to Chile, as the country never reached the epidemic characteristics observed in the US during the 1980s and early 1990s. The same observation applies for gun proliferation; therefore, gun control policy is not an effective explanation for the decline in Chilean victimisation rates.

Farrell (2013) proposed five tests to assess whether a particular hypothesis is a "viable theory of the crime drop". According to Farrell´s system, the hypotheses listed in the previous paragraph would not pass the second test: the cross-national test. Other authors have also noted that many explanations for the crime drop do not account for the fact that there are significant differences regarding the proposed explanatory variables across countries experiencing very similar downward trends in crime (van Dijk et al., 2005; Zimring, 2007).

Another critical test according to Farrell is the "phone theft and e-crime test", which examines whether the proposed hypothesis is "compatible with the fact that some crimes such as phone theft and e-crimes were increasing while many crime types were decreasing". Most hypotheses to explain the crime drop fail to pass this test because they focus on the number or the motivation of offenders. If a reduction in crime rates can be explained by improvements in the economy or by demographic changes, these factors should negatively affect all types of (property) crimes. However, these hypotheses are unable to explain why some (property) crimes have decreased in prevalence while others have increased.

According to Farrell, the security hypothesis is the only hypothesis to explain the crime drop that passes the five tests.[26] The security hypothesis was first proposed by Clarke and Newman (2006) and van Dijk (2007) and was further developed by Farrell and colleagues (Farrel et al., 2008, 2010, 2011a, 2011b, 2014; Tseloni et al., 2010, 2014; Tilley et al., 2011). With opportunity theories of crime as the theoretical framework, the security hypothesis proposes that "change in the quantity and quality of security was a key driver of the crime drop" in Western countries (Farrell et al., 2011).

Evidence regarding vehicle theft and burglary supports the security hypothesis. Several studies have found that the prevalence of vehicle security devices

[26] The other tests are: preliminary empirical evidence, the prior crime increase test, and the varying trajectories test.

increased in parallel with the observed decrease in vehicle theft across many countries (Fujita and Maxfiel, 2012; Brown, 2013; Brown and Thomas, 2003; Van Ours and Vollard, 2013; Kriven and Ziersch, 2007; Farrell et. al., 2011; 2014). These studies also found that the average age of stolen vehicles increased in parallel with the decline in vehicle theft. This finding is consistent with the security hypothesis, as newer vehicles, which have more and better security protections, are more difficult to steal. These studies similarly found that temporary theft declined at a larger and faster rate than permanent theft, which is also consistent with the security hypothesis, because security devices are more likely to deter “less experienced adolescent car thieves” (Farrell et al., 2014).

The literature linking the increasing prevalence of household security devices to the decline in burglary rates is less extensive than that for vehicle theft (Tilley et al., 2011; Tilley et al., 2014; Tseloni et al., 2014; Vollard and Van Ours, 2011), but it is also consistent with the security hypothesis. Tilley et al. (2014), for example, found that the reduction in burglaries in which security had to be overcome was twice as large as the reduction in burglaries by another entry method; this finding links the declining burglary rates to improvements in the quality of household protection.

Most evidence supporting the security hypothesis relies on bivariate analyses that explored the correlations between the prevalence of security devices and burglary rates at the individual level (Tseloni et al., 2014) or aggregate level (Tilley et al. 2014). Few studies on the security hypothesis have included a comprehensive set of crime-influencing variables in their analysis. As suggested by the literature reviewed in Chapter 2, crime levels are affected by many factors, such as law enforcement, social-economic conditions and demographic composition. Omitting some of these factors can lead to spurious correlations if the omitted variables are correlated with the included explanatory variable. For example, the negative correlation between the prevalence of security devices and car theft and burglary rates may be due to the negative correlation between crime rates and a third variable that is not included in the model specifications (e.g., economic conditions), but correlated with the prevalence of security devices. In the security hypothesis literature to date, only Vollard and van Ours (2011) used a set of control variables to estimate the effect of mandatory improvements in household protection on burglary rates in the Netherlands.

As established by Farrell et al. (2014), the security hypothesis passes the cross-national test, as supportive evidence has been found in several countries, namely the US, the UK, Australia, the Netherlands and other European countries. However, to this researcher's knowledge, there is no evidence on the relationship of between the prevalence of security devices and burglary rates in developing countries. Given that evidence about the crime drop, particularly regarding burglary, suggests that the decline in crime may be larger in Latin America, Africa and Asia (Tseloni et al., 2010), the lack of evidence from these countries is a gap for validation of the security hypothesis.

The analysis presented in this chapter aims to contribute to the existing literature on the security hypothesis by examining the effect of the increasing prevalence of household security devices on burglary rates across Chilean administrative regions during a seven-year period (2007-2013). As explored in Chapter 4, a notable decline in burglary rates was observed during this period across Chilean administrative regions. By analysing a pseudo-panel data set of 15 regions and seven years, containing 105 observations, this chapter tests the following hypothesis:

> *The increasing prevalence of household security devices negatively affected burglary rates in Chile between 2007 and 2013.*

6.2 Modelling strategy

Pseudo-panels were used to estimate the effects of the increasing prevalence of security devices on Chilean burglary rates across the country. The pseudo-panel approach offers a method to "longitudinalise/panelise" the cross-sectional data from the ENUSC and enables the use of panel models on the constructed "pseudo-panels". Pseudo-panels have been used to model a wide range of topics, including car ownership (Dargay et al. 1999), the price elasticity of alcohol demand (Meng et al., 2014), investment (Duhautois, 2001), consumption (Gardes et al., 2005), women's participation in the labour market (Afsa and Buffeteau, 2005) and subjective well-being (Afsa and Marcus, 2008).

In a seminal paper, Deaton (1985) suggested that repeated cross-sectional data may be used to estimate fixed effect models (see Chapter 3) by grouping individuals sharing some time-invariant characteristic (e.g., geographic region) into cohorts and subsequently considering the model in terms of cohorts rather than individuals. In other words, the means of the observed variables are replaced by the means of these variables within each cohort. These data can then be treated as panel data and panel data estimation techniques can be applied.

This model can be written as:

$$\underline{y}_{ct} = \underline{x}_{ct}\beta + \underline{\alpha}_{ct} + \underline{\mu}_{ct}, \qquad c = 1,...,C; \quad t = 1,....,T$$

where c = 1,...,C denote the cohorts, and $\underline{y}_{ct}$ and $\underline{x}_{ct}$ denote the cohort averages. In this research, cohorts are defined by Chilean administrative regions, which result in a pseudo-panel of 15 cohorts over seven time periods based on seven cross-sectional surveys from 2007 to 2013.

Two considerations should be taken into account when using pseudo-panels. Firstly, the sample cohort/region means are error-ridden estimates of the unobserved regional population means, which might lead to biased estimations. Secondly, it may be that $\underline{\alpha}_{ct}$ depends on t and is thereby likely to be correlated with $\underline{x}_{ct}$ (if α_i is correlated with x_{it}, see Section 3). That is, it may be that the cohort effect varies over time, thereby reducing the precision of estimators (Guillerm, 2017). However, if the cohort/region averages are based on a large number of individual observations, measurement errors may be overlooked, as $\underline{\alpha}_{ct}$ can be treated as a fixed unknown parameter $\underline{\alpha}_{ct} = \alpha_c$, over time (Verbeek, 2008). In this case, the model can be written as:

$$\underline{y}_{ct} = \underline{x}_{ct}\beta + \alpha_c + \underline{\mu}_{ct}$$

where all error components that are correlated with the explanatory variables have been ruled out from the error term. The result is a consistent fixed effect estimation (see Sub-section 3.5.2.2).

There is no general rule to judge whether the number of individuals per cohort (n_c) is large enough to assume $\underline{\alpha}_{ct} = \alpha_c$. Verbeek and Nijman (1992) concluded that if cohorts contain at least 100 individuals and there is sufficient time variation in the cohort means, the bias due to measurement error is small and can be ignored. Verbeek (2008, p.7) provided an overview of the sample sizes used in several important empirical studies:

	T	C	$\underline{n}_c$
Browning, Deaton and Irish (1985)	7	16	190
Banks, Blundell and Preston (1994)	20	11	354
Blundell, Browning and Meghir (1994)	17	9	520
Alessie, Devereux and Weber (1997)	14	5	> 1000
Blundell, Duncan and Meghir (1998)	25	8	142
Propper, Rees and Green (2001)	19	70	80

In this research, the sample size is $T = 7$, $C = 15$ and $n_c \cong 9{,}000$ for metropolitan areas and between 500 and 3,000 for other regions. Thus, the number of observations in each cohort is sufficiently large to ignore potential measurement errors.

The other methodological issue may arise from the fact that the different cohorts vary in size and also vary in size within each cohort over time. These variations in cohort size may induce heteroscedasticity in the error term, thereby affecting the statistical tests of the estimators' significance. To correct for heteroscedasticity, every estimation performed in this chapter was performed using the robust standard error procedure developed by White and Huber (.Wooldridge, 2010).

6.3 Data description and variable selection

The data derives from a series of seven repeated cross-sections of the ENUSC for the years 2007 to 2013 (see Chapter 3). The time period of study was limited by the availability of data on household protection, which has been included since 2007 in ENUSC surveys.

The seven repeated cross-sections of data were used to construct a pseudo-panel data set based on Chilean administrative regions.[27] The data included 15 cohorts over seven years, resulting in a pseudo-panel of 105 observations.

Informed by previous research, this analysis estimated the effects of the prevalence of security devices after controlling for several variables related to crime levels. These control variables included measures of law enforcement, incarceration rates and economic and demographic regional indicators.

[27] There are a total of 15 administrative regions in Chile. They are: Arica y Parinacota, Tarapacá, Antofagasta, Coquimbo, Valparaíso, Metropolitan Santiago, O´Higgins, Maule, Araucanía, Los Ríos, Los Lagos, Aysén and Magallanes.

The models were estimated at the regional level because most official data, such as the incarceration rate and unemployment rate, are available only at the national and regional level. In addition, the accuracy of the variables, namely of the dependent and security variables, is significantly better at this level than at the borough or city level (see Chapter 3).

In contrast to the data set used in Chapter 5, the longitudinal analysis presented in this chapter did not manipulate or cut the ENUSC sample. Therefore, regional burglary rates and the regional prevalence of security devices were estimated using the full ENUSC sample.

6.3.1 Dependent variables

This section describes the variables used for the pseudo-panel analysis. The dependent variables are as follows:

- **Regional burglary incidence**, defined as the number of burglaries per 100,000 households and
- **Regional burglary prevalence**, defined as the number of households victimised per 100,000 households.

Both burglary rates were estimated from the ENUSC data, with a sample error of 2.3 at the 95% confidence level (see Chapter 3).

Table 6.1 presents the statistical summaries for the burglary rates. The summary table also reports the number of observations and the skewness/kurtosis statistic for normality. The skewness/kurtosis test indicates that no significant departure from normality was found for either variable.

TABLE 6.1: STATISTICS FOR BURGLARY RATES 2007-2013

	Incidence	**Prevalence**
MEAN	6538.38	4885.5
MEDIAN	6302.52	4846.1
MAXIMUM	13930.35	10613.6
MINIMUM	929.37	743.5
STD. DEV.	2571.11	1747.9
OBSERVATIONS	105	105
SKEWNESS/KURTOSIS TEST	0.14	0.09

6.3.2 Security variables

Informed by the results from Chapter 5, the following measures of the prevalence of security devices were utilised in this analysis:

- Regional percentage of households with any security device,
- Regional percentage of households with each of the seven security devices examined in Chapter 5,
- Regional percentage of households with hardening security configuration,
- Regional percentage of households with detection security configuration,
- Regional percentage of households with CCTV as single device,
- Regional percentage of households with grills as single device,
- Regional percentage of households with GAD configuration,
- Regional percentage of households with GADP configuration,
- Regional percentage of households with ED configuration,
- Regional percentage of households with EDP configuration and
- Regional percentage of households with DP configuration

The statistical summaries for these measures of prevalence are provided in Table 6.2.

Table 6.2: Statistics for prevalence of burglary security devices 2007-2013

	Any	**A**larm	**C**CTV	**G**rill	**E**lectr. Protect.	Non-elect. **P**rotect.	**D**ouble -lock	Light **S**ensor
Mean	69.3	9.2	2.9	46.4	5.3	17.3	32.1	8.1
Median	72.5	8.1	2.4	52.3	3.5	15.7	31.3	8.0
Maximum	89.9	31.0	9.8	73.5	33.1	39.2	55.8	16.8
Minimum	25.5	1.9	0.3	8.1	0.6	3.7	10.0	2.1
Std. Dev.	12.9	5.1	1.8	18.1	5.6	7.8	10.1	3.2

	Hardening	Detection	C	G	GAD	GADP	ED	EDP	DP
Mean	53.9	3.3	0.5	19.7	0.8	0.4	0.7	0.17	1.9
Median	58.1	2.9	0.4	20.8	0.7	0.3	0.3	0.03	1.2
Maximum	74.4	11.8	3.3	36.6	5.1	3.3	8.3	2.9	7.1
Minimum	19.3	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.2
Std. Dev.	12.2	1.9	0.4	9.3	0.6	0.5	1.3	0.41	1.7

6.3.3 Control variables

Informed by previous research on the determinants of crime level, the models estimated in this chapter incorporate a set of variables addressing law enforcement and incarceration rates, economic conditions and demographic composition. The number of control variables was limited by the small sample size (105 observations). The models in this chapter therefore include six control variables disaggregated at the regional level: arrest certainty, prosecution certainty, incarceration rates, unemployment rates and population size.

Burglary apprehension rate

Arrest certainty is measured as the ratio of the number of arrests for burglary to the number of burglaries known to the police. Arrest certainty is included in the analysis as a proxy for the probability of apprehension. According to rational theories of crime (Becker, 1968; Ehrlich, 1973; Clarke and Cornish, 1986;

Clarke and Felson, 1993), a higher probability of apprehension increases the risk of committing burglary. As a result, burglary rates should decrease due to the deterrent effect of a higher probability of apprehension.

The data on arrest ratios were obtained from the "Annual Report on Offences known to the Police and apprehension rates" published by Chilean Ministry of Interior. This report separately provided the number of burglaries reported to police and the number of apprehensions related to burglary at the borough and regional level. To calculate the arrest ratio, the number of arrests related to burglary was divided by the number of burglaries reported to the police in each region. The basic statistics for the arrest ratio are presented in Table 6.3.

Table 6.3: Statistics for arrest certainty 2007-2013

	Nº arrests per 100 burglaries known by police
Mean	8.2
Median	7.5
Maximum	19.4
Minimum	2.4
Std. Dev.	2.9
Observations	105

Incarceration rate

Incarceration rate is included as an independent variable in this analysis because the imprisonment rate may reduce crime rates through three main mechanisms: deterrence – the behavioural response to threat of punishment; incapacitation – offender cannot commit further crimes while incarcerated and rehabilitation or specific deterrence – the behavioural response to the experience of incarceration.

The incarceration rate is calculated as the number of offenders sentenced to prison divided by the total population in each region. In other words, it measures the regional number of offenders in prison per 100,000 people. The data were obtained from the Statistic Annual Report published each year by the Chilean Prison Service.[28] The basic statistics are summarised in Table 6.4.

Table 6.4: Statistics for incarceration rate 2007-2013	
	Nº of offenders in prison per 100,000 population
Mean	390.6
Median	298.3
Minimum	189.2
Maximum	1313.4
Std. Dev.	257.0
Observations	105

Unemployment rate

The unemployment rate is defined as the ratio of the number of people (older than 15 years-old) without a job and seeking work to the number of people in the work force. The original data were collected and published at the regional level by the INE.[29]

An increase in unemployment is expected to have a positive effect on burglary rates, as higher unemployment rates reduce the labour market opportunities for potential offenders and thus increase their incentive to commit crimes. However, some authors have suggested that higher unemployment rates reduce the opportunities for burglary, as more people are at home. Table 6.5 summarises the basic statistics on unemployment rate.

Table 6.5: Statistics for unemployment rate 2007-2013	
Mean	7.0
Median	7.0
Maximum	14.1
Minimum	2.2
Std. Dev.	2.3
Observations	105

[28] http://www.gendarmeria.gob.cl/

[29] http://www.ine.cl/ene/

Region population size

Population size is also included as a control variable because there may be a higher concentration of offenders in highly populated regions, thereby increasing the likelihood of contact between a motivated burglar and a potential target (Wiles and Costello, 2000). Highly populated areas may also be characterised by limited social interactions and a lack of common values, leading to higher levels of crime (Shaw and McKay, 1942). The logarithm of population size was utilised for conducting the regression analysis. Table 6.6 summarises the population size statistics.

Table 6.6: Statistics for population size 2007-2013

	Population
Mean	1,137,777
Median	710,780
Maximum	7,142,893
Minimum	99,929
Std. Dev.	1,638,138
Observations	105

6.4 Results

This section first reports the results of the aggregated any-protection measure of household protection. This analysis tests **Hypothesis 3**, that the increasing prevalence of household security protection negatively affected burglary rates in Chile between 2007 and 2013. The results of more specific measures of the prevalence of security devices are subsequently reported to provide evidence on the role played by different security devices.

Each measure of security prevalence was analysed regarding its effect on burglary incidence and prevalence. The logarithm of both dependent variables, burglary incidence and prevalence, was utilised for conducting the regression analyses in order to facilitate interpretation of the results. All independent variables, except youth population, were kept to original scale. Therefore, the results must be interpreted as “a one-unit change in x_i generates a 100*β_i percent change in victimisation rate". As its logarithm is used, youth population, must be interpreted as “a one-percent change in youth population, generates a change in victimisation rate by β percent”.

6.4.1 Effect of the prevalence of household security protection.

Table 6.8 presents the estimation results for a model that includes the prevalence of any security device. For each victimisation rate - incidence and prevalence - fixed and random effects models were estimated. The Hausman test, provided at the bottom of Table 6.8, indicates that compared to the fixed model, the estimations from the random effects model were biased (they are systematically different), indicating that the fixed model should be considered.

Table 6.8 Panel models Burglary rates 2007-2013

	log_incidence		**log_prevalence**	
	Fixed	**Random**	**Fixed**	**Random**
Security protection	-0.010**	-0.009**	-0.007**	-0.007***
	(0.004)	(0.004)	(0.003)	(0.003)
burglary aprehension rate	-0.044**	-0.020	-0.030*	-0.012
	(0.017)	(0.015)	(0.014)	(0.014)
incarceration rate	-0.001	0.0004	-0.001	0.0003
	(0.001)	(0.0004)	(0.001)	(0.0003)
unemployement	0.035**	0.04***	0.018*	0.023**
	(0.013)	(0.015)	(0.009)	(0.010)
log_youth male population	3.93**	0.118	3.085**	(0.130)
	(1.39)	(0.122)	(1.42)	(0.121)
_cons	-32.20**	7.74***	-23.569	7.31***
	(14.64)	(1.393)	(15.073)	(1.47)
Prob>F	0.008		0.002	
Prob> chi2		0.18		0.04
Within R_sq	0.17	0.125	0.129	0.078
Hausman test	24.13 (prob>chi2:0.0002)		10.29 (prob>chi2:0.036)	

As presented in the first row of Table 6.8, the prevalence of household protection has a negative and significant effect, at a 95% confidence level, on both burglary incidence and prevalence rates. When the fixed effects were eliminated and only effects within the region were estimated, an increase by one percentage point in the prevalence of household protection was associated with a 1% decrease in the burglary incidence rate. Regarding the burglary prevalence rate, the coefficient of security prevalence indicates that a one-percentage-point increase in the prevalence of security protection was associated with a decrease of 0.7% in burglary prevalence. According to the models, in a given administrative region, the increase in the prevalence of security devices over time was significantly associated with a reduction in burglary rates in that region.

Regarding control variables, Table 6.8 demonstrates that the apprehension rate exhibited the expected negative effect in all estimations. The interpretation of the fixed model's coefficient is that, for a given region, as apprehension rate increased by one unit, the incidence rate decreased by 4.4%. This coefficient decreased in magnitude to 3% for the prevalence model. The effect of the apprehension rate on the incidence rate was statistically significant in both models.

The coefficient for incarceration rate was negative in fixed models, and positive in random models. This result indicates that, for a given region, the incidence and prevalence rates decreased as incarceration rates increased; however, when between effects are incorporated (i.e., the regional difference in incarceration rates), it becomes evident that regions with higher incidence rates also had higher incarceration rates (and vice versa). In any case, the effect of incarceration rates on burglary incidence was statically insignificant.

In fixed models, the effect of unemployment rate is positive and statistically significant at a 95% confidence level for the incidence rate and at a 90% confidence level for the prevalence rate. On average, an increase of one unit in unemployment rate was associated with an increase of 3.5% in the incidence rate. This result indicates that, in the Chilean case, the motivation mechanism, through which unemployment increases burglary rates, is stronger than the reduction-opportunity mechanism detected in other studies, through which unemployment has a negative effect on burglary rates. Both within and random estimations indicate that unemployment affected burglary rates by increasing the number of motivated offenders.

The number of men aged 15-24 years-old had the expected positive effect on burglary rates in both fixed models. For a given region, an increase by 1% in the number of young men increased the burglary incidence by 4% and the burglary prevalence by 3%. The effect of the number of men aged 15-24 years-old on the incidence rate was statistically significant in both models.

6.4.2 Estimating the role played by changes in the prevalence of household protection

The estimated coefficients in Table 6.8 indicate to what degree changes in the prevalence of security devices can explain changes in burglary incidence. The results presented in previous sections are far from conclusive about “the determinants” of changes in incidence rates. The analysis presented above did not aim to identify the determinants of changes in burglary incidence; rather, it examined to what degree temporal changes in the prevalence of household security devices affected burglary incidence rates. Thus, the significant coefficient of the tested variable reflects to what degree temporal changes in the prevalence of security devices affected burglary rates, after controlling for unobserved regional differences.

The results in Table 6.8, coupled with information about observed temporal changes in the prevalence of household protection, can be used to estimate the role played by temporal changes in burglary trends. Table 6.8 reports that a one-percentage-point increase in the prevalence of security protection was associated with a reduction of 1% in burglary incidence. Between 2007 and 2013, the prevalence of household security protection increased by 12 percentage points, from 64.2% to 76.2%. Thus, according to Table 6.8, if all other variables had remained constant, burglary rates would have decreased by 12%. Given that, between 2007 and 2013, the burglary incidence decreased 40%, from 7.6 to 4.6 per 100 households (see Table 4.2), the increasing prevalence of security devices explains around 30% of the decrease in burglary incidence rates.

6.4.3 Which devices are most strongly related to changes in burglary rates?

Having established the significant contribution of the increasing prevalence of household protection toward reducing burglary incidence at the regional level, the next question is which devices most affected burglary rates. Answering this question involves estimating the effects of protection prevalence on burglary rates and the magnitude of changes in protection prevalence.

To differentially measure the effect of changes in the prevalence of each security device on burglary rates, three measures of device prevalence were considered. The first measure is the percentage of households with a particular device, either as a single device or in combination with other devices. For the second measure, security devices were classified into two categories following the distinction made by Hope and Lab (2001): fortress or hardening security (consisting of physical resistance measures such as grills/bars on windows, double-locks and electric and non-electric protections added to fence) and technological or detection security (consisting of surveillance measures such as alarms, CCTVs and light sensors). Finally, the third measure is the percentage of households with each device as a single configuration.

6.4.3.1 Prevalence of individual security devices in single or combined configurations

The estimated effects of the prevalence of security devices, either in single or combined configurations, can be compared with each other and with the average effect of household protection recorded in Table 6.8 to assess which devices are most strongly correlated to changes in burglary rates. As the security configurations are not mutually exclusive, it is not possible to estimate the effect of each device in a single model. Therefore, seven models were estimated, one for each security device considered. The estimated coefficients from those models represent the temporal percentage change in regional burglary rate when the prevalence of each device increases by one unit, regardless of whether this device was used as a single device or in combination with other devices. The results are presented in Tables 6.10 and 6.11.

In each model, the estimated coefficients for the control variables were similar to those recorded in Table 6.8. Incarceration rates were consistently insignificant across models. The unemployment rate and young male population were significantly correlated to increases in burglary incidence. Burglary apprehension rates were significant and negatively associated with burglary incidence.

Apart from electric protection added to fences, each tested security device had the expected negative coefficient, even though not all effects were statistically significant. The increasing prevalence of burglar alarms was significantly associated with a reduction in burglary incidence rates. The within-region estimation was a reduction in burglary incidence by 1.8% for each one-unit increase in the prevalence of burglar alarms. The coefficients for the effect burglar alarms on incidence rate were larger than the coefficients for the any-security variable reported in Table 6.8. Regarding the burglary prevalence rate, a temporal increase by one percentage point in the percentage of households with alarms in a given region was significantly associated with a 1.1% decrease in burglary prevalence in that region.

The increasing prevalence of double-locks was also significant and negatively associated with burglary incidence and prevalence rates. Table 6.10 demonstrates that a one-percentage-point increase in the prevalence of double-locks was associated with a reduction in both incidence and prevalence rates by 0.6%. Compared to the estimation reported in Table 6.8, the magnitude of the effect of a one-unit increase in the prevalence of double-locks is smaller than the same estimator for the general household protection measure.

Both CCTV and light sensors exhibited negative coefficients that were larger than the any-protection coefficient recorded in Table 6.8. In fact, they had the largest negative coefficients among the seven security devices considered. However, the effect was not statistically significant for either of the two devices.

Table 6.10. Effect of security devices on Burglary incidence 2007-2013

log_incidence	**Alarm**	**CCTV**	**Grill**	**Elect. Protect.**	**No Elect. Prot.**	**Double lock**	**Light Sensor**
Security protection	**-0.018*** **	-0.032	-0.005	0.003	-0.007	**-0.006***	-0.033
	(0.006)	(0.024)	(0.007)	(0.011)	(0.005)	(0.003)	(0.023)
burglary aprehension rate	**-0.036***	**-0.040****	**-0.041****	**-0.041****	**-0.040****	**-0.043****	**-0.043****
	(0.017)	(0.018)	(0.018)	(0.018)	(0.017)	(0.017)	(0.018)
incarceration rate	-0.002	-0.001	-0.001	-0.001	-0.001	-0.001	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
unemployement	**0.042****	**0.037****	**0.042*** **	**0.043*** **	**0.035****	**0.037****	**0.036****
	(0.015)	(0.015)	(0.014)	(0.012)	(0.015)	(0.014)	(0.013)
log_youth male population	**4.808****	**4.072****	**4.093****	**3.777***	**3.625****	**4.250****	**4.451****
	(1.857)	(1.654)	(1.718)	(1.946)	(1.619)	(1.540)	(1.807)
_cons	**-41.972****	**-34.270***	**-34.388***	-31.169	**-29.403***	**-36.077****	**-38.028***
	(19.569)	(17.496)	(18.062)	(20.619)	17.200	(16.217)	(19.015)
Prob>F	0.010	0.029	0.200	0.000	0.003	0.027	0.051
Within R_sq	0.152	0.136	0.133	0.130	0.141	0.149	0.161

Table 6.11. Effect of security devices on Burglary prevalence 2007-2013

log_prevalence	**Alarm**	**CCTV**	**Grill**	**Elect. Protect.**	**No Elect. Prot.**	**Double lock**	**Light Sensor**
Security protection	**-0.011***	-0.025	-0.004	0.009	-0.006	**-0.006****	-0.02
	(0.005)	(0.021)	(-0.006)	(0.008)	(0.004)	(0.003)	(0.019)
burglary aprehension rate	-0.025	**-0.027***	**-0.0278***	**-0.029***	**-0.027***	**-0.029****	**-0.029***
	(0.015)	(0.015)	(0.015)	(0.014)	(0.014)	(0.014)	(0.015)
incarceration rate	-0.002	-0.001	-0.001	**-0.002***	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
unemployement	**0.023****	**0.019***	**0.022****	**0.025****	0.017	0.018	**0.019***
	(0.010)	(0.009)	(0.010)	(0.010)	(0.011)	(0.010)	(0.010)
log_youth male population	**3.604***	**3.214****	**3.288***	**3.240***	**2.864***	**3.450****	**3.374****
	(1.864)	(1.480)	(1.623)	(1.607)	(1.368)	(1.297)	(1.329)
_cons	-29.421	-25.345	-26.036	-25.650	-21.513	**-27.765***	**-26.894***
	(19.715)	(15.692)	(17.059)	(17.013)	(14.511)	(13.728)	(14.108)
Prob>F	0.022	0.026	0.035	0.008	0.005	0.000	0.005
Within R_sq	0.109	0.102	0.101	0.116	0.113	0.124	0.114

6.4.3.2 Prevalence of security devices by hardening and detection mechanisms

The seven individual security measures considered in the ENUSC were theoretically organised by the preventive mechanism targeted by the measures. The first configuration, hardening security, comprises devices that increase the physical resistance of households to burglary through the use of double-locks, bars or grills on doors and windows or electric and non-electric protection on fences. The second configuration comprises more sophisticated surveillance devices oriented to increase the risk of detection, such as alarms, CCTV, and lights on movement sensors. A third configuration comprises any mix of hardening and detection devices.

To analyse which security devices were more effective in the reduction of burglary rates over time, the prevalence of the mutually exclusive hardening and detection configurations were included in the model described in Table 6.12. The results demonstrate to what degree regional burglary rates were affected by temporal changes in the prevalence of these configurations, after controlling for relevant variables and non-observable (fixed) regional effects.

One of the first observations from this model is that the estimated effects of the control variables were consistent with those recorded in previous models. Increases in the burglary apprehension rate had the expected significant and negative effect;increases in the incarceration rate had a negative, but insignificant effect and increases in unemployment rate and the male youth population had the expected positive and significant effects.

Table 6.12 demonstrates that temporal changes in the prevalence of both hardening and detection configurations were significantly correlated to changes in burglary rates over time. A one-percentage-point increase in the prevalence of hardening configurations was associated with a reduction in incidence rate by 1.4% and with a reduction in burglary prevalence by 1.1%. A one-percentage-point increase in the prevalence of detection configurations was associated with a decrease in both incidence and prevalence rates by 6.3%.

The effect of temporal increases in the prevalence of detection configurations on burglary rates was clearly larger than the effect of increases in the prevalence of hardening configurations, suggesting that technological devices were more effective than fortress protection in reducing regional burglary rates during the observed period. In addition, the results suggest that detection devices affected burglary rates primarily through a reduction in burglary prevalence, while hardening devices affected both the prevalence and concentration rates (the effects on burglary incidence were larger than the effects on burglary prevalence).

Table 6.12: Effects of (prevalence of) combined security devices on burglary incidence		
	log_incidence	log_prevalence
Hardening prot.	-0.014*	-0.011**
	(0.007)	(0.004)
Detection prot.	-0.063**	-0.063**
	(0.024)	(0.023)
Burglary aprehension rate	-0.053**	-0.038**
	(0.018)	(0.014)
Incarcerartion rate	-0.001	-0.001
	(0.001)	(0.001)
Unemployement rate	0.038**	0.020*
	(0.013)	(0.010)
log_youth male pop.	4.194**	3.535**
	(1.779)	(1.515)
_cons	-34.654*	-27.948*
	(18.834)	(16.200)
Prob>F	0.026	0.000
Within R_sq	0.179	0.166

6.4.3.3 Prevalence of single security devices

Another way to estimate the relative effect of individual security devices is to measure the percentage of households with the observed security protection as a single device. This measure can be interpreted as the percentage of households with no previous protection that chose the observed security device as the main (or first) dwelling protection. It is then possible to compare the effects of an increase by one unit in the percentage of households that chose different security devices as the main (first) protection the on burglary incidence rate.

As prevalence variables, which mark the prevalence of single security devices, are mutually exclusive (there is no reason to assume multicollinearity between them), they can be jointly included in a single model. Table 6.13 presents the results from that model.

The single-device measure of protection prevalence improves the fit of this model compared to the model outlined in Table 6.8. The within R^2 coefficients demonstrate that the goodness of fit improved from 0.17 to 0.22 and from 0.13 to 0.23 for the incidence and prevalence rate, respectively.

The effects of the control variables were consistent with the results in previous models.

The results demonstrate that temporal changes in the percentage of households with a burglar alarm as a single device were significantly correlated to burglary incidence, at a 10% significance level. The within estimated effect of an increase of one unit in the percentage of households with a single alarm was a 4.9% reduction in incidence rate and a 4.7% reduction in prevalence rate.

Changes in the prevalence of CCTVs as single devices had the largest negative effect on burglary rates. Regarding incidence rates, an increase by one percentage point in the prevalence of CCTVs as single devices in a given region was associated with a reduction of 13% in the incidence rate in that region. A temporal variation by one percentage point in the prevalence of CCTVs was similarly associated with a 15% reduction in incidence rates. These correlations were statistically significant at the 10% and 5% level, respectively.

Regarding hardening measures, changes in the prevalence of two hardening measures were significantly correlated to changes in burglary rates. An increase by one percentage point in the prevalence of non-electric protection on fences was associated with a reduction by 2.4% in the incidence rate, at a 90% confidence level. An increase in the proportion of households with non-electric protection on fences was also associated with a reduction in the prevalence rate; however this result was not statistically significant.

The rise in the prevalence of double-locks was also significantly correlated to reductions in burglary rates between 2007 and 2013. The results in Table 6.13 demonstrate that a one-percentage-point increase in the prevalence of those security devices was associated with a reduction by 3.6% in the incidence rate and with a reduction by 2.6% in the prevalence rate. Both estimates were significat at a 90% confidence level.

Regarding the other devices, although the estimated coefficients indicate a negative effect of the increasing prevalence of the devices on burglary incidence, it is not possible to disprove that the effects were actually zero (p-value > 0.1).

Table 6.13: Effects of (prevalence of) single security devices on burglary rates		
	log_incidence	log_prevalence
Alarm	**-0.049***	**-0.047***
	(0.028)	(0.024)
Cctv	**-0.131***	**-0.150****
	(0.069)	(0.060)
Grill	-0.004	0.003
	(0.013)	(0.009)
Elect. Protect.	-0.009	0.018
	(0.047)	(0.041)
No Elect. Prot.	-0.024	-0.010
	(0.012)	(0.008)
Double lock	**-0.036***	**-0.026***
	(0.018)	(0.012)
Light Sensor	-0.053	-0.049
	(0.078)	(0.103)
Burglary aprehension rate	**-0.055****	**-0.037****
	(0.022)	(0.014)
Incarcerartion rate	-0.001	-0.001
	(0.001)	(0.001)
Unemployement	**0.039***	**0.020**
	(0.019)	(0.014)
Youth male pop.	**3.149***	**3.520***
	(1.669)	(1.772)
_cons	-23.700	-28.230
	(17.959)	(19.017)
Prob>F	0.000	0.001
Within R_sq	0.215	0.230

6.5 Discussion

In this chapter, various panel data analyses are performed to test whether changes in the prevalence of household protection influenced burglary rates over the observed period (2007-2013) in Chile. The main motivation of this research was the fact that most evidence supporting the security hypothesis as an explanation for the observed fall in crime rates comes from industrialised Western societies, even though the ICVS reported that the decrease in crime rates may be larger in developing countries, particularly in Latin America. In addition, most of the evidence is derived from bivariate analyses of the relationship between security devices and crime rates (either cross-sectional or longitudinal analyses), which involves the risk of biased conclusions due to omitted variables and potential spurious correlations. Therefore, this research tested the ability of the security hypothesis to explain temporal changes in Chilean crime rates by adopting appropriate methodologies and variables.

The crime rates examined in this research were the burglary incidence and buglary prevalence rate and the examined explanatory variable was the prevalence of household protection. The latter was first measured as the presence of any security device or combination of devices in a dwelling and subsequently measured as the prevalence of specific configurations and individual security devices. The control variables were chosen according to relevant literature, accounting for factors related to law enforcement, the prison population, economic conditions and demographic features.

By using pseudo-panel data at the region level, the analyses in this chapter avoid the potential bias caused by region heterogeneity. The pseudo-panel data were analysed by using fixed and random effects models. While the fixed effect model removed regional fixed characteristics to estimate the net effect of predictors on burglary incidence, the random effects model assumes that those effects are random and uncorrelated with the predictor variables. The Hausman test was used to evaluate whether the regional error terms were correlated to independent variables. The results from the Hausman test (p>chi2: 0.000) suggest that the fixed model should be considered. The Wooldridge test (Wooldrige, 2010) was used to test serial correlation: the results (p>F: 0.41) suggest that it was not possible to reject the null hypothesis; thus, the resulting conclusion was that the data do not have first-order autocorrelation. The modified Wald test (Greene, 2000) (xttest3 in Stata) was also used to detect the presence of heteroscedasticity; the test (p>chi2: 0.000) indicated the presence of heteroscedasticity in the data; therefore, the Huber/White estimator (robust option in Stata) was used to obtain heteroscedasticity-robust standard errors (Hoecle, 2007).

The estimation results can be summarised as follows. First, the estimated models accounted for 10-25% of the within-region variance in burglary rates. This result indicates that 10-23% of the variance in temporal changes in burglary rates in the same region was explained by the models. These results are not particularly relevant in this research given its aim to evaluate whether temporal changes in the prevalence of security protection were significantly correlated to temporal changes in burglary rates, not to identify "the determinants" of burglary trends. However, it is clear that further research (and variables) is needed to identify the determinants of burglary trends. In addition, the results (not presented in tables) indicated that more than 95% of the total unexplained variance was due to variance between regions, which suggests that further research on the determinants of burglary trends should include both time-invariant variables (fixed region characteristics) and variables that vary over time within a region.

Second, the prevalence of household protection, burglary apprehension rates, unemployment rates and the size of the male youth population were significant predictors of the regional rates of burglary incidence and prevalence during the observed period. Burglary apprehension rates demonstrate a negative and significant effect on burglary incidence, which was consistent across different estimations. This result is coherent with the findings from other studies using Chilean data (Nuñez et al., 2003; Rivera et al. ,2003; Gallardo et al. ,2012; Vergara, 2012). By using survey data to estimate the victimisation rates in place of police records, this research avoided the endogeneity problem caused by the fact that the number of burglaries known by police is in both the numerator of the dependent variable and in the denominator of the independent variable in the measurements of previous studies, which calculated the number of arrests divided by the number of burglaries known by police (Shoesmith, 2010). Thus, in line with international evidence (Cameron, 1988; Lott and Mustard, 1997; Levitt, 1998; Imrohoroglu et al. ,2004), the results from this analysis confirm the effectiveness of increasing police efficacy as a strategy to decrease burglary victimisation.

Unemployment rates were also a consistent predictor of burglary incidence across different estimations. As expected, unemployment rates were significantly and positively correlated with burglary rates in both the fixed and random models. This result is coherent with studies that have found a positive relationship in the US and Europe (Raphael and Winter-Ebmer, 2001; Gould et al., 2002; Lin, 2008; Oster and Agell, 2007; Fougere et al., 2009). In addition, the results are aligned with results from previous longitudinal studies using Chilean data (Nunez et al., 2003; Rivera et al., 2003; Benavente and Melo, 2006; Ruiz et al., 2007; Vergara, 2012).

The size of the male youth population was also positively correlated to burglary rates. This result was unexpected, as previous studies using Chilean data found no significant effect of growth in the male youth population on the rates of offences known by police (Nuñez et al. 2003; Rivera et al. 2003; Benavente and Melo, 2006; Vergara, 2012; Gallardo et al. 2012).

Third, the incarceration rate was not significantly associated with burglary incidence over the observed period. The insignificance of the coefficients for incarceration rate indicate that incarceration rates have no effect on burglary incidence. The fact that apprehension rate is significantly associated with burglary incidence while incarceration rate is not suggests that increasing policy efficacy may be a better crime prevention strategy than hardening sentences.

Fourth, the prevalence of household security protection, which is the main concern of this research, also exhibited significant correlations with burglary rates. The results from Table 6.8 demonstrate that the percentage of households with at least one of the measured security devices was negatively correlated to regional burglary rates over the studied period. The significance test indicates that the null hypothesis of no correlation between temporal changes in the prevalence of household protection and temporal changes in burglary rates (both incidence and prevalence) may be rejected at the 95% confidence level. This result provides strong support to the security hypothesis and its ability to explain burglary trends in Chile.

In contrast to other studies that incorporated measures of household protection (Tseloni et al., 2004), this research did not confront endogeneity between burglary rates and the prevalence of security protection. Endogeneity is an issue in this field because security measures might be "taken as a response to burglary rather than in anticipation of a burglary" (Tseloni et al., 2004). However, as illustrated in Graph 5.1, the percentage of victimised households with security protection remained stable at around 2% over the study period. As the fixed model cancels out effects that do not vary across time, the positive effect of (responsive) protection was eliminated from the estimations, along with regional fixed effects.

Although there is strong evidence for the negative relationship between burglary incidence rate and the prevalence of at least one security protection, it is not clear which specific security devices are most responsible for significant association. There are many potential combinations of security devices, and attempting to test the effect of the prevalence of each of them would be a useless effort. Instead, the analyses in this research aimed to explore the relative contribution of each security device by utilising three measures for the prevalence of security devices. The first was the percentage of households with a given device, either as a single device or in combination with other(s) device(s). The second measure was the prevalence of hardening and detection security configurations. The third measure was the percentage of households with each individual security device as a single-device configuration. This methodology allows for drawing conclusions about which individual security devices were more strongly associated with burglary trends.

The prevalence of burglar alarms and the prevalence of double-locks were significantly negatively associated with burglary rates over the studied period. Whether these devices were used as single devices or combined with other devices, changes in their prevalence were significantly associated with reductions in burglary rates at the regional level. These significant correlations were found for both burglary incidence and prevalence rates. The effects of the increasing prevalence of burglar alarms were larger than similar estimations for prevalence of double-locks. These results differ from those reported by Tilley et al. (2015) and suggest that, in the Chilean case, the increasing prevalence of burglar alarms may be a valid, although partial, explanation of the decline in burglary rates, at least at the aggregate level.

Changes in the prevalence of CCTVs and non-electric protection on fences were also significantly correlated to burglary rates, but only in the model on single devices. In addition, non-electric protection was only significantly correlated to incidence rates. Despite the large negative coefficients for CCTV when estimated as simple prevalence (single or combined configurations), the relationship between the prevalence of CCTV and changes in burglary rates was not statistically significant. However, when measuring single devices, changes in the prevalence of CCTVs had the largest effect on burglary rates.

The case for CCTV as an effective device to prevent burglary is also strengthened by the results from the models presented in Table 6.12, which isolated the effects from technological surveillance devices. The detection configuration (combinations of alarms, CCTV, and light sensors) was clearly correlated to changes in burglary rates.

An empirical explanation for why certain devices are significant only when measured as single devices and why single-device models yielded larger coefficients for security prevalence than simple-prevalence models is beyond the reach of this research. One explanation may be that the prevalence of single devices serves as a proxy for the prevalence of new dwellings with security devices built in (especially CCTV). It is also possible that the prevalence of single devices reflects the relative number of households living in safer areas that install a first security protection.

Overall, the findings from the longitudinal analyses of regional burglary incidence rates and covariates support the security hypothesis, as the increasing prevalence of security devices was significantly correlated to decreases in burglary incidence at the regional level.

Regarding individual devices, it is clear that the prevalence of burglar alarms and double-locks played a significant role in regional burglary incidence rates. The contribution of the prevalence of CCTV is less clear, as the effect was significant only when measuring the single device and the "detection" configuration.

Comparing the size of average negative effects on burglary incidence reveals that the increase in the prevalence of burglar alarms was more effective in reducing burglary at the regional level than the increase in the prevalence of double-locks. When considering single devices, the effect of the increase in the prevalence of CCTVs was several times larger than the effects for alarms and double-locks.

While temporal changes in the prevalence of double-locks had the lowest estimated effect on burglary rates, the actual growth in prevalence was largest for this device. According to Table 5.2.2, between 2007 and 2013, the prevalence of double-locks increased by 15.7 percentage points, while other devices such as alarms and CCTVs increased by only 3.9 and 1.8 percentage points, respectively. These figures suggest that much of the drop in Chilean burglary rates between 2007 and 2013 was driven by increases in the prevalence of double-locks, and to a lesser extent by the more effective, but incipient increase in the prevalence of surveillance technologies.

6.6 Theoretical implications

According to the findings from this research, the unemployment rate, police detection rate and prevalence of household protection were significant factors for explaining burglary trends across Chilean regions.

This chapter performed several (pseudo) panel data analyses to test whether the security hypothesis is a feasible explanation for the observed decrease in Chilean burglary rates between 2007 and 2013. The main motivation for these analyses was the fact that there have been no studies to date on the reported decrease in Chilean victimisation rates or about the factors that drove this trend. The literature on the crime drop in Western countries has suggested a number of hypotheses to explain the negative crime trend. The security hypothesis is a useful tool to improve understanding of the decrease in crime rates in Chile, particularly regarding burglary.

The core idea in the security hypothesis is that more and better security protections have driven the drop in crime rates observed in several countries (Farrel et al., 2008). However, nearly all available evidence supporting the security hypothesis has come from developed countries. The existing literature on the crime drop is based exclusively on data from Western countries, even though there is evidence, such as that from the ICVS, suggesting that the decrease in crime rates may be even larger in developing countries. Given that the security hypothesis is offered as a "transnational" explanation for the crime drop observed in different societies (Farrell et al., 2014), testing the hypothesis in a developing country importantly contributes to the literature on the crime drop.

The crime rate of interest in this research was burglary and its temporal changes over time. The control variables were chosen according to the literature on crime trends to reduce the risk of omitting relevant variables and to incorporate factors related to law enforcement, economic conditions and demographic features. In addition, pseudo-panel data aggregated by administrative regions enabled the analyses to avoid the potential bias caused by the correlation between independent variables and region-specific fixed effects and the potential endogeneity of security variables.

The results confirmed the significant effects of the control variables, which had the expected sign. Apprehension rates had the expected negative sign, while unemployment rates and the male youth population size had a positive sign. The coefficients for incarceration rates were also negative, but not statistically significant across models.

The results discussed in previous sections suggest that the security hypothesis is a feasible theoretical tool to investigate the observed decrease in burglary rates in Chile. Several measures of security protection were used to evaluate the correlations between temporal changes in the prevalence of security devices and burglary rates. The results overall indicate a significant and negative association.

In comparison to the control variables, the effect of temporary changes in the prevalence of security protection on burglary rates was smaller. According to the model presented in Table 6.8, a change of one percentage point in the percentage of households that had at least one safety measure to prevent burglary was associated with a 1% decrease in burglary incidence, while a one-point increase in the burglary apprehension rate was associated with a reduction by 4.4% in burglary incidence. Similar results were found regarding the unemployment rate.

However, given the magnitude of the changes in the prevalence of security protection over time, its net effect on burglary rates in the 2007-2013 period was clearly higher than the observed effect of the other variables considered. As presented in Table 6.9, if the percentage of households with security measures would have remained at the level observed in 2007, the burglary rate would have been 45% larger than the figures actually observed in 2013.

These findings support the security hypothesis as a plausible explanation for the downward trend in burglary observed in Chile between 2007 and 2013 and as a useful theoretical tool to explore the still under-researched decrease in chilean victimisation rates. To the researcher's knowledge, there have been no studies to date on the unexpected decrease in victimisation rates observed in Chile between 2005 and 2013. The security hypothesis, and the opportunity theories that underpin it, appear to be an appropriate framework to explore this field and to provide insights regarding the unexplained decrease in burglary victimisation in Chile.

According to opportunities theories, anti-burglar protection may affect burglary victimisation through two main mechanisms: protection devices can increase the difficulty of breaking and/or can increase the risk of detection and identification. The results in this chapter suggest that configurations of surveillance technologies, such as those including alarms and CCTVS, were more effective than "hardening" configurations. In fact, the only device whose prevalence was found to be significantly correlated to burglary rates was double-locks.

These results raise the question of why detection configurations were more effective than fortress configurations. To be effective, detection devices rest on the ability to convince a potential thief that something will happen if the device is activated – either because neighbours or others, alerted by the alarm, will intervene and stop the burglary or because the camera will record the offender's image and enable identification. In either scenario, the activation of the preventive mechanism depends on the expected (by the potential offender) response of a third party, either community members or the criminal prosecution system. The fact that CCTVs are more effective than alarms suggests that, from the point of view of the offender, the risk of identification by the criminal prosecution system is higher than the risk associated with the intervention of neighbours. However, the latter is still more worrisome than the difficulties posed by the presence of fortress devices, especially if there are no restrictions on time to deactivate them without being detected.

These considerations suggest the importance of considering the context in which security devices are installed. Devices aimed at increasing the risk of detection will be more effective in communities where the potential offender perceives a greater willingness to mobilise in the case of hearing the alarm of a neighbour. Hardening devices will be more effective in places where visibility is greater and therefore the possibility of being detected while trying to deactivate them is greater. The lack of data on such factors is one of the main limitations of the analyses presented in this chapter and these factors represent a valuable area for future research.

The role of technological developments and the quality of protection devices is another aspect to consider. It is expected that devices with more recent technology will be more effective than those with obsolete technologies. In the case of surveillance technologies, such as alarms and CCTVs, it is clear that such devices today are technologically more sophisticated than they were years ago, and the results in this chapter suggest that such devices were also more effective in preventing burglary in the study period (alarms and CCTVs were more effective when considered as single devices or part of detection configurations than when considered in combination with hardening devices). However, there is no reason to believe that the increasing quality of technological devices will be constant. New technology produces new methods for committing burglary and new means for thwarting it. Thus, whether technological surveillance devices will continue to improve in quality and effectiveness will depend on the ability to adapt and respond to criminal responses as well as the capacity to adapt to the specific contexts where devices will operate.

Another conclusion from the analyses presented in this chapter is that there is still room to improve the effectiveness of household investments in security in Chile. While the results demonstrated that technological surveillance devices were more effective than fortress devices, the prevalence of the former category was clearly lower than the latter. Most household investments were directed to installing bars and double-locks (available in 46% and 32% of households, respectively), while surveillance technologies were available in less than 10% of households. During the observed period, the prevalence of double-locks increased from 24% to

41%, while alarms increased from 8% to 14% and CCTVs increased from 3% to 5%.

Household decisions on security protection concern not only the effectiveness of the devices, but also their costs and distribution. The prices of surveillance devices, especially those using the most recent technologies, are prohibitive for most households. Therefore, it is expected that the prevalence of technological security devices will remain low until the prices allow larger sections of society to afford them. Meanwhile, such devices will likely remain concentrated in more affluent neighbourhoods and dwellings. From a public policy perspective, expanding the prevalence of anti-burglar technological devices would be socially beneficial, as such devices are more effective in reducing burglary rates than most popular hardening devices. Subsidies and the responsibilisation of housing developers may be means of accelerating the growth of more sophisticated security measures (Tilley et al., 2011).

Finally, the fact that the security hypothesis may be a useful theoretical tool to explain the decrease in burglary victimisation in a developing country such as Chile is a valuable contribution to the existing literature on the crime drop, which has been largely supported by evidence from developed countries. The results presented in this chapter contribute to confirming the “cross-nationality” properties of the security hypothesis as proposed by Farrell (2014).

Chapter 7: General conclusions

To test the security hypothesis, this research explored both the downward trends in and the characteristics of burglary rates in Chile over time. Aebi and Linde (2010) argued that, to make inferences about why there was a fall in crime rates, it is first necessary to test whether the fall was statistically significant or whether it was an artefact of aggregated data. Therefore, this research first established that there was a real drop in Chilean burglary rates. The security hypothesis was then tested to evaluate its pertinence as a potential explanation for that trend.

The applicability of the security hypothesis as an explanation requires that protection measures were effective at both the individual and region level in order to reduce the risk of spurious correlation over time at the aggregate level. Therefore, this research first tested whether protection measures were effective in preventing burglary at the household level. The results demonstrate that protection measures reduced the risk of burglary victimisation and that the effects of most household characteristics on burglary risk were aligned with opportunity theories. At the regional level, pseudo-panel models found negative and significant correlations between temporal changes in the prevalence of household security and burglary rate. These findings mark an important contribution to the literature on the crime drop and opportunity theories, as nearly all existing evidence comes from industrialised countries. In addition, this is the first study in Chile to investigate burglary from a situational crime prevention perspective.

Understanding the nature and extent of crime trends can be a powerful tool for crime prevention. Analysing the crime drop and its driving factors is the first step "to identify those factors that…are amenable to manipulation" (Rosenfeld and Messner, 2012). In the case of Chile, however, although there was a notable reduction in victimisation for most measured crimes, there have been no studies to analyse the magnitude, significance or driving factors of the observed downward trends in victimisation rates. This research explored the fall in Chilean crime rates by focusing on burglary. Different kinds of crime respond to different motivations and opportunities;

thus, “any explanations for crime drops must also be sought by examining specific crime types” (Farrell, Tilley et al., 2008). Analysing trends and risk factors associated with burglary over time can inform subsequent hypotheses and research regarding the fall of other types of crime in Chile, as well as broader policy and practices to reduce crime (Hough *et al*., 2007).

This research raises many theoretical contributions, policy recommendations, methodological suggestions and recommendations for future research, which are presented in the following sections.

7.1 Theoretical contributions

The crime drop has been called “the most important criminological phenomenon of modern times” (Farrel et al., 2014). Research on why crime rates have fallen, and when and where they did, is important in order to yield lessons on how to best sustain the observed reductions and replicate them elsewhere. However, research on the extent, nature and causes of the crime drop has largely been limited to North America, Australia and Western Europe, while little is known about whether the same type and levels of crime reduction have been observed in developing countries.

This research contributes to bridge this gap in knowledge by documenting the general decrease in Chilean victimisation rates and focusing in particular on downard trends in burglary rate. To the researcher’s knowledge, there is no existing literature analysing victimisation trends, particularly downward trends, in Latin American. Thus, this thesis contributes to the literature on the crime drop by addressing the lack of crime drop research in that region. This thesis seeks to contribute to understanding the scope of the crime drop as “social fact” (Durkheim, 1895) and to its construction as an “object of research” (Bourdieu, 2008).

The first finding of this research is the statistical significance of downward trends in Chilean burglary rates. Aebi and Linde (2010) argued that, before hypothesizing about the causes and factors of the crime drop, it should be established that a reduction in crime rates actually occurred. The results in Chapter 4 indicate that, despite regional idiosyncratic variations, there was a significant downward trend in burglary rates across Chilean regions between 2005 and 2013. Although those analyses were focused on burglary rates, it is reasonable to expect that similar results would be found regarding other types of crimes, which have also exhibited steady reductions in victimization rates. The evidence from this thesis on the decrease in Chilean burglary rates is the first step to analyze the crime drop in Chile. The findings highlight that the crime drop should be analyzed as a global phenomenon and that its explanations must be applicable in very different national settings.

The composition of the drop in Chilean burglary rates demonstrates some differences from what has been reported in other countries, which should be taken into account in explanations about the international crime drop. The importance of the decrease in repeat victimization to explain the Chilean drop in burglary is an important finding of this research. The statistical model of burglary trends presented in Chapter 4 demonstrated a reduction in burglary incidents by 60% between 2005 and 2013, while prevalence rates decreased by 50%. This result indicates that the decrease in burglary rates was composed of a reduction in both the number of households targeted and the victimization frequency. Alongside the 50% reduction in prevalence rates, the average number of burglaries per victimized household also decreased by 45% from 2005 to 2013. These figures were confirmed by the analysis of repeat victimization, which revealed a reduction by 78% in the number of repeat victims over the period of study.

These results differ from previous studies that have questioned the role of repeat victimization in the drop in burglary rates. In the case of England and Wales, Thorpe (2007) stated that trends in burglary concentration rates "had no clear relationship to overall levels of burglary". Tseloni et. al (2010) similarly found that while concentration rates for theft from cars and theft from persons decreased significantly across the ICVS sample, the burglary concentration rate did not fall internationally during their period of study (1995-2004).

Another important issue relates to who experienced reductions in burglary victimization. The findings in Chapter 4 demonstrated that each social class experienced a reduction in burglary rates. Despite this general decrease in burglary rates across socio-economic groups, the analysis of the slope of the reduction for each socio-economic group revealed that the national drop in burglary incidence was mainly driven by a reduction in burglary incidence among lower-middle-class households ("c3") and working-class households ("d"). These results suggest a different pattern for the drop in burglary rates compared to what was found in England and Wales, where affluent groups benefitted most from the burglary drop (Grove et al., 2012; Tilley et al., 2011).

These findings related to repeat victimization and the most affected socio-economic group reinforce the plausibility of the security hypothesis as an explanation for the Chilean crime drop. Firstly, it is reasonable to assume that increases in security protection will have greater effects on repeat victimization (and thereby incidence rates) than prevalence, as security measures are often adopted in response to victimization (van Dijk and Vollaard, 2012). Secondly, because it is among socio-economic groups, here labeled as, lower-middle class and working class where the prevalence of household`s security protection increased more.

This research tested the security hypothesis as an explanation for the observed decrease in victimization rates in Chile. Given that falls in crime rates have occurred in different countries (Van Dijk et al., 2008; Rosenfeld and Messner, 2009; Tseloni et al., 2010), Farrell (2013) argued that any hypothesis on the crime drop must be applicable in different countries to be seriously considered, and they concluded that the security hypothesis passes that test. However, a quick overview of the evidence supporting the "cross-national" property of the security hypothesis indicates that the evidence comes from Western industrialised countries (Van Dijk, 2006; Fujita and Maxfield, 2012; Laycock, 2004; Van Ours and Vollard, 2013; Farrell et al., 2011; Kriven and Zeirsch, 2007; Tilley, Farrell and Clarke, 2014), mainly from the US, England and Wales, the Netherlands and Australia. This research therefore contributes to the existing literature on the security hypothesis by testing its applicability in the context of developing countries and providing evidence on its applicability in countries with different socio-economic dynamics. Thus, a further theoretical contribution of this thesis to the existing crime drop literature is the evidence suggesting that the security hypothesis may explain downward crime trends in a developing country such as Chile, thereby supporting the “cross-nationality” property of the security hypothesis.

In order to accept or reject the security hypothesis, this research first tested whether security protection in Chilean households actually exhibited the expected preventive effect (at the household level). The estimated models considered not only the prevalence of security protection, but also a number of variables that, according to opportunity theories, affect the risk of burglary victimization. Once the preventive effect of security protection at the household level was established, this research tested whether the increasing prevalence of security protection over the studied period was significantly associated with regional burglary rates after controlling for variables that are usually used in the literature on crime trends and are also applicable in Chile: detection rates and law enforcement variables, the prison population, economic conditions, and demographic features.

As reviewed throughout this thesis, the literature on crime events have demonstrated that the opportunity framework is a powerful theoretical tool for understanding crime victimization and delivering preventive measures. According to such research, victimization risk is not randomly distributed; rather, it is affected by household and area characteristics that make burglary incidents concentrated in some households and areas. According to this literature, the risk of burglary victimization is strongly associated with factors such as target exposure, absence of capable guardianship, attractiveness, and proximity to potential offenders (Tseloni et al., 2004)

To this researcher’s knowledge, this is the first study on burglary victimization to employ the theoretical framework of opportunities theories in Chile. Therefore, this research contributes to the emergence of opportunity theory research in Latin America and other developing countries.

The results presented in Chapter 5 suggest that opportunity theories may be an effective framework to analyze the patterns of victimization in Chile. The structural choice model proposed by Meithe and Meier (1990) in particular appears to be a useful theoretical tool to explore burglary risk. The four components of this model (exposure, proximity to offenders, guardianship, and vulnerability) are relevant to explaining victimization risk in Chile, and most variables in this research that operationalized these components had the expected effects on burglary risk. For example, regarding exposure, the findings of this thesis were similar to those from previous studies conducted in other contexts, as detached and semi-detached houses and houses located on major roads were exhibited a higher risk of burglary compared to flats (Osborn and Tseloni, 1998; Tseloni et al., 2004), or to houses located on culs-de-sac (Johnson and Bowers, 2010). Similar results were found regarding guardianship and attractiveness.

Regarding guardianship, which is the main concern of this thesis, cross-sectional/micro level and longitudinal/macro level analyses clearly demonstrate that security protections were negatively associated with burglary rates. These analyses also suggest that protection devices were more effective in reducing incidence rates than prevalence rates, which indicates that the effectiveness of security protections increases when repeat victimization is considered. A possible explanation for this finding is the fact that security measures are often adopted in response to victimization (Van Dijk and Vollaard, 2012), thereby preventing subsequent victimizations. The idea that security devices affect incidence rates more than prevalence rates is aligned with the larger drop in incidences rates compared to the drop in prevalence rates observed in Chile between 2005 and 2013.

Regarding particular security devices, the results from this research suggest that burglar alarms, double-locks, extra protection on fences, CCTVs and combinations of these devices were effective in preventing burglary. The effects, however, were different for different socio-economic groups. Combinations of alarms and double-locks with grills/bars on windows/doors were the most effective configurations for working-class households. That the prevalence of alarms and double-locks increased among working-class households (while grills/bars remained stable at high level) and that the drop in burglary was largely driven by falls in burglary rates among such households indicates these security measures played a crucial role in the observed drop in burglary rates in Chile between 2005 and 2013.

Overall, the findings of this research suggest the following:

a) There was a real burglary drop in Chile between 2005 and 2013 and likely a drop in other types of crimes as well. This evidence should be taken into account by hypotheses on the causes of the international crime drop.
b) The security hypothesis seems to be an effective theoretical tool to explain burglary trends in Chile. The results from this research, at both the cross-sectional/micro level and longitudinal/macro level provide support for the assumption that the security hypothesis passes the cross-national test.
c) Although developed in industrialised countries, the theoretical framework of opportunity theories also applies in the context of developing countries such as Chile and has the potential to inform the implementation of situational crime prevention measures (Clarke, 1980; Clarke, 1983; Cornish and Clarke, 2003). The effectiveness of these approaches has been largely supported by studies conducted in Western industrialised cities and countries (Clarke, 1997; Cozen et al., 2005). It is clear that what works in one country may not work elsewhere (Pawson and Tilley; Johnson et al., 2015); however, future crime prevention policies in Chile can still benefit from the findings reported in this thesis.

7.2 Limitations of the research

This research relied entirely upon the ENUSC, which has several limitations that are common to this kind of research tool, namely response bias, sampling bias and measurement error. These limitations are addressed by the methodological design of the ENUSC in order to make the total survey error (i.e., the difference between estimates and the true population values) as small as practicably possible.

Several additional limitations were addressed in this research. These limitations are generally mainly related to the lack of data that would have improved the accuracy of estimates.

First, during the study period, the ENUSC questionnaire did not include questions about the presence of security devices at the time of burglary incidents (if any). This limitation is a common weakness of crime surveys, which often fail to ask subjects when they installed security devices (Phillips & Walker, 1997). When studying the impact of anti-burglary devices, this issue can lead to a reverse causal problem: burglary victimization may cause the installation of security devices, and not the other way around (Tseloni et al., 2004). This endogeneity issue was not a problem in the longitudinal analyses performed in this research due to the use of fixed effect models. However, in the cross-sectional analyses, the endogeneity of variables can lead to an underestimation of the effect of security devices and a loss of statistical significance. The methodological strategy to overcome this problem was to eliminate every case (household) in which a security device was installed during the reference period (12 months prior to interview). This approach ensured that in every case where security protection was present, it was installed before reported burglary incidents (if any). Although appropriate to overcome endogeneity bias, this strategy is not free from biases. In removing every case in which security protection was installed during the reference period, it is likely that many at-risk households (e.g., those placed in areas that experienced a burglary wave during the reference year) were removed from the analyses. These biases do not invalidate the findings reported in Chapter 5, but the findings should be interpreted cautiously given that they might refer only to the effect of security devices in low-risk areas and households.

Moreover, in the longitudinal analyses presented in Chapter 6, the number of observations (105) was relatively low. The number of observations could have been increased by performing analyses at the city or borough level; however, data on the control variables were not available at those area levels. Therefore, although there are examples of pseudo-panel analyses using even smaller numbers of observations in the literature, the results in Chapter 6 should be interpreted in light of this data limitation.

7.3 Implications for crime prevention

The overarching objective of this research was to test whether the security hypothesis, a theoretical framework developed to explain the crime drop in developing countries, could explain the observed downward trends in crime victimization, particularly burglary rates, in Chile. The main goal was to test whether the increasing prevalence of household security devices was significantly correlated to the observed drop in Chilean burglary rates. The findings presented in this thesis, however, have several practical implications for crime prevention.

In general terms, these findings have the potential to inform the implementation of situational crime prevention measures in Chile. By analyzing residential burglary victimization patterns, this research revealed several factors associated with the level of burglary risk, which may support assessment of the appropriate responses in terms of preventive strategies and resource allocation. For example, knowing the characteristics of high-risk households can be effectively utilized in publicity campaigns and targeted advice: lifestyle and demographic characteristics provide insights into the most appropriate and effective communication tools and strategies to be used towards those at risk. In addition, by identifying areas at higher risk of burglary (because of layout, population characteristics or accessibility) surveillance and policing strategies can be better focused and optimized.

The findings in this research suggest that increasing the availability of household security protection may reduce burglary rates in Chile. Tilley et al. (2011) proposed two strategies for public policies to pursue this goal. The first strategy is to subsidize security installations and upgrades for previously victimized households. The results from this research demonstrate that security protections were particularly effective for preventing repeat burglary incidents. Hence, by targeting subsidies in households at high risk (as prior victimization is the best predictor of burglary victimization), the number of burglary incidents could be reduced. The second strategy suggested by Tilley et al. (2011) is “responsibilization”, which in the case of Chile may adopt the form of minimum security standards for housing developers, including the state as the main developer of social housing. This strategy has been successfully implemented in the Netherlands (Vollaard and van Ours, 2011), and it is likely that its implementation in Chile would yield greater social benefits than economic costs.

7.4 Future research

The findings presented in this thesis have provided new insights into the crime drop and into the security hypothesis as a possible explanation for the crime drop in developing countries. This research has also demonstrated that the opportunity theory framework is a useful theoretical tool for modeling burglary victimization rates in Chile. The modelling of specific crime victimization rates, trends in crime rates and the unexpected crime drop observed between 2005 and 2013 are still unexplored research areas in Chile. Therefore, each part of this research generates further questions and avenues for future research.

Extending the analyses in this thesis to other crime types would be useful to build a comprehensive picture of crime trends in Chile. This extension would also allow for the testing of the crime drop and the security hypothesis for other crimes. It is possible that different patterns may emerge for other crime types, although most crimes have exhibited an aggregated national decrease in victimization rates 2005-2013. Further research could explore the flux of victimization, the interaction between victim prevalence and victimization concentration (Hope, 1995), in order to analyze changes in the distribution of crime. Distinguishing incidence rates from prevalence and concentration rates allows for analyzing the pattern of distribution and the concentration of crime over time and examining whether temporal changes in incidence rates are due to changes in prevalence rates or due to changes in concentration rates and repeat victimization. By analyzing the distribution of crime victimization further, questions regarding the distributive justice of crime risk may also be answered, such as whether there are there differences in trends across Chilean regions and cities or whether some socio-economic groups benefit more than others from crime trends. This research provides some answers related to burglary trends, and future work can extend the analysis to the other offences measured by the ENUSC.

As proposed by Tseloni et al. (2012), explaining falls in burglary rates falls under the broader research agenda of understanding the role of opportunity in decreasing victimization rates. Investigating changes in modi operandi and types of products stolen during burglaries could provide further insights into how changes in situational factors affect burglary trends. Such analyses could also be extended to other types of crimes, such as vehicle theft, which is considered more responsive to securitisation than other types of crime. Furthermore, analyses of particular signatures in specific crime trends, and its relationships, would allow for testing different hypotheses to explain crime trends, including for emerging forms of crime, such as the observed increase in armed robberies against vehicle drivers as a response to better security for preventing vehicle thefts.

Further research is also needed on the effectiveness of different security devices for preventing burglary. This thesis demonstrated that the prevalence of any security device is a strong predictor of victimisation risk at the individual level and of regional burglary trends at the area level. However, the relative effect of each security device is not clear from this research. An alternative method for measuring the effectiveness of security devices is to calculate the security protection factor (Farrell et al., 2011;

Tseloni et al., 2010). This factor estimates the change in the odds of burglary victimization due to the availability of single and combined household security configurations. This is an interesting area of future research which can help to more clearly establish the role of security in affecting the rates of burglary and other crime types.

The findings reported in Chapter 5 provide strong support for opportunity theories of crime. The usefulness of opportunity theories for modelling burglary victimization in Chile may also be extended to other crime types, and many practical implications could be obtained from such research. Further research is needed on repeat burglary victimization at the individual and area level. The practical implications of burglary repeat victimization research are clear in the English literature of crime prevention, and it is likely that many lessons would be valid in Chile. In addition, research on repeat victimization in Chile may offer data and findings from a developing country to the more general discussion about the “flags” and “boosts” of burglary repeat victimization.

7.5 Thesis conclusion

This thesis sought to address a key research question regarding whether the security hypothesis, developed to explain trends in crime in Western developed countries, can effectively explain crime trends in other settings, specifically Chile. Using the frameworks of the environmental criminology perspective in particular, this thesis provided evidence that patterns of burglary in Chile are consistent, to an extent, with the theoretical expectations of the security hypothesis. Strong supporting evidence was found for the negative association between the increasing prevalence of security protection and burglary rates. This thesis therefore demonstrates the possibilities of employing the theoretical framework of environmental criminology to explore victimisation trends in understudied regions, such as Chile and Latin America.

References

Aebi, MF, Linde, A (2010) Is there a crime drop in Western Europe? *European Journal on Criminal Policy and Research 16*(4): 251–277. https://doi.org/10.1007/s10610-010-9130-y

Arvanites, T. M., & Defina, R. H. (2006). Business cycles and street crime. *Criminology 44*: 139-164. https://doi.org/10.1111/j.1745-9125.2006.00045.x

Ayres,I. & Levitt,S. (1998). "Measuring Positive Externalities from Unobservable Victim Precaution: An Empirical Analysis of Lojack", *The Quarterly Journal of Economics, 113* (1). Retrieved from http://www.jstor.org/stable/2586985

BAILEY, W.C. (1984), Poverty, Inequality, and City Homicide Rates. *Criminology, 22*: 531-550. https://doi.org/10.1111/j.1745-9125.1984.tb00314.x

Baldwin, J., Bottoms, A. Edward, & Walker, M. A. (1976). *The urban criminal: a study in Sheffield*. London: Tavistock.

Baltagi, B.H. (2005) *Econometric Analysis of Panel Data* (3rd ed.). John Wiley & Sons Inc., New York.

Barbarino, A., & Mastrobuoni, G. (2014). The Incapacitation Effect of Incarceration: Evidence from Several Italian Collective Pardons. *American Economic Journal: Economic Policy, 6*(1), 1-37. Retrieved from http://www.jstor.org/stable/43189364

Barker, V. (2010). Explaining the Great American Crime Decline: A Review of Blumstein and Wallman, Goldberger and Rosenfeld, and Zimring. *Law & Social Inquiry, 35*(2), 489-516. https://doi.org/10.1111/j.1747-4469.2010.01192.x

Baumer, Eric. (2008). An Empirical Assessment of the Contemporary Crime Trends Puzzle: A Modest Step toward a More Comprehensive Research Agenda. In National Research Council. *Understanding Crime Trends: Workshop Report*. The National Academies Press. https://doi.org/10.17226/12472.

Bayer, Harold (2011). Que veinte años no es nada…Una Mirada a la desigualdad de ingresos a partir de la encuesta Casen. *Revista Estudios Públicos 121,* 5-32. Retrieved from https://www.cepchile.cl/cep/estudios-publicos/n-121-a-la-150/estudios-publicos-n-121-2011/que-veinte-anos-no-es-nada-una-mirada-a-la-desigualdad-de-ingresos

Beck, U. (2004). *Poder y Contrapoder*. Paidos.

Beck, U. (2007). The Cosmopolitan Condition: Why Methodological Nationalism Fails. *Theory, Culture & Society 24*(7–8), 286–290. https://doi.org/10.1177/02632764070240072505

Becker, G. (1968). Crime and Punishment: An Economic Approach. *Journal of Political Economy 76*(2), 169-217. Retrieved from http://www.jstor.org/stable/1830482

Becsi, Z. (1999). Economics and crime in the states. *Economic Review 84* (1), 38-56. Federal Reserve Bank of Atlanta. Retrieved from https://ideas.repec.org/a/fip/fedaer/y1999iq1p38-56nv.84no.1.html

Benavente, J. y E. Merlo (2006). ”Determinantes socio-económicos de la criminalidad en Chile durante los noventa”. *Serie Documentos de Trabajo del Departamento de Economía*. Universidad de Chile. Retrieved from https://econ.uchile.cl/uploads/publicacion/b3d61496-7760-4da1-9eee-72109d6b69aa.pdf

Benavente, JM; Contreras, D; and Melo, E. (2010) "Anti-Crime Programs: An Evaluation (and recognition) of the Plan Comuna Segura," *Working Papers 1*, Facultad de Economía y Empresa, Universidad Diego Portales. Retrieved from https://ideas.repec.org/p/ptl/wpaper/1.html

Bernasco,W., Nieuwbeerta,P. (2005). How Do Residential Burglars Select Target Areas? A New Approach to the Analysis of Criminal Location Choice, *The British Journal of Criminology 45*(3), 296–315. https://doi.org/10.1093/bjc/azh070

Blumstein , A . (2000) Some recent trends in US violence . In: A. Blumstein and J. Wallman (eds.) *The Crime Drop in America* . Cambridge University Press.

Blumstein , A . and Wallman , J . (2000) *The Crime Drop in America*. Cambridge University Press.

Blumstein, A. (2006). The Crime Drop in America: An Exploration of Some Recent Crime Trends. *Journal of Scandinavian Studies in Criminology and CrimePrevention 7*(1), 17–35. https://doi.org/10.1080/14043850601037938

Blumstein, A. & Rosenfeld, R. (2008). Factors Contributing to US Crime Trends. *In National Research Council. Understanding Crime Trends: Workshop Report* (pp.13-44). The National Academies Press. https://doi.org/10.17226/12472.

Blumstein, A. (2005). Disaggregating the Violence Trends. In Blumstein, A. & Wallman,J. (eds.).*The Crime Drop in America* (pp. 13-44). Cambridge: Cambridge University Press.

Bourguignon F. (2001). Crime as a Social Cost of Poverty and Inequality: A Review Focusing on Developing Countries. *Revista Desarrollo y Sociedad 44*, 61-99. https://doi.org/10.13043/dys.44.5.

Bourguignon, F. (1999). Crime, Violence, and Inequitable Development. Annual World Bank Conference on Development Economics. Retrieved from https://www.researchgate.net/publication/245815187_Crime_Violence_and_Inequitable_Development

Bowers, K.J; Johnson, S.D. & Hirschfield, A.F. (2004). Closing off opportunities for crime: An evaluation of Alley-Gating. *European J. on Criminal Policy and Research 10*(4), 285-308. https://doi.org/10.1007/s10610-005-5502-0

Braga, A. A. (2001). The Effects of Hot Spots Policing on Crime. *The ANNALS of the American Academy of Political and Social Science 578*(1), 104–125. https://doi.org/10.1177/000271620157800107

Braga, A. A. (2008). The Prevention of Gun Homicide Through Pulling Levers Focused Deterrence Strategies. *Journal of Criminal Justice 36*, 332-346.

Braga, A.A; Hureau, D.M. & Papachristos, A.V. (2011). An ex post facto evaluation framework for place-based police interventions. *Evaluation Review 35*(6), 592-626. https://doi.org/10.1177/0193841X11433827

Braga, A., Papachristos, A. & Hureau, D. (2012), Hot spots policing effects on crime. *Campbell Systematic Reviews 8*, 1-96. https://doi.org/10.4073/csr.2012.8

Brantingham, P.J., P.L. Brantingham. (1978). A theoretical model of crime site selection. In: M.D. Krohn, R.L. Akers (eds.). *Crime, Law and Sanctions* (pp. 105-118). Sage.

Britton, A.; Kershaw, C.; Osborne, S.& Smith, K. (2012). Underlying Patterns within the England and Wales Crime Drop. In: van Dijk J., Tseloni A., Farrell G. (eds) *The International Crime Drop. Crime Prevention and Security Management*. Palgrave Macmillan.

Brown, R. (2004). The Effectiveness of Electronic Immobilization: Changing Patterns on Temporary and Permanent Theft. In Maxfield, M. and Clarke, R.V. (eds) Understanding and Preventing Car Theft. Crime Prevention Studies Vol. 17. Monsey: NY. Criminal Justice Press.

Brown, R. & Thomas, N. (2003). Aging Vehicles: Evidence of the Effectiveness of New Car Security from the Home Office Car Theft Index. *Security Journal 16*, 45–53. https://doi.org/10.1057/palgrave.sj.8340139

Budd, T. 1999. Burglary of domestic dwellings: Findings from the British Crime Survey. Home Office Statistical Bulletin, Research Development Statistics (4).

Buonanno, P.; Drago, F.; Galbiati, R.; Zanella, G.; Adda, J. & Jacobs, B. (2011). Crime in Europe and the United States: Dissecting the 'reversal of misfortunes'. *Economic Policy 26*(67), 347-385. Retrieved from http://www.jstor.org/stable/41261992

Cameron, C. & Trivedi, P. (2005). *Microeconometrics: Methods and Applications*. Cambridge University Press.

Cameron, S. (1988). The economics of crime deterrence: a survey of theory and evidence. *Kyklos 41*(2), 301-323. https://doi.org/10.1111/j.1467-6435.1988.tb02311.x

Centre for Multilevel Modelling. LEMMA (Learning Environment for Multilevel Methodology and Applications). University of Bristol. https://www.cmm.bris.ac.uk/lemma/course/view.php?id=13

Clarke, R and Felson, M. (1993). Introduction: Criminology, Routine Activity, and Rational Choice. In Clarke, R. and Felson, M. (eds*.). Routine Activity and Rational Choice*. Transaction Press

Clarke, R. V. (1997). *Situational crime prevention*. Criminal Justice Press.

Clarke, R. V. (1999). Hot products: understanding, anticipating and reducing demand for stolen goods. Home Office. Retrieved from https://popcenter.asu.edu/sites/default/files/hot_products_understanding_anticipating_and_reducing_demand_for_stolen_goods_clarke_1999.pdf

Clarke, R., & Cornish, D. (1985). Modeling Offenders' Decisions: A Framework for Research and Policy. *Crime and Justice 6*, 147-185. Retrieved from http://www.jstor.org/stable/1147498

Clarke, R.V, & Newman, G. (2006). *Outsmarting the terrorists*. Praeger Security International.

Clarke, R.V. & Eck, J. (2003). *Become a Problem Solving Crime Analyst in 55 Small Steps*. Jill Dando Institute of Crime Scene.

Claro E. & García J.F. (2011). El costo de la delincuencia en Chile 2000-2010. Serie Informe Justicia N° 6. Libertad y Desarrollo.

Cohen, L. E., & Cantor, D. (1981). Residential Burglary in the United States: Life-Style and Demographic Factors Associated With the Probability of Victimization. *Journal of Research in Crime and Delinquency 18*(1), 113–127. https://doi.org/10.1177/002242788101800107

Cohen, L., & Land, K. (1987). Age Structure and Crime: Symmetry Versus Asymmetry and the Projection of Crime Rates Through the 1990s. *American Sociological Review 52*(2), 170-183. https://doi.org/10.2307/2095446

Cohen, L., & Felson, M. (1979). Social Change and Crime Rate Trends: A Routine Activity Approach. *American Sociological Review 44*(4), 588-608. https://doi.org/10.2307/2094589

Corman, H., & Mocan, H. (2000). A Time-Series Analysis of Crime, Deterrence, and Drug Abuse in New York City. *The American Economic Review 90*(3), 584-604. Retrieved from http://www.jstor.org/stable/117344

Cornish, Derek B. (1994). The Procedural Analysis of Offending and its Relevance for Situational Prevention. In Clarke, R. (ed.). Crime Prevention Studies, Vol. 3. Criminal Justice Press.

Cornish, D. B. and Clarke, R. V. (1987). Understanding crime displacement: An application of rational choice theory. *Criminology 25*(4), 933-948. https://doi.org/10.1111/j.1745-9125.1987.tb00826.x

Cornish, D., & Clarke, R. (2003). Opportunities, precipitators, and criminal decisions: A reply to Wortley’s critique of situational crime prevention. In M. Smith & D. Cornish (Eds.), *Theory for practice in situational crime prevention* (pp. 41-96). Criminal Justice Press.

Cornish, D. B., and Clarke, R. V. (Eds.). (1986). *The reasoning criminal: Rational choice perspectives on offending*. New York: Springer-Verlag.

Cornish, D., & Clarke, R. (2008). The rational choice perspective. In Wortley, R and Mazerolle,L. (eds) *Environmental criminology and crime analysis*. Routledge

Coupe,T. & Blake, L. (2006). Daylight and Darkness Targeting Strategies and the Risks of Being Seen at Residential Burglaries. *Criminology 44*, 431 - 464. https://doi.org/10.1111/j.1745-9125.2006.00054.x

De La Fuente, H.; Mejías, C. & Castro, P. (2011). Análisis econométrico de los determinantes de la criminalidad en Chile. *Política Criminal 6*(11), pp. 192 – 208. http://dx.doi.org/10.4067/S0718-33992011000100007

De Souza, E. & Miller, J. (2012). Homicide in the Brazilian Favela: Does Opportunity Make the Killer? *The British Journal of Criminology 52* (4), 786–807. https://doi.org/10.1093/bjc/azs011

DeAngelo, G. & Hansen, B. (2014). Life and Death in the Fast Lane: Police Enforcement and Traffic Fatalities. *American Economic Journal: Economic Policy 6* (2), 231-57. Retrieved from http://www.jstor.org/stable/43189384

Deaton, A. (1985). Panel Data from Time Series of Cross-Sections. *Journal of Econometrics 30*, 109-126. Retrieved from http://www.princeton.edu/~deaton/downloads/Panel_Data_from_Time_Series_of_Cross_Sections.pdf

Devine, J. A., Sheley, J. F., & Smith, M. D. (1988). Macroeconomic and social-control policy influences on crime rate changes, 1948-1985. *American Sociological Review 53*(3), 407-420. https://doi.org/10.2307/2095648

Di Tella, R., & Schargrodsky, E. (2004). Do police reduce crime? Estimates using the allocation of police forces after a terrorist attack. *The American Economic Review 94*(1), 115-133. Retrieved from http://www.jstor.org/stable/3592772

DiIulio, J., & Piehl, A. (1991). Does Prison Pay? The Stormy National Debate over the Cost-Effectiveness of Imprisonment. *The Brookings Review 9*(4), 28-35. https://doi.org/10.2307/20080247

Donohue, J. (2009). Assessing the Relative Benefits of Incarceration: Overall Changes and the Benefits on the Margin. In Raphael S. & Stoll M. (Eds.), *Do Prisons Make Us Safer?: The Benefits and Costs of the Prison Boom* (pp. 269-342). Russell Sage Foundation

Donohue, J. J., & Levitt, S. D. (2001). The impact of legalized abortion on crime. *Quarterly Journal of Economics 116(2)*, 379–420. https://doi.org/10.1162/00335530151144050

Draca, M., Machin,S. & Witt,R. (2008). Panic on the Streets of London: Police, Crime and the July 2005 Terror Attacks. *IZA Discussion Paper no. 3410*. Bonn, Germany : Institute for the Study of Labour. Retrieved from http://ftp.iza.org/dp3410.pdf

Drago, F., Galbiati, R., & Vertova, P. (2009). The Deterrent Effects of Prison: Evidence from a Natural Experiment. *Journal of Political Economy 117*(2), 257-280. https://doi.org/10.1086/599286

Durlauf, S.N. and Nagin, D.S. (2011), Imprisonment and crime. *Criminology & Public Policy 10*, 13-54. https://doi.org/10.1111/j.1745-9133.2010.00680.x

Eberts, P. and Sehwirian, K.P. (1968), Metropolitan Crime Rates and Relative Deprivation. Criminology, 5: 43-52. https://doi.org/10.1111/j.1745-9125.1968.tb00719.x

Eck, J. & Maguire, E.R. (2000). Have changes in policing reduced violent crime? In: Blumstein, A. and Wallman, J. (eds.) *The Crime Drop in America*. New York: Cambridge University Press.

Eck, J. (1994). *Drug Markets and Drug Places: A Case-Control Study of the Spatial Structure of Illicit Drug Dealing*. (Publication No 9514517). [Doctoral dissertation, University of Maryland]. ProQuest Dissertations Publishing.

Ehrlich, I. (1973). Participation in Illegitimate Activities: A Theoretical and Empirical Investigation. *Journal of Political Economy 81*(3), 521-56. Retrieved from http://www.jstor.org/stable/1831025

Eisner, M. 2008. Modernity strikes back? A Historical perspective on the Latest Increase in Interpersonal Violence (1960-1990). *International Journal of Conflict and Violence 2*(2), 288-316. https://doi.org/10.4119/ijcv-2769

Ellingworth, D.; Hope, T.; Pease, K.; Trickett, T.; & Osborn, D. (1997). Prior victimisation and crime risk. *International Journal of Risk, Security and Crime Prevention 2*, 210-214. Retrieved from https://www.researchgate.net/profile/Tim-Hope/publication/289380921_Prior_victimization_and_crime_risk/links/56f1547908aeb4e2ede8d54b/Prior-victimization-and-crime-risk.pdf

Entorf, H. & Hannes, S. (2000). Socioeconomic and demographic factors of crime in Germany: evidence from panel data of the German states. *International review of law and economics 20 (1)*. https://doi.org/10.1016/S0144-8188(00)00022-3.

Fajnzylber, P.; Lederman, D.; & Loayza, N. (2002). Inequality and Violent Crime. *The Journal of Law & Economics, 45*(1), 1-39. http://dx.doi.org/10.1086/338347

Fajnzylber, P.; Lederman, D.; Loayza, N. (2002b). What causes violent crime? *European Economic Review 46*(7), 1323-1357. Retrieved from https://EconPapers.repec.org/RePEc:eee:eecrev:v:46:y:2002:i:7:p:1323-1357

Farrell G. & Pease, K. (2007).Preventing Repeat Residential Burglary Victimization. In: Welsh B.C., Farrington D.P. (eds) *Preventing Crime*. Springer, New York, NY. https://doi.org/10.1007/978-0-387-69169-5_11

Farrell, G. (2013). Five tests for a theory of the crime drop. *Crime Science 2* (5). https://doi.org/10.1186/2193-7680-2-5

Farrell, G. & Pease, K. (1993). Once Bitten, Twice Bitten: Repeat Victimization and Its Implications for Crime Prevention. *Crime Prevention Unit 46*. Home Office Police Research Group, London. ISBN 9781858930909

Farrel, G. & Pease, K. (2001). Why repeat victimization matters. In Farrell, G. and Pease, K. (eds.). *Crime Prevention Studies 12*, pp. 1-4. Retrieved from https://repository.lboro.ac.uk/articles/journal_contribution/Why_repeat_victimization_matters/9580517

Farrell, G.; Tilley, N.; Tseloni, A.; & Mailley, J. (2010). Explaining and sustaining the crime drop: Exploring the role of opportunity-related theories. *Crime Prevention and Community Safety: An International Journal, 12*(12), 24–41. https://doi.org/10.1057/cpcs.2009.20

Farrell, G., Tseloni, A., & Tilley, N. (2011). The effectiveness of vehicle security devices and their role in the crime drop. *Criminology & Criminal Justice, 11*(1), 21–35. https://doi.org/10.1177/1748895810392190

Farrell, G., Tseloni, A., Mailley, J., & Tilley, N. (2011). The Crime Drop and the Security Hypothesis. *Journal of Research in Crime and Delinquency, 48*(2), 147–175. https://doi.org/10.1177/0022427810391539

Farrell, G., Tilley, N., Tseloni, A. "Why the Crime Drop?," Crime and Justice 43 (2014): 421-490. Retrieved from https://www.journals.uchicago.edu/doi/pdf/10.1086/678081

Farrington, D.O. (2003). Developmental and life-course criminology: Key theoretical and empirical issues- The 2002 Sutherland award address*. *Criminology, 41*(2): 221-225. https://doi.org/10.1111/j.1745-9125.2003.tb00987.x

Felson, M. (1995). Those Who Discourage Crime. In Eck, J. & Weisburd, D. (eds*.).* *Crime and Place* (pp. 53-66). Monsey, NY: Criminal Justice Press. Retrieved from https://popcenter.asu.edu/sites/default/files/library/crimeprevention/volume_04/03-Felson.pdf

Felson, M. (1986). Linking criminal choices, routine activities, informal control, and criminal outcomes. In: Cornish, D. B. & Clarke, R. (eds). *The reasoning criminal: Rational choice perspectives on offending*. New York: Springer-Verlag.

Felson, M. & Clarke, R. (1998). Opportunity Makes the Thief: Practical Theory for Crime Prevention. *Crime Prevention and Detection Series Paper 98*. London, UK: Home Office.

Felson, M. (1994). *Crime and Everyday Life*. Pine Forge Press.

Fielding N.G., Clarke A. & Witt R. (2000). An Introduction to the Economic Dimensions of Crime and Punishment. In Fielding N.G.; Clarke A. & Witt R. (eds). *The Economic Dimensions of Crime*. Palgrave Macmillan. https://doi.org/10.1007/978-1-349-62853-7

Flatley, J.; Kershaw, C.; Smith, K.; Chaplin, R. & Moon, D. (2010). *Crime in England and Wales 2009/10: Findings from the British Crime Survey and Police Recorded Crime*. London: Home Office.

Fleisher, B. (1966). The Effect of Income on Delinquency. *The American economic review 56*(1/2), 118-137. Retrieved from http://www.jstor.org/stable/1821199

Fougère, D., Kramarz, F. & Pouget, J. (2009). Youth unemployment and crime in France. *Journal of the European Economic Association, 7*(5), 909-938. Retrieved from http://www.jstor.org/stable/40282795

Fox, J. (2005). Demographics and U.S. Homicide. In Blumstein, A. & Wallman, J. (eds.). *The Crime Drop in America* (pp. 288-318). Cambridge University Press

Fox, J. A., & Piquero, A. R. (2003). Deadly Demographics: Population Characteristics and Forecasting Homicide Trends. *Crime & Delinquency, 49*(3), 339–359. https://doi.org/10.1177/0011128703049003001

Fujita, S. & Maxfield, M. (2012) Security and the drop in car theft in the United States. In Van Dijk, J.; Tseloni, A. & Farrell, G. (eds) *The International Crime Drop: New Directions in Research* (pp. 231-249) Basingstoke: Palgrave Macmillan.

Gallardo, M.; Vallone, A. & Sfeir, R. (2012) Determinantes de los Crímenes a la Propiedad en Chile, 1997-2009: Un Análisis Regional. *Anales de la Asociación Argentina de Economía Política Argentina.* Retrieved from https://www.inesad.edu.bo/bcde2012/papers/61.%20Vallone_Crimen_Chile.pdf

Gardes, F.; Duncan, G.; Gaubert, P.; Gurgand, M. & Starzec, C. (2005). Panel and Pseudo-Panel Estimation of Cross-Sectional and Time Series Elasticities of Food Consumption: The Case of U.S. and Polish Data. *Journal of Business & Economic Statistics, 23*(2), 242-253. Retrieved from www.jstor.org/stable/27638815.

Garland, D. (1996).The Limits of the Sovereign State Strategies of Crime Control in Contemporary Society. British journal of criminology 36 (4), 445-471. Retrieved from http://www.jstor.org/stable/23638075

Sherman, L.W.; Gottfredson, D.; MacKenzie, D.; Eck,J.; Reuter, P. & Bushway, S. (1997) *Preventing Crime: What Works, What Doesn't, What's Promising*. US Department of Justice. Retrieved from https://www.ojp.gov/ncjrs/virtual-library/abstracts/preventing-crime-what-works-what-doesnt-whats-promising-report

Gould, E.; Weinberg, B. & Mustard, D. (2002) Crime rates and local labor market opportunities in the United States: 1979–1997. *The Review of Economics and Statistics 84*(1), 45–6. Retrieved from https://econpapers.repec.org/scripts/redir.pf?u=http%3A%2F%2Fwww.mitpressjournals.org%2Fdoi%2Fpdf%2F10.1162%2F003465302317331919;h=repec:tpr:restat:v:84:y:2002:i:1:p:45-61

Greenberg, D.F. (2001). Time Series Analysis of Crime Rates. Journal of Quantitative Criminology 17(4), 291–327. https://doi.org/10.1023/A:1012507119569

Greene, W. (2000). *Econometric Analysis*. New York: Prentice-Hall.

Griliches, Z. & Hausman, J. (1986). Errors in variables in panel data. *Journal of econometrics 31*(1), 93-118. https://doi.org/10.1016/0304-4076(86)90058-8

Grogger, J. (2000). An Economic Model of Recent trends in Violence. In Blumstein, A. & Wallman, J. (eds.). *The Crime Drop in America*. New York: Cambridge University Press.

Grogger, J. (1998). Market Wages and Youth Crime. *Journal of Labour Economics 16*(4), 756-791. https://doi.org/10.1086/209905

Grove, L.; Tseloni, A. & Tilley, N. (2012). Crime, inequality and change in England and Wales. In Van Dijk, J.; Tseloni, A. & Farrell, G. (eds.). *The International crime drop: new directions in research* (pp. 182–199). Hampshire: Palgrave Macmillan.

Guillerm, M. (2017). Pseudo-panel methods and an example of application to Household Wealth data. *Economie et Statistique / Economics and Statistics*, 491-492, 109-130. https://doi.org/10.24187/ecostat.2017.491d.1908

DeAngelo, G., & Hansen, B. (2014). Life and Death in the Fast Lane: Police Enforcement and Traffic Fatalities. *American Economic Journal: Economic Policy 6*(2), 231-257. Retrieved from http://www.jstor.org/stable/43189384

Hirschi, T., & Gottfredson, M. (1983). Age and the explanation of crime. *American Journal of Sociology, 89*(3), 552–584. https://doi.org/10.1086/227905

Hoechle, D. (2007). Robust Standard Errors for Panel Regressions with Cross-Sectional Dependence. *The Stata Journal 7*(3), 281–312. https://doi.org/10.1177/1536867X0700700301

Hollis, M., Felson, M. & Welsh, B. (2013). The capable guardian in routine activities theory: A theoretical and conceptual reappraisal. *Crime Prevention and Community Safety 15*, 65–79. https://doi.org/10.1057/cpcs.2012.14

Hollis-Peel, M.E.; Reynald, D.M.; van Bavel, M.; Elffers, H. & Welsh, B. (2011). Guardianship for crime prevention: a critical review of the literature. Crime Law and Social Change 56, 53–70. https://doi.org/10.1007/s10611-011-9309-2

Hope, T. & Lab, S.P. (2001). ‘Variation in crime prevention participation: evidence from the British Crime Survey. *Crime prevention and community safety 3*, 7-22. https://doi.org/10.1057/palgrave.cpcs.8140078

Hope, T., & Trickett, A. (2008). The Distribution of Crime Victimisation in the Population. International Review of Victimology, 15(1), 37–58. https://doi.org/10.1177/026975800801500103

İmrohoroğlu, A.; Merlo, A. & Rupert, P. (2000). On the Political Economy of Income Redistribution and Crime. *International Economic Review 41*(1), 1-25. Retrieved from http://www.jstor.org/stable/2648821

İmrohoroĝlu, A.; Merlo, A. & Rupert, P. (2006). Understanding the determinants of crime. *Journal of Economics and Finance 30*, 270–284. https://doi.org/10.1007/BF02761491

İmrohoroğlu, A., Merlo, A., & Rupert, P. (2004). What Accounts for the Decline in Crime? *International Economic Review, 45*(3), 707-729. Retrieved from http://www.jstor.org/stable/3663634

Johnson, S. & Bowers, K. J. (2010). Permeability and burglary risk: Are cul-de-sacs safer? *Quantitative Journal of Criminology 26*, 89-111. https://doi.org/10.1007/s10940-009-9084-8

Johnson, S.; Summers, L. & Pease, K. (2008). Offender as forager? A direct test of the boost account of victimisation. *Journal of Quantitative Criminology 25*(2), 181-200. https://doi.org/10.1007/s10940-008-9060-8

Johnson, S. & Bowers, K. (2004) The Stability of Space-Time Clusters of Burglary, *The British Journal of Criminology 44*(1), 55–6. https://doi.org/10.1093/bjc/44.1.55

Johnson, S.D. (2014), How do offenders choose where to offend? Perspectives from animal foraging. *Legal and Criminological Psychology 19(*2), 193-210. https://doi.org/10.1111/lcrp.12061

Johnston, J. (1984) *Econometric Methods*, Singapore: McGraw-Hill.

Kawachi, I.; Kennedy, B. P. & Wilkinson, R. G. (1999). Crime: social disorganization and relative deprivation. *Social science & medicine 48*(6), 719-731. https://doi.org/10.1016/S0277-9536(98)00400-6

Kelly, M. (2000). Inequality and crime. *The Review of Economics and Statistics 82*(4), 530-539. Retrieved from http://www.jstor.org/stable/2646649

Kennedy, B. P.; Kawachi, I.; Prothrow-Stith, D.; Lochner, K. & Gupta, V. (1998). Social capital, income inequality, and firearm violent crime. *Social* *science and medicine 47*(1), 7-17. https://doi.org/10.1016/S0277-9536(98)00097-5

Kennedy, L.W. & Forde, D.R. (1990), Routine activities and crime: An analysis of victimization in Canada. *Criminology 28*(1), 137-152. https://doi.org/10.1111/j.1745-9125.1990.tb01321.x

Kleck, G. & Chiricos, T. (2002), Unemployment and property crime: A target-specific assessment of opportunity and motivation as mediating factors. *Criminology 40*(3), 649-680. https://doi.org/10.1111/j.1745-9125.2002.tb00969.x

Klick, J. & Tabarrok, A. (2005).Using Terror Alert Levels to Estimate the Effect of Police on Crime. *The Journal of Law and Economics 48* (1), 267-279. https://doi.org/10.1086/426877

Kovandzic, T. & Sloan, J. (2002). Police levels and crime rates revisited: A county-level analysis from Florida (1980-1998). *Journal of Criminal Justice 30*(1), 65-76. https://doi.org/10.1016/S0047-2352(01)00123-4

Kriven, S., & Ziersch, E. (2007). New car security and shifting vehicle theft pat- terns in Australia. *Security Journal 20*(2), 111–122. https://doi.org/10.1057/palgrave.sj.8350026

Kruger, T. & Landman, K. (2008). Crime and the Physical Environment in South Africa: Contextualizing International Crime Prevention Experiences. *Built Environment 34*(1), 75-87. Retrieved from http://www.jstor.org/stable/23289742

LaFree, G. (1999). Declining Violent Crime Rates in the 1990s: Predicting Crime Booms and Busts. *Annual Review of Sociology 25*, 145-168. Retrieved from http://www.jstor.org/stable/223501

LaFree, G., & Drass, K. (1996). The Effect of Changes in Intraracial Income Inequality and Educational Attainment on Changes in Arrest Rates for African Americans and Whites, 1957 to 1990. American Sociological Review, 61(4), 614-634. https://doi.org/10.2307/2096396

Land, K. C.; McCall, P. L. & Cohen, L. E. (1990). Structural covariates of homicide rates: Are there any invariances across time and social space? *American Journal of Sociology 95*(4), 922-963. Retrieved from http://www.jstor.org/stable/2780646

Langan, P. and Farrington, D. (1998) *Crime and Justice in the United States and in England and Wales, 1981 – 96*. U.S. Bureau of Justice Statistics (BJS). Retrieved from https://static.prisonpolicy.org/scans/bjs/cjusew96.pdf

Larragana, O. (2010). El Estado Bienestar en Chile: 1910 – 2010. In Lagos, R. (ed.) *Cien años de luces y Sombras*. Santiago. Taurus

Laycock, G. (2004). The U.K. Car Theft Index: An Example of Government Leverage. In Maxfield, M. and Clarke, R.V. (eds). *Understanding and Preventing Car Theft. Crime Prevention Studies 17* (pp. 25-44). Criminal Justice Press.

Lemieux, A., Clarke, R.(2009). The International Ban on Ivory Sales and its Effects on Elephant Poaching in Africa. *The British Journal of Criminology 49* (4), 451–471. https://doi.org/10.1093/bjc/azp030

Levitt, S. & Dubner, S. (2005). *Freakonomics*. London: Allen Lane .

Levitt, S. (1997). Using Electoral Cycles in Police Hiring to Estimate the Effect of Police on Crime. *The American Economic Review, 87*(3), 270-290. https://doi.org/10.3386/w4991

Levitt, S. (1998). The relationship between crime reporting and police: Implications for the use of Uniform Crime Reports. *Journal of Quantitative Criminology 14*(1), 61-81. https://doi.org/10.1023/A:1023096425367

Levitt, S. (2004). Understanding why crime fell in the 1990s: Four factors that explain the decline and six that do not. *Journal of Economic Perspectives 18*, 163–190. https://doi.org/10.1257/089533004773563485

Levitt,S. (1996). The Effect of Prison Population Size on Crime Rates: Evidence from Prison Overcrowding Litigation. *The Quarterly Journal of Economics 111*(2), 319–351. https://doi.org/10.2307/2946681

Lin, M. (2008). Does Unemployment Increase Crime? Evidence from U.S. Data 1974-2000. *The Journal of Human Resources 43*(2), 413-436. Retrieved from http://www.jstor.org/stable/40057352

Lin, M. (2009). More police, less crime: Evidence from US state data. *International Review of Law and Economics 29*(2), 73-80. https://doi.org/10.1016/j.irle.2008.12.003

Lott, J. & Mustard, D. (1997). Crime, Deterrence, and Right-to-Carry Concealed Handguns. *The Journal of Legal Studies 26*(1), 1-68.

Marvell, T. & Moody, C. (1991). Age structure and crime rates: The conflicting evidence. *Journal of Quantitative Criminology 7* (3), 237- 273. https://doi.org/10.1007/BF01063233

Marvell, T. B. and Moody, C. E. (1997). The impact of prison growth on homicide. *Homicide Studies* *1*(3), 205 - 233. https://doi.org/10.1177/1088767997001003002

Marvell, T. & Moody, C. (1994). Prison Population Growth and Crime Reduction. Journal of Quantitative Criminology, 10(2), 109-140. https://doi.org/10.1007/BF02221155

Marvell, T.B. & Moody, C.E. (1996). Determinate sentencing and abolishing parole: The long-term impacts on prisons and crime. *Criminology 34*(1), 107-128. https://doi.org/10.1111/j.1745-9125.1996.tb01197.x

Marvell, T.B. & Moody, C.E. (1996). Specification problems, police levels, and crime rates. *Criminology 34*(4), 609-646. https://doi.org/10.1111/j.1745-9125.1996.tb01221.x

McCullagh, P. & Nelder, J.A. (1989). *Generalized Linear Models* (2nd ed.). Chapman and Hall, London.

Merton, R.K. (1968). *Social Theory and Social Structure*. Free Press, New York.

Messner, S.F. (1989). Economic discrimination and societal homicide rates: further evidence on the cost of inequality. *American Sociological Review 54*(4), 597-611. https://doi.org/10.2307/2095881

Miethe, T.D. & McDowall, D. (1993). Contextual Effects in Models of Criminal Victimisation. *Social Forces* *71*(3), 741-759. https://doi.org/10.2307/2579893

Miethe, T.D. and Meier, R.F. (1990). Opportunity, Choice and Criminal Victimisation: A Test of a Theorical model. *Journal of Research in Crime and Delinquency* *27*(3), 243-266. https://doi.org/10.1177/0022427890027003003

Nagin, D.S. & Land, K.C. (1993). Age, criminal careers, and population heterogeneity: specification and estimation of a nonparametric, mixed poisson model. *Criminology 31*(3), 327-362. https://doi.org/10.1111/j.1745-9125.1993.tb01133.x

Navarro, J. & Jasinki, J. (2012). Going Cyber: Using Routine Activities Theory to Predict Cyberbullying Experiences. *Sociological Spectrum 32*(1), 81-94. https://doi.org/10.1080/02732173.2012.628560

Nelson, J. (1980). Multiple Victimization in American Cities: A Statistical Analysis of Rare Events. *American Journal of Sociology 85*(4), 870-891. Retrieved from http://www.jstor.org/stable/2778710

Nuñez, J.; Rivera, J.; Villavicencio, X. & Molina, O. (2003). Determinantes socioeconómicos y demográficos del crimen en Chile". Evidencia desde un panel de datos de las Regiones de Chile. Estudios de Economía 30, 55-85.

Osborn, D., & Tseloni, A. (1998). The Distribution of Household Property Crimes. *Journal of Quantitative Criminology 14*(3), 307-330. https://doi.org/10.1023/A:1023086530548

Öster, A. & Agell, J. (2007). Crime and unemployment in turbulent times. *Journal of the European Economic Association 5*(4), 752-775. https://doi.org/10.1162/JEEA.2007.5.4.752

Outlaw, M., Ruback, B., & Britt, C. (2002). Repeat and multiple victimizations: The role of individual and contextual factors. *Violence and Victims 17*(2), 187–204. https://doi.org/10.1891/vivi.17.2.187.33648

Pease K. (1997) Repeat Victimisation: Taking Stock. *Crime Detection and Prevention Paper 90*. London: Home Office. Retrieved from https://popcenter.asu.edu/sites/default/files/problems/domestic_violence/PDFs/Pease_1998.pdf

Pease, K., & Tseloni, A. (2014). *Using modelling to predict and prevent victimisation*, Springer International Publishing. https://doi.org/10.1007/978-3-319-03185-9

Piehl, A. M., and Dilulio, J. (1995). Does Prison Pay? Revisited. *Brookings Review, 13*(1), 20+. Retrieved from https://link.gale.com/apps/doc/A16348325/AONE?u=ucl_ttda&sid=googleScholarFullText&xid=d3b2dc45

Potter R and Thomas P (2001) *Engine Immobilizers: How Effective are They?* Australia: National Motor Vehicle Theft Reduction Council. Retrieved from https://carsafe.com.au/docs/immobiliser_paper.pdf

Raphael, S. & Winter-Ebmer, R. (2001) Identifying the Effect of Unemployment on Crime. *The Journal of Law & Economics 44*(1), 259-283. https://doi.org/10.1086/320275

Ratcliffe, J. (2003). Suburb boundaries and residential burglars. *Trends & issues in crime and criminal justice 246*. Australian Institute of Criminology. Retrieved from https://www.aic.gov.au/publications/tandi/tandi246

Ratcliffe, J. (2004) The Hotspot Matrix: A Framework for the Spatio-Temporal Targeting of Crime Reduction. *Police Practice and Research 5*(1), 5-23. https://doi.org/10.1080/1561426042000191305

Rivera, J.; Nunez, J. and Villavicencio, X. (2004). ”Crimen y disuasión. Evidencia desde un modelo de ecuaciones simultaneas para las regiones de Chile”. *El Trimestre Economico,71*(284(4)), 811-846. Retrieved from http://www.jstor.org/stable/20856837

Rosenfeld, R. (1996) Gun buy-backs: Crime control or community mobilization. In Plotkin, M.R. (ed.). *Under Fire: Gun Buy-Backs, Exchanges, and Amnesty Programs* (pp 1 -28). Washington, DC: Police Executive Research Forum.

Rosenfeld, R. (2004). The case of the Unsolved Crime Decline. *Scientific American, 290*(2), 82-89.

Rosenfeld, R. (2000). Patterns in Adult Homicide 1980-1995. In Blumstein, A. & Wallman, J. (eds.). *The crime drop in America* (pp.130-163). Cambridge University Press

Rosenfeld, R., & Fornango, R. (2007). The impact of economic conditions on robbery and property crime: the role of consumer sentiment. Criminology: An Interdisciplinary Journal 45(4), 735-769. https://doi.org/10.1111/j.1745-9125.2007.00096.x

Rosenfeld, R., & Messner, S. F. (2009). The crime drop in comparative perspective: the impact of the economy and imprisonment on American and European burglary rates. *The British journal of sociology, 60*(3), 445–471. https://doi.org/10.1111/j.1468-4446.2009.01251.x

Rountree, P. W., & Land, K. C. (1996). Burglary Victimization, Perceptions of Crime Risk, and Routine Activities: A Multilevel Analysis Across Seattle Neighborhoods and Census Tracts. *Journal of Research in Crime and Delinquency, 33*(2), 147–180. https://doi.org/10.1177/0022427896033002001

Rountree, P.W., Land, K.C. & Miethe, T.D. (1994). Macro-micro integration in the study of victimization: a hierarchical logistic model analysis across Seattle neighborhoods. *Criminology 32* (3), 387-414. https://doi.org/10.1111/j.1745-9125.1994.tb01159.x

Cea, M., Ruiz, P., Rodríguez, C., & Matus J.P. (2007). Determinantes de la criminalidad: Análisis de Resultados. *Política Criminal 2*(3)), pp. 1-80. Retrieved from http://politcrim.com/wp-content/uploads/2019/04/d_1_3.pdf

Sagi, P. & Wellford, C. (1968) 'Age composition and patterns of change in criminal statistics. *Journal of Criminal Law, Criminology and Police Science, 59* (1), 29-36. https://doi.org/10.2307/1142148

Sampson, R. & Laub, J. (2003). Life-Course Desisters? Trajectories Of Crime Among Delinquent Boys Followed To Age 70. *Criminology 41* (3), 555- 592. https://doi.org/10.1111/j.1745-9125.2003.tb00997.x

Sampson, R. J., Raudenbush, S. W., & Earls, F. (1997). Neighborhoods and violent crime: a multilevel study of collective efficacy. *Science 277*(5328), 918–924. Retrieved from http://www.jstor.org/stable/2892902

Sampson, R.J., & Wooldredge, J.D. (1987) Linking the micro- and macro-level dimensions of lifestyle-routine activity and opportunity models of predatory victimization. *Journal of Quantitative Criminology 3*, 371–393. https://doi.org/10.1007/BF01066837

Sherman, L. & Eck, J. (2002). Policing for prevention. In (Sherman, L.; Farrington ,D. & Welsh, B. (eds.), *Evidence Based Crime Prevention*. New York : Routledge.

Sherman, L. W. & Weisburd, D. (1995). General deterrent effects of police patrol in crime hot spots: A randomized controlled trial. *Justice Quarterly, 12* (4), 625-648. https://doi.org/10.1080/07418829500096221

Sherman, L. (1995). Hot spots of crime and criminal careers of places. In Eck, J. & Weisburd, D. (eds), Crime and place: Crime prevention studies 4, 35- 52. Retrieved from https://popcenter.asu.edu/content/crime-prevention-studies-volume-4-volume-4

Sherman, L.W., Gartin, P.R. & Buerger, M.E. (1989) Hot spots of predatory crime: Routine activities and the criminology of place. *Criminology 27*(1), 27-56. https://doi.org/10.1111/j.1745-9125.1989.tb00862.x

Shi, Lan. (2009). The Limits of Oversight in Policing: Evidence from the 2001 Cincinnati Riot." *Journal of Public Economics 93*(1-2), 99–113. https://doi.org/10.1016/j.jpubeco.2008.07.007

Shoesmith, G. (2010). Four factors that explain both the rise and fall of US crime, 1970–2003. *Applied Economics, 42*(23), 2957-2973. https://doi.org/10.1080/00036840801964765

Skogan, W. (1992). *Impact of policing on social disorder: Summary of findings*. Washington, DC: U.S. Department of Justice, Office of Justice Programs.

Spelman, W. (2005). The Limited Importance of Prison Expansion. In Blumstein, A. & Wallman, J. (eds.), *The Crime Drop in America* (pp. 97-129). Cambridge University Press.

Spelman, W. (1994). *Criminal Incapacitation*. New York: Plenum

Taylor, R., & Gottfredson, S. (1986). Environmental Design, Crime, and Prevention: An Examination of Community Dynamics. *Crime and Justice 8*, 387-416.

Telep, C. W., & Weisburd, D. (2012). What is Known About the Effectiveness of Police Practices in Reducing Crime and Disorder? *Police Quarterly, 15*(4), 331–357. https://doi.org/10.1177/1098611112447611

Thorpe, K. (2007). Multiple and repeat victimisation. In Jansson, K., Budd, S., Lovbakke, J., Moley, S., & Thorpe, K. (eds*) Attitudes, Perceptions and Risks of Crime*. Home Office Statistical Bulletin 19/07. London: Home Office, 81–98.

Tilley N., Farrell G., Clarke R.V. (2015) Target Suitability and the Crime Drop. In Andresen M.A., & Farrell G. (eds) *The Criminal Act*. Palgrave Macmillan, London.

Tilley, N. (2009) *Crime Prevention*. Collumpton, Devon: Willan Publishing.

Tilley, N., Thompson, R., Farrell, G., Grove, L. & Tseloni, A. (2015). Do burglar alarms increase burglary risk? A counter-intuitive finding and possible explanations. *Crime Prevention and Community Safety 17*, 1–19. https://doi.org/10.1057/cpcs.2014.17

Tilley, N., Tseloni, A. & Farrell, G. (2011). Income Disparities of Burglary Risk Security Availability during the Crime Drop. The British Journal of Criminology, 51(2), 296-313. https://doi.org/10.1093/bjc/azr010

Tocornal, X., Tapia, R., & Carvajal, Y. (2014). Delincuencia y violencia en entornos residenciales de Santiago de Chile. *Revista de Geografía Norte Grande 57*, 83-10. http://dx.doi.org/10.4067/S0718-34022014000100007

Tonry, M., & Farrington, D. (2005). Punishment and Crime across Space and Time. *Crime and Justice, 33*, 1-39. Retrieved from http://www.jstor.org/stable/3488331

Trickett, A., Ellingworth, D., Hope, T., & Pease, K. (1995). Crime victimization in the eighties: Changes in Area and Regional Inequality*. The British Journal of Criminology, 35*(3), 343-359. Retrieved from http://www.jstor.org/stable/23637888

Trickett, A., Osborn, D., Seymour, & J., Pease, K. (1992). What is different about high crime areas? *The British Journal of Criminology 32*(1), 81–89. https://doi.org/10.1093/oxfordjournals.bjc.a048181

Tseloni, A., Farrell, G., Tilley, N., Grove, L., Thompson, R., & Garius, L. (2012). Towards a comprehensive research plan on opportunity theory and the crime falls. In Van Dijk J, Tseloni, A; & Farrell, G. (eds). *The International Crime Drop. Crime Prevention and Security Management* (pp 286-299). Palgrave Macmillan. https://doi.org/10.1057/9781137291462_14.

Tseloni, A. (2006). Multilevel modelling of the number of property crimes: household and area effects. *Journal of the Royal Statistical Society: Series A (Statistics in Society) 169*(2), 205-233. https://doi.org/10.1111/j.1467-985X.2005.00388.x

Tseloni, A., & Pease, K. (2003). Repeat personal victimization: 'Boosts' or 'Flags'? *The British Journal of Criminology, 43*(1), 196-212. Retrieved from http://www.jstor.org/stable/23638923

Tseloni, A., Farrell, G., Thompson, R., Evans, E., & Tilley, N. (2017) Domestic burglary drop and the security hypothesis. *Crime Science 6*(3). https://doi.org/10.1186/s40163-017-0064-2

Tseloni, A., Mailley, J., Farrell, G., & Tilley, N. (2010). Exploring the international decline in crime rates. *European Journal of Criminology, 7*(5), 375–394. https://doi.org/10.1177/1477370810367014

Tseloni, A., Thompson, R., Grove, L., Tilley, N., & Farrell, G. (2017). The effectiveness of burglary security devices. *Security Journal 30*, 646-664. https://doi.org/10.1057/sj.2014.30

Tseloni, A., Wittebrood, K., Farrell,G., Pease,K. (2004). Burglary Victimization in England and Wales, the United States and the Netherlands: *A Cross-National Comparative Test of Routine Activities and*

Lifestyle Theories. *The British Journal of Criminology 44*(1), 66–91. https://doi.org/10.1093/bjc/44.1.66

Van Dijk , J . (2006) What goes up, comes down: Explaining the falling crime rates .*Criminology in Europe, Newsletter of the European Society of Criminology 5* (3), 17-18.

Van Dijk, J., Manchin, R. , van Kesteren, J. , Hideg, G .& Navala, S. (2007) *The Burden of Crime in the EU: A Comparative Analysis of the European Survey of Crime and Safety (EU ICS 2005)*, Gallup Europe . Retrieved from https://research.tilburguniversity.edu/en/publications/the-burden-of-crime-in-the-eu-a-comparative-analysis-of-the-europ

Van Dijk, J., Tseloni, A., & Farrell, G. (Eds.). (2012). *The international crime drop: New directions in research*. London: Palgrave Macmillan.

van Dijk, J. J. M., van Kesteren, J. N., & Smit, P. (2008). *Criminal Victimization in International Perspective. Key findings from the 2004-2005 ICVS and EU ICS*. (Onderzoek en Beleid, WODC; No. 257). Boom Legal Publishers. Retrieved from https://research.tilburguniversity.edu/en/publications/criminal-victimisation-in-international-perspective-key-findings-

Van Ours, J.C. & Vollaard, B. (2014). The engine immobilizer: A nonstarter for car thieves. *The Economic Journal 126*(593), 1264- 1291. https://doi.org/10.1111/ecoj.12196

Verbeek, M. (2008). Pseudo-Panels and Repeated Cross-Sections. In Mátyás, L., Sevestre, P. (eds) *The Econometrics of Panel Data. Fundamental and recent Developments in Theory and Practice*. Springer. https://doi.org/10.1007/978-3-540-75892-1_11

Vergara, R. (2012). Crime prevention programs: Evidence from Chile. *The Developing Economies, 50*(1), 1-24. https://doi.org/10.1111/j.1746-1049.2011.00152.x

Webb, B. (2005). Preventing car crime. In Tilley, N. (ed.) *Handbook of Crime Prevention and Community Safety*. Cullompton: Willan

Weisburd, D., & Eck, J. (2004). What Can Police Do to Reduce Crime, Disorder, and Fear? *The ANNALS of the American Academy of Political and Social Science 593*(1), 42-65. https://doi.org/10.1177/0002716203262548

Wilcox, P., Madensen, T. D. & Tillyer, M. S. (2007). Guardianship in context: implications for burglary victimization risk and prevention. *Criminology, 45*(4), 771-803. https://doi.org/10.1111/j.1745-9125.2007.00094.x

Wiles, P., & Costello, A. (2008). The ‘Road to Nowhere’: The evidence for traveling criminals. In Canter, D. & Youngs, D. *Principles of Geographical Offender Profiling*. Routledge.

Wilson, James Q (1975). *Thinking about crime*. Basic Books

Witte, A. 1980. ‘‘Estimating the Economic Model of Crime with Individual Data. *The Quarterly Journal of Economics 94*(1), 57-84. https://doi.org/10.2307/1884604

Wooldridge, J. (2010). *Econometric Analysis of Cross Section and Panel Data*. The MIT Press.

Wortley, R & Mazerolle ,L. (eds). 2008. *Environmental criminology and crime analysis*. Routledge

Zhang,L., Messner, S., Liu,J. (2007). A multilevel analysis of the risk of household burglary in the city of Tianjin, China. *The British Journal of Criminology 47* (6), 918–937. https://doi.org/10.1093/bjc/azm026

Zimring, F. (2007). *The Great American Crime Decline*. New York: Oxford University Press.

Apendix 1

Distribution of Security devices in the full simple

(Including those that installed a security devices during the reference year)

Security devices

a. **A**larm
b. **C**CTV
c. **G**rills or rails on windows (and doors)
d. **E**lectrified fence
e. No-electric **P**rotection adds on fence
f. **D**ouble locks on doors and windows
g. **L**ight on movement sensor

Prevalence of security devices and configuration 2007-2013. Full sample.							
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
no sec	31.64	25.29	26.66	25.23	21.73	20.58	20.34
Alarm	8.38	10.67	9.91	11.08	11.94	13.12	13.84
CCTV	2.8	4.09	3.27	4.03	4.72	4.67	4.77
Grills	52.24	55.98	53.53	54.21	56.81	57.16	53.69
Elect. Fence	3.72	4.06	3.55	4.35	4.42	4.05	4.64
No elect. Protection	18.71	17.62	16.95	18.62	22.86	23.58	25.1
Double lock	24.27	29.32	32.6	32.99	38.76	39.92	40.63
Light sensor	6.82	8.08	7.99	8.28	9.86	9.84	10.41
Detection	2.75	3.55	3.27	3.70	3.00	3.28	3.88
Hardening	55.07	57.99	57.63	57.30	59.24	59.12	58.09
Mixed conf.	10.49	13.12	12.38	13.71	16.01	17.01	17.69
G	25.26	26.19	24.46	22.44	20.74	20.24	18.15
GD	8.42	10.54	10.28	11.37	12.56	12.27	11.48
D	4.82	5.68	8.16	7.09	7.48	8.03	8.44
GP	5.42	4.58	4.19	4.77	5.00	4.87	4.88
GPD	3.77	3.49	4.17	4.18	5.82	6.13	5.78
P	3.74	3.19	2.36	3.04	3.18	3.25	3.99
PD	1.02	1.45	1.49	1.33	1.84	2.06	2.47
AG	1.25	1.73	1.46	1.69	1.47	1.89	1.97
A	1.03	1.21	1.21	1.61	1.20	1.50	1.62
AGD	0.59	0.95	0.85	0.99	1.09	1.33	1.18
GDS	0.50	0.66	0.68	0.78	0.88	1.08	0.98
E	0.86	0.85	0.68	0.86	0.86	0.61	0.87
GS	0.65	0.88	0.76	0.83	0.79	0.77	0.75

AGPD	0.48	0.44	0.61	0.50	0.67	0.94	0.95
GPDS	0.41	0.49	0.54	0.48	0.75	0.81	0.87
S	0.53	0.48	0.68	0.68	0.61	0.64	0.73
C	0.57	0.92	0.67	0.47	0.50	0.40	0.48
AD	0.25	0.45	0.51	0.62	0.62	0.69	0.84

Apendix 2.

Distribution of demographic variables in the full sample.

	2008	2009	2010	2011	2012	2013	Average
Age	50.4	50.0	50.1	51.7	50.8	50.7	50.6
Female_hh	32.1	33.2	34.7	35.8	37.4	38.0	35.2
Children	57.0	57.3	54.9	52.7	52.3	51.1	54.2
Lone parent	11.5	12.5	12.8	13.3	13.5	13.7	12.9
N° adults							
1(base)	6.4	6.8	7.6	7.5	8.0	8.5	7.5
2	37.3	38.1	39.1	36.5	38.4	38.6	38.0
3	56.3	55.1	53.3	56.0	53.6	52.9	54.6
Occupancy	63.8	62.8	61.5	62.0	59.7	57.4	61.3
Employ. status							
employed	71.6	71.5	71.4	68.5	70.5	71.9	70.9
unemployed (base)	3.5	4.2	3.3	3.1	3.3	3.0	3.4
inactive	24.9	24.3	25.3	28.4	26.3	25.0	25.7
Qualifications							
no (base)	1.9	1.8	1.8	2.2	1.8	1.9	1.9
primary	28.2	26.7	25.7	26.8	26.1	24.4	26.3
secundary	47.9	47.6	47.5	46.7	45.8	45.5	46.8
technical education	6.4	7.2	7.7	7.1	7.9	9.0	7.5
universitary education	15.6	16.0	16.8	16.6	18.0	18.9	17.0
Socioeconomic group							
abc1	2.5	1.9	1.5	2.7	2.6	2.6	2.2
c2	8.0	7.1	7.9	8.3	7.2	9.1	7.8
c3	41.2	39.0	36.5	37.2	39.7	43.4	39.1
d	43.4	46.8	50.6	45.3	46.3	42.5	46.0
e (base)	5.0	5.3	3.4	6.5	4.3	2.4	5.0
Type of accommodation							
flat (base)	11.9	14.6	14.4	10.2	16.7	16.8	
house	62.5	54.4	57.0	60.3	55.8	54.1	58.7
house on cul de sac	24.8	29.9	28.2	28.8	26.5	28.3	26.8
house in gated community	0.8	1.2	0.5	0.7	1.0	0.9	0.8
Length of residence (years)							
1 (base)	7.3	7.0	7.4	6.2	6.7	7.1	7.0
2	18.4	18.1	17.9	15.9	17.0	16.8	16.9
3	14.9	16.7	16.0	15.0	15.9	16.7	15.8
4	12.1	12.8	12.4	11.7	12.5	12.8	12.4
5 or more	47.3	45.4	46.3	51.2	47.9	46.6	47.9
Metropolitan area							
no metro area	58.0	58.1	58.0	58.0	58.0	58.0	57.8
Great Santiago	30.9	30.9	30.9	30.9	30.9	30.9	31.3

Great Valparaíso	5.1	5.1	5.1	5.1	5.1	5.1	5.0
Great Concepción	6.0	6.0	6.0	6.0	6.0	6.0	6.0
% poor households	0.5	0.5	0.5	0.5	0.5	0.5	0.5
% flats	0.1	0.1	0.1	0.1	0.1	0.1	0.1
% hh with security protection	0.8	0.8	0.8	0.8	0.8	0.8	0.8