



MINISTRY OF
JUSTICE
Tāhū o te Ture



**EXPLORING CRIME TRENDS IN NEW ZEALAND AND THE
DRIVERS OF RECORDED BURGLARY RATES**

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Body text

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The views expressed in this Working Paper are those of the authors and do not necessarily reflect the views of the Ministry of Justice. The paper is presented not as policy, but with a view to inform and stimulate wider debate.

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ABSTRACT

The incidence and recording of crime is influenced by a vast and complex array of factors, most of which are well documented in the theoretical and empirical literature. In New Zealand, overall recorded crime rates increased rapidly for each decade from 1950 to 1990. However, over the last two decades, the overall rate of recorded crime has reduced. This paper investigates what factors have influenced changes in recorded burglary rates in New Zealand from 1980 to 2008. Both univariate correlation analysis and multivariate regression analysis are used to determine what demographic, economic, social and justice-related variables are most closely related to both short-term and long-term changes in recorded burglary rates. This study finds that economic factors (the inflation rate, GDP (both current year and lagged one year), and personal consumption) provide the best explanation of changes in recorded burglary rates in the short term. In the long term, the effective teenage birth rate, the unemployment rate and general business confidence explain most of the variation in recorded burglary rates over the 1980 to 2008 period (89% of the variation). There is little evidence that justice-related factors, such as increasing Police numbers or increasing the rate of imprisonment are effective mechanisms for reducing burglary rates.

Keywords

Crime, burglary, correlation, unemployment, general business confidence, Gross Domestic Product, inflation rate, personal consumption, teenage birth rate, abortion rate, police numbers, prison numbers.

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EXECUTIVE SUMMARY

A large number of empirical studies have examined the factors that drive the changing patterns in crime trends. However, no firm conclusions have been reached about the causes of crime. In some instances, studies contradict each other, making it difficult to assess what factors are important levers for governments wanting to take action to reduce crime.

The most exhaustive paper to date on interpreting trends in recorded crime in New Zealand was undertaken by Sue Triggs in 1997. Triggs found that short-term fluctuations in most recorded crime rates are associated with economic cycles. When business confidence is high, dishonesty offences tend to decrease, while violence and property damage are more likely to increase. Triggs noted that social factors are likely to influence long-term trends in crime, rather than short-term fluctuations. However, many of the social factors are difficult to quantify.

This report examines trends in recorded crime in New Zealand since 1950. A range of demographic, economic, social and justice-related factors that the theoretical and/or empirical literature has found to be associated with criminal behaviour are then analysed to determine what factors have influenced changes in recorded burglary rates in New Zealand from 1980 to 2008.

Crime trends in New Zealand

Overall recorded crime rates increased rapidly for each decade from 1950 to 1990. The highest rate of growth occurred in the 1950s, when the rate of recorded crime more than doubled. Over the last two decades, however, the overall rate of recorded crime has decreased. The net effect is that the current overall recorded crime rate is approximately the same as it was in 1981.

When broken down by different types of offence, the trends in recorded crime rates are very disparate. The most marked change in rates over time has been for violent crime, with a 3.7-fold increase in the recorded rate of violent crime between 1980 and 2008. In contrast, the pattern for dishonesty offences resembles that for total crime to some degree. The recorded crime rate for all dishonesty offences increased by 3.6% per annum on average from 1980 but declined by 3.7% per annum on average between 1992 and 2008. This decline was considerably larger than the average annual decrease for overall crime over the same period.

Burglary is the second largest dishonesty offence in terms of the number of recorded crimes. The pattern of changes for recorded burglary rates closely resembles that for all dishonesty offences, with a 4.6% average annual increase to 1992, and a 4.1% average annual decrease since 1992.

However, changes in recorded crime may not accurately reflect changes in actual crime, but may also be a function of changes in reporting and recording practices. To test whether variations in recorded crime levels represent changes in actual crime rates, recorded crime rates are compared with changes in victimisation prevalence rates for New Zealand from the International Crime and Victimization Surveys (ICVS).¹ The closest correspondence between changes in victimisation prevalence and recorded crime rates occurs for dishonesty crimes – burglary, vehicle crime and theft. This suggests that demographic, economic, social and justice-related factors associated with changes in recorded crime rates will be related to changes in actual burglary rates. Therefore, the model for burglary can be employed as a prototype for use with other offence types.

Methodology

Univariate correlation analysis is used to determine what variables are correlated with changes in recorded burglary rates. Multivariate regression analysis is used to model the relationship between recorded burglary rates and the variables that were found to be significantly correlated with changes in recorded burglary rates in the univariate analysis.

The analysis is at a macro-level, based solely on aggregate rates of the variables because sample selection and the effects of omitted variables make it difficult to perform a robust statistical analysis at an individual or regional level.

Main findings

A number of variables are correlated with changes in recorded burglary rates over the 1980 to 2008 period. These include the inflation rate, Gross Domestic Product (GDP), and personal consumption. The unemployment rate, general business confidence, household disposable income, net migration, the percentage of female labour force participation, the effective teenage birth rate, the effective abortion rate, total police staff (lagged one year), and the prison population (lagged three years) are also correlated with changes in recorded burglary rates. These variables are included in the multivariate regression analysis.

A range of variables are not significantly correlated with changes in recorded burglary rates over the 1980 to 2008 period. The percentage of the population aged 10 to 24 years, the birth rate per 1,000 women aged 15 to 44 years, income inequality, poverty levels, school attainment, alcohol consumption, government expenditure on justice, prosecution, conviction, and imprisonment rates for burglary, and the average custodial sentence imposed for burglary are not found to be significantly correlated with changes in recorded burglary rates. It is important to note that demographic change, both in terms of the changing

¹ Van Dijk, van Kesteren and Smit (2008).

age and ethnic distribution of the population, has had only a minor impact on overall changes in the recorded burglary rate over the period 1980 to 2008.

Multivariate regression analyses reveal that a number of economic factors, namely, the inflation rate, GDP (both current year and lagged one year), and personal consumption, provide the best explanation for changes in recorded burglary rates in the short term. A model including the effective teenage birth rate, the unemployment rate and general business confidence is the best predictor of recorded burglary rates over the long term.

A decline in GDP (both current year and lagged one year), high inflation, corresponding with a growth in personal consumption, are associated with an increase in recorded burglary rates. High effective teenage birth rates and unemployment rates, together with a reduction in general business confidence, are associated with high recorded burglary rates. Therefore, the results indicate that the health of the economy and the number of births to teenage mothers are key indicators of recorded burglary rates in New Zealand.

1. INTRODUCTION

The incidence and recording of crime is influenced by a vast and complex array of factors, including a range of demographic, economic, social and justice-related factors. Most of these are well documented in the theoretical and empirical literature.

This paper examines trends in reported crime in New Zealand, with a particular focus on changes in recorded burglary rates in New Zealand from 1980 to 2008. Understanding what factors are associated with changes in recorded burglary rates in New Zealand is the primary focus of this paper for two reasons.

Firstly, trends in recorded burglary rates have not been consistent with trends in the number of people in prison for burglary offences. The number of people sentenced to prison for a burglary offence was fairly stable from 1980 to 1987. From that time there has been an increase in the prison population, with a particularly sharp increase from 2003 (after the introduction of the Sentencing and Parole Act 2002). However, burglary rates generally increased from 1980 before starting to decline in 1992, and continued to decline until 2004, when the trend levelled out. It is important to understand what factors are driving these trends in order to better inform policy choices. Secondly, based on a comparison with victimisation prevalence rates, recorded burglary rates are most likely to mirror actual burglary rates and are therefore less likely to be subject to measurement error.

The paper begins with an examination of trends in recorded crime statistics in New Zealand, with a particular focus on the period 1980 to 2008. Changes in crime rates per 1,000 population are shown for all crime, as well as for a number of different offence types. To measure offending levels over time, Police recorded crime statistics are used.

Section 3 provides an overview of the international and New Zealand literature on the causes of crime, with a particular focus on property crime.

Section 4 details the methodology used in this research to determine what factors have influenced changes in recorded burglary rates in New Zealand from 1980 to 2008. It also outlines some of the methodological challenges associated with this type of research. The methodology applied in this paper is a prototype for use with other offence types.

Section 5 presents the results of the univariate correlation analysis. This analysis assesses the level of correlation between changes in recorded burglary rates and a number of variables individually.

Section 6 provides the results of the multivariate regression analysis. Several different models are analysed using the variables that are found to have a statistically significant correlation with changes in recorded burglary rates in the univariate correlation analysis. Based on these regressions, conclusions can be generated about what factors are most strongly associated with recorded burglary rates, both in the short and long term. These conclusions are discussed in Section 7.

2. TRENDS IN RECORDED CRIME IN NEW ZEALAND

2.1 Overall crime rates

Overall recorded crime rates increased rapidly for each decade from 1950 to 1990, as shown in Table 1. The highest rate of growth occurred in the 1950s, when the rate of recorded crime more than doubled. However, over the last two decades, the overall rate of recorded crime has decreased.

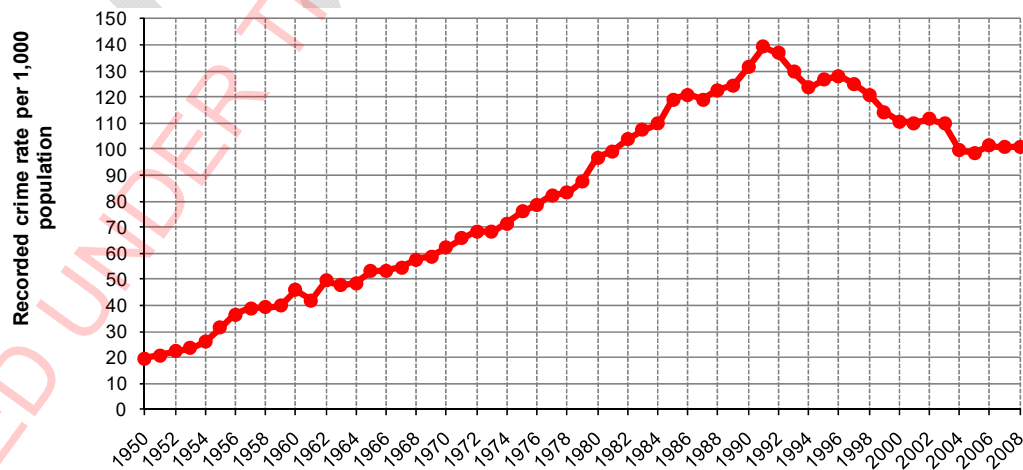
Table 1: Average annual rates of change in recorded crime rates

Period	Percentage change
1950-1960	8.8
1960-1970	3.1
1970-1980	4.5
1980-1990	3.1
1990-2000	-1.7
2000-2008	-0.5
1950-2008	2.9

Source: New Zealand Police

Overall recorded crime rates for each year are shown in Figure 1. Although the large increases in recorded crime from 1950 to 1990 (as displayed in Table 1) are apparent, there are periods over these four decades when crime reduces from one year to the next (for example, the early 1960s, mid-1970s and mid-1980s).

Figure 1: Overall crime rates per 1,000 population: 1950 to 2008



Source: New Zealand Police

Levels of overall crime peaked in the early 1990s, increasing by 3.4% per annum from 97 per 1,000 population in 1980 to 139 per 1,000 population in 1991 (a 44% increase in total). However, despite negligible change in the mid-1990s, the overall crime rate dropped by 1.9% per annum from 1991, to 101 per 1,000 population in 2008 (a 27% decrease in total), though there has been a slight increase in the overall crime rate since 2004. The net effect is that the current overall recorded crime rate is approximately the same as it was in 1981.

2.2 Crime trends by offence type

When broken down by different types of offence, the trends in recorded crime rates are very disparate, as displayed in Figure 2. The most marked change in rates over time has been for violent crime, with a 3.7-fold increase in the recorded rate of violent crime between 1980 and 2008. Apart from a slight decline in the violent crime rate in the second half of the 1990s, after a 46% increase between 1992 and 1994, the rise in recorded violent crime has been almost continuous, though with marked variations in annual growth rates since 1980.

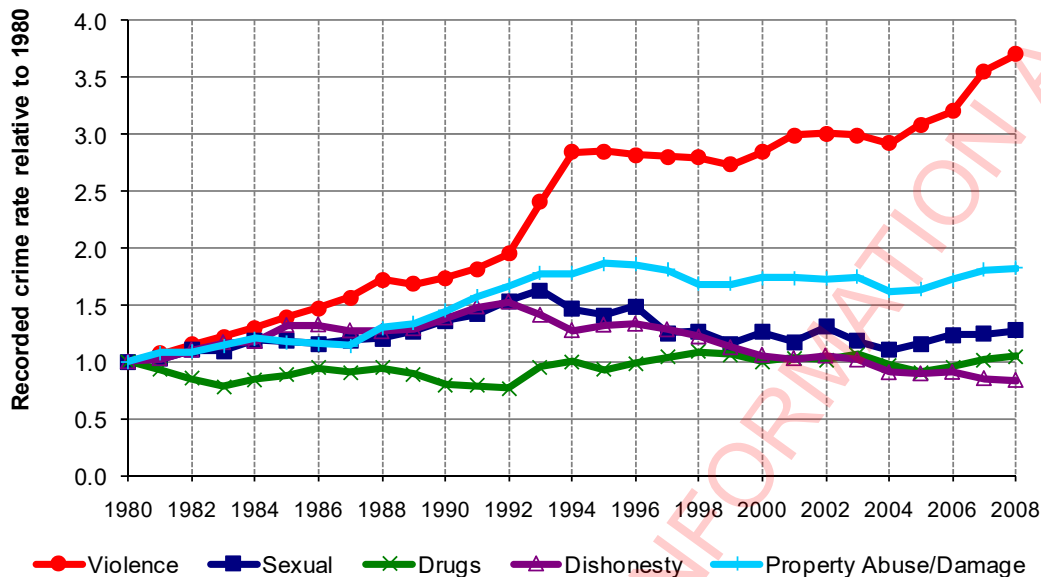
In contrast, the pattern for dishonesty offences resembles that for total crime to some degree. The recorded crime rate for dishonesty offences increased by 3.6% per annum on average from 1980, to a peak of 95 per 1,000 population in 1992. However, recorded crime rates for dishonesty offences declined by 3.7% per annum on average between 1992 and 2008, considerably larger than the average annual decrease for overall crime over the same period. This is not surprising given that dishonesty crime accounted for 70% of all recorded crime in 1992, but dropped to 52% in 2008. As with violent crime, there have been marked variations in annual changes in recorded rates over time.

The pattern of recorded crime rates for sexual offences is also similar to that for overall crime, with a 3.8% average annual growth rate from 1980 to a peak of 1.1 per 1,000 population in 1993. Between 1993 and 2008, the overall recorded crime rate for sexual offences declined by 1.6% per annum on average.

The recorded crime rate for property abuse/damage increased continuously through to 1995, with a 4.2% average annual increase. Since 1995, the crime rate for property abuse/damage declined fairly steadily, but has increased markedly since 2004 to be at a level just below that of 1995.

In contrast to sexual and property abuse/damage offences, there has been little change in the recorded crime rate for drugs-related offences (including alcohol) since 1980, compared with the other types of offences. For sexual, property abuse/damage, and drugs offences, however, there has been marked variation in year-to-year recorded crime rates.

Figure 2: Trends in recorded crime rates by offence type: 1980 to 2008



Source: New Zealand Police

2.2.1 Homicide trends

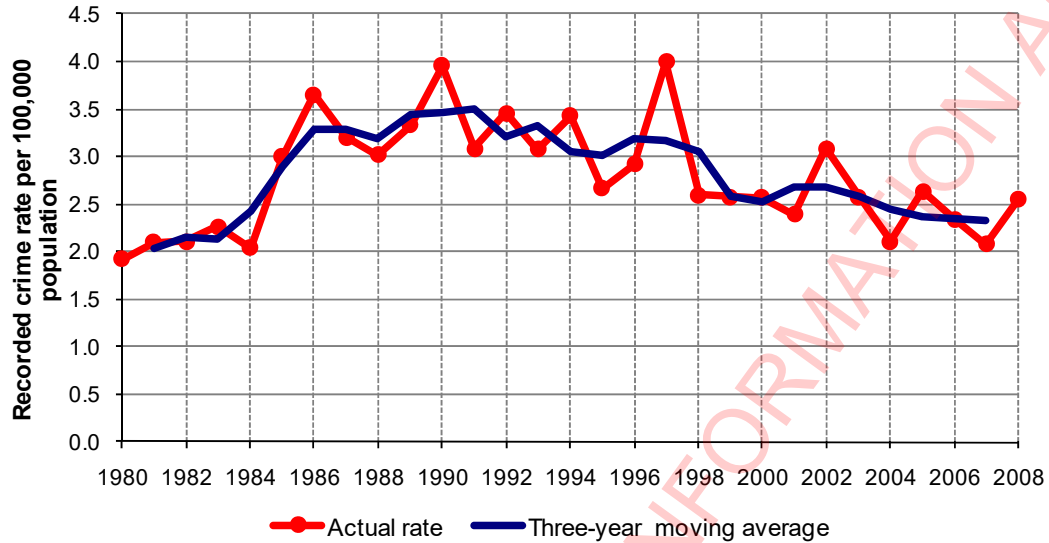
Of all offences, homicide is the most serious, and as such should be the most accurately recorded over time, so that any changes in recorded homicide rates will reflect reality. Figure 3 shows that homicide rates have been extremely variable over the period 1980 to 2008. This is largely due to the fact that the number of homicides is very low – 60 minimum and 150 maximum per annum over the entire 1980 to 2008 period – so that a fluctuation of 20 or so homicides in one year will appear relatively large.

To more accurately reflect the trend over time, a three-year moving average rate for homicide has been calculated.² The trend for the three-year moving averages appears to indicate that the homicide rate increased steadily from 1980 up to 1986, and remained comparatively high (between 3-3.5 per 100,000) until 1998, but has since declined to a rate between 2-2.5 per 100,000. A Wald-Wolfowitz runs test is used to determine if there is a non-random pattern in the rates over time. The runs test is highly significant ($p < 0.001$), indicating that levels of homicide rates in the period 1985-1997 were significantly higher than either the preceding or following time periods.³

² This rate for each year equals the average of the rates for the current, preceding and following years.

³ The homicide rate in each year from 1985-1997 was higher than the median rate over the 1980-2008 period. Only in one other year (2002), was the annual homicide rate higher than the median rate.

Figure 3: Recorded homicide rates per 100,000 population: 1980 to 2008



Source: Derived from Statistics New Zealand and New Zealand Police data by the Ministry of Justice

Further evidence for homicide being at a higher level from the mid-1980s to the mid-1990s is provided in the Social Report 2009, which details the age-standardised assault mortality rate from 1980 to 2006. The data shows that the rate of people who died as a result of an assault or intentional injury was highest over the same period as displayed in Figure 3, with the rate generally declining since 1997.

2.2.2 Violent crime trends

To further investigate changes in violent crime, recorded crime rates for robbery and grievous assault are displayed in Figure 4. These are the third and fourth most serious violent offences respectively in terms of average seriousness scores of offences.⁴ (Kidnapping and abductions has the second highest average seriousness score for violent offences but is not analysed due to there being only a small number of cases).⁵ It is apparent that for the next most serious offence, namely robbery, there was rapid growth in the level of recorded crime through to 1998, with a 7.8% average annual increase over that period. The greatest rate of change in recorded robberies occurred from 1980 to 1986,

⁴ The seriousness score gives imprisonable offences a weight according to how serious judges have deemed each offence in terms of length of custodial sentences over a specific time period. These scores provide one way of being able to rank offences in terms of their relative seriousness. The 2005 seriousness scores are based on court sentencing data for the period 2000 to 2004. The seriousness score assigned to each offence is the average number of days of imprisonment imposed on every offender convicted of that offence between 2000 and 2004, irrespective of whether they received a custodial sentence or not. Note that all offences that are not imprisonable are scored as zero.

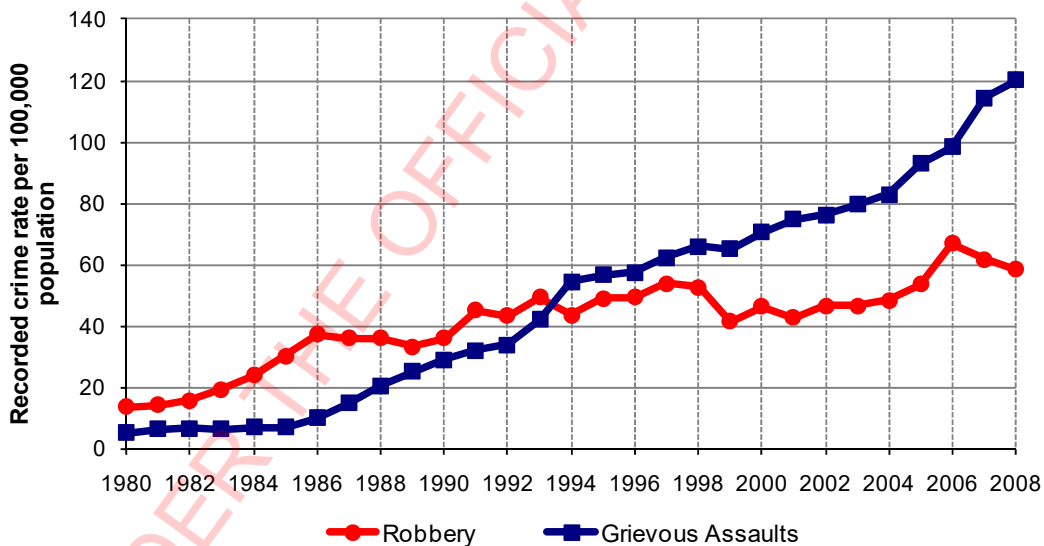
⁵ There were 254 recorded crimes for kidnapping and abductions in 2008, compared with 160 in 1995.

with the rate almost trebling. Over the last ten years, the rate of recorded robberies has almost levelled off, with only a 1.1% per annum increase, and this was principally due to the increase between 2005 and 2006.⁶

There are a number of key characteristics of robbery that differentiate this offence from other violent crimes. Firstly, one of the primary motivations is financial gain and the taking of someone else's property. Secondly, it is more likely than other violent crime to involve multiple offenders. And finally, it is much more likely to be perpetrated by a stranger or strangers.

For grievous assaults, the pattern of changes is very reflective of that for total violent crime, though not in magnitude, with almost continual growth through to 2008. The recorded rate of grievous assaults increased by 18% per annum from 5.1 per 100,000 population in 1980 to 32 per 100,000 population in 1991, over a six-fold increase. Since 1991, there has been an 8.1% average per annum increase in the recorded rate of grievous assaults. The overall effect is that the recorded crime rate for grievous assaults in 2008 is over 23 times the rate that was recorded in 1980, compared with a 3.7-fold increase for total violent crime.

Figure 4: Recorded grievous assault and robbery rates per 100,000 population: 1980 to 2008



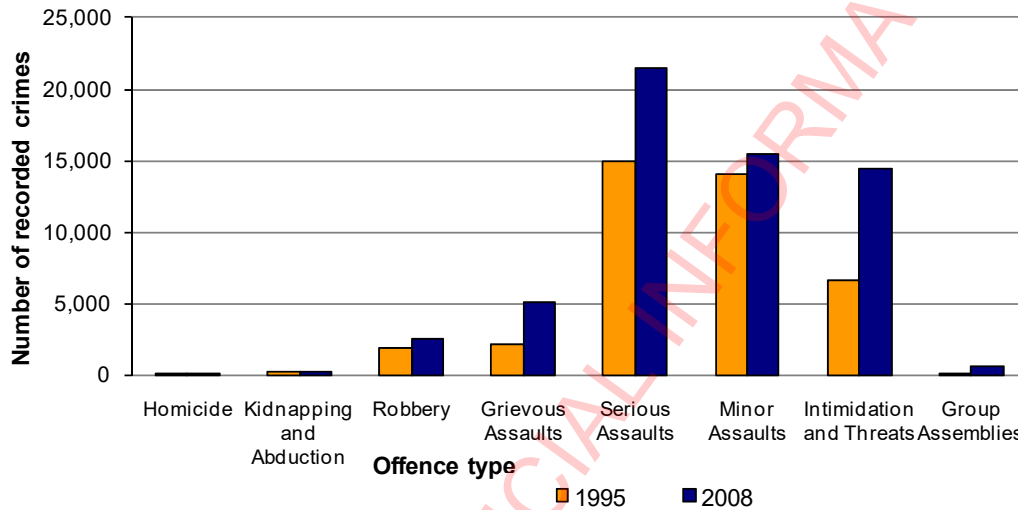
Source: New Zealand Police

Changes in recorded violent crime by offence type are shown in Figure 5, with offence types sorted in descending order of seriousness scores. In terms of absolute numbers, the largest increases in violent crime since 1995 have occurred for intimidation and threats, and serious assaults, with increases of 7,860 and 6,572 respectively to 2008. In percentage terms, however, the

⁶ This could be due to a change in Police's crime recording IT system, which occurred in July 2005.

highest rate of growth has occurred for grievous assaults, with a 2.5-fold increase since 1995, and intimidation and threats, with a 2.2-fold increase. In contrast, the percentage growth for minor assaults was the lowest of all the violent offence types. This large disparity in growth rates by offence type points to a change in police charging behaviour over time – the exact extent of this though is unknown.

Figure 5: Changes in the levels of recorded violent crime, by offence type: 1995 and 2008



Source: New Zealand Police

In examining trends in violent crime since 1997/98, Smith (2008) was unable to conclude that the actual level of violence in society is increasing. Rather, her analysis suggested that the increase in recorded violent crime is more likely due to a combination of:

- changes in Police recording practices, in particular, the change in Police's crime recording IT system in July 2005 (as shown by Axist Consulting New Zealand Ltd, 2006)
- a lower public tolerance of family violence and hence increased propensity to report assaults in the home to Police
- an associated change in Police attitudes towards and focus on family violence, together with changes in recording practices, and,
- changes in the focus of pro-active Police activity, detection and enforcement, and decision-making around charging and prosecution.

Smith (2008) noted the need for more statistical analysis, particularly at District level, to explore the impact of regional variations in Police practice on drivers of recorded crime, and the need for qualitative analysis of Police charging and prosecution decisions, to identify systemic issues underlying the trends in crime statistics.

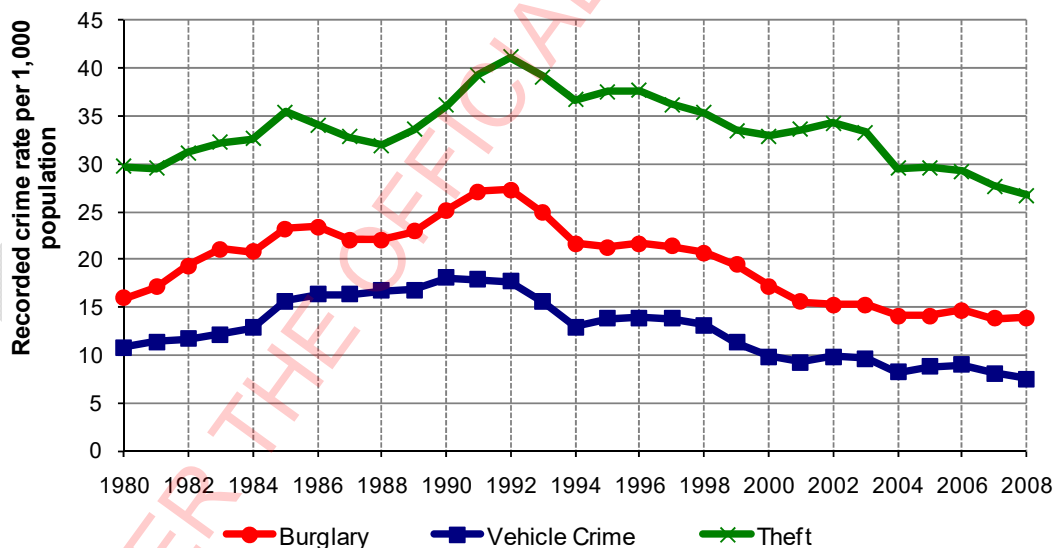
Police have attributed all of the increase in violence over the past few years to an increase in reporting of family violence. They have commented that, “[m]any people may now be reporting family violence to police which in the past may not have come to our attention at all. This does not necessarily equate to an increased prevalence of family violence offending” (New Zealand Police, 2008).

Based on the analysis presented here, and the findings above from Smith (2008) and the Police, it would appear that both low-end and high-end violent crime did increase during the 1980s and peaked during the late 1980s through to the mid-1990s. The evidence would suggest that the real level of high-end violent crime has levelled off since the mid-1990s. Changes in the levels of low-end violent crime may have also been flat over the last decade.

2.2.3 Dishonesty crime trends

Recorded crime rates for the three highest-volume dishonesty crimes – burglary, vehicle crime, and theft – are displayed in Figure 6.

Figure 6: Recorded burglary, vehicle crime and theft rates per 1,000 population: 1980 to 2008



Source: New Zealand Police

The pattern of changes in recorded rates of theft and burglary are very similar – rapid growth in recorded crimes over the first half of the 1980s, followed by a decline through to 1988, then an increase to peak rates in 1992. Since 1992, there has been an almost continuous reduction in the rates of both offence types. In magnitude, however, there is a considerable difference - the rate of burglaries increased by 4.6% per annum on average from 1980 to 1992, while the theft rate increased by 2.8% per annum over the corresponding period. In contrast, since 1992, the recorded rate of burglaries has declined at a faster rate

than that of theft, with 4.1% and 2.7% per annum reductions for burglary and theft respectively.

Recorded vehicle crime rates exhibit a similar pattern to that of burglary and theft from 1992 on, with an almost continual decline, but with a sharper rate of decrease (a 5.2% per annum reduction from 1992 to 2008). However, although the overall rate of increase for vehicle crime between 1980 and 1992 is very similar to that of burglary (64% versus 71%), the annual rates of change differ noticeably. The recorded vehicle crime rate increased every year between 1980 and 1990 – there was no decline in the rate in the second half of the decade. Also, the rate peaked in 1990, declining slightly over each of the following two years.

2.3 Measuring crime

This study examines what variables have been driving trends in burglary rates recorded by Police. Recorded crime statistics are determined by not only the incidence of crime, but also by public perceptions of what is crime, confidence in the Police and the justice system, and hence whether the crime is reported to the Police, and how the crime is recorded and counted by the Police. Therefore, changes in recorded crime may not accurately reflect changes in actual crime, but also represent changes in reporting and recording practices over time. For example, Myers (1980) found that actual crimes rates during 1970 to 1974, for a sample of large United States cities, were from one and one-half to three times as large as reported crime rates.

Myers (1980) questions whether it is necessary to correct for an under-reporting in crime and suggests that under-reporting does matter if the interest is only in the actual extent of crime. However, if the analysis is only concerned with the general magnitudes and signs of the coefficients, it does not matter.

To test whether variations in actual crime levels are related to changes in the reporting and recording of crime, recorded crime rates are compared with victimisation prevalence rates for New Zealand from the International Crime and Victimization Surveys (ICVS)⁷. Based on this analysis, the feasibility of analysing the relationship between changes in Police recorded crime and a range of demographic, economic, social and justice-related variables, for each offence type, can be determined.

Field (1990) examined victimisation surveys to see if they matched trends in Police recorded crime. However, as noted by Lynch and Addington (2007), however, neither measure will accurately reflect the true level of crime at a particular time. Therefore, it is necessary to compare changes in the rates of recorded crime and victimisation over time.

⁷ Van Dijk, van Kesteren and Smit (2008).

Data from the 1991 and 2003/04 ICVS are available for New Zealand, thus enabling a comparison between recorded and surveyed crime rates between these two years. Table 2 presents percentage changes in victimisation prevalence and recorded crime rates between 1991 to 2003/04.

Table 2: Percentage changes in victimisation prevalence (ICVS) and recorded crime rates for New Zealand between 1991 and 2003/04

Type of crime	Victimisation prevalence (ICVS)	Recorded crime
Robbery	57	5
Assault	-14	63
Sexual offences	-46	-19
Burglary	-26	-46
Vehicle crime	-33	-50
Theft	-23	-20

Source: International Crime and Victimisation Survey and New Zealand Police

It is apparent that the closest correspondence between changes in victimisation prevalence and recorded crime rates occurred for dishonesty crimes – burglary, vehicle crime and theft. Given the statistical error involved in calculating victimisation rates using survey data, this implies that there is no evidence to suggest that the variables associated with changes in recorded crime rates for dishonesty crimes will not be linked to changes in actual dishonesty crime rates.

Although there is less correspondence between changes in victimisation prevalence and recorded crime rates over the period for robbery and sexual offences, both are relatively low volume offences, and therefore, the variability around the victimisation rates is relatively large. This implies that although there is no conclusive evidence to suggest that the overall changes in recorded sexual offences and robbery rates do not mirror changes in actual crime rates, any variables associated with changes in recorded crime rates for these two offence types should be treated with a degree of caution.

For assaults, however, the results from the two ICVS indicate that there was a slight reduction between 1991 and 2003/04. Taking statistical variation into account, there is no evidence of any change in assaults over the period. However, the recorded crime rate for assaults increased by 63% over the same period. Given this vast difference between changes in victimisation prevalence and recorded assault rates, any analysis of variables affecting changes in recorded crime rates for assaults will be highly questionable.

3. FINDINGS FROM THE LITERATURE

The desire to understand what drives the changing patterns in crime trends have kept economists and criminologists occupied for several decades. Both theoretical and empirical studies have postulated a range of possible factors underlying trends in crime. These include social factors such as the breakdown of social values, alienation, poor parental practices, and family structure, economic factors such as income equality, poverty, and unemployment, and justice-related deterrent factors, such as the number of Police and the rate of imprisonment.

The literature on the causes of property crime is more extensive than the literature on the causes of violent crime. However, despite the large number of empirical studies, no firm conclusions have been reached about the causes of crime.

This section does not attempt to provide an exhaustive literature review of the topic. Rather, it summarises the findings of some of the key studies that have been undertaken over the last 50 years, both internationally and within New Zealand.

3.1 International literature

The literature reviewed was organised into the following groups: those that examined the impact of police numbers and other deterrent factors on crime; those that examined economic factors associated with crime; those that considered the effects of demographic factors on crime; and, those that examined social effects, such as the legalisation of abortion. This section begins with an overview of two key studies that examined what factors explained crime trends over distinct periods of time.

Dills *et al* (2008) evaluated what economists have learned over the past 40 years about the determinants of crime. They examined aggregate data over long time periods and across countries, and also undertook a critical review of the literature.

Their empirical analysis compared crime rates one-by-one with potential determinants, that is, they examined the univariate relationships between crime and possible explanatory variables. This approach is not ideal as the true model of crime is likely to include multiple factors and the raw correlation between crime and a possible determinant might mask the presence of endogeneity between explanatory variables. But examining the one-on-one relationship between crime rates and potential determinants reveals what variables are empirically important, and what factors have no relationship with levels of crime.

Dills *et al* found that multivariate approaches fail to display the correct correlations in the majority of cases. This led them to conclude that economists

know relatively little about the determinants of crime. Hypotheses that find some support in the United States data in recent decades are inconsistent over longer time periods and across countries. This conclusion applies to a range of variables, including arrest rates, abortion rates or gun laws. However, they do find that the hypothesis that drug prohibition generates violence is consistent with time-series data and cross-country facts.

In an earlier study, Levitt (2004) examined what factors were behind the sharp decline in crime in the United States in the 1990s. Experts failed to anticipate the decline, but after the fact, postulated a range of reasons for the drop in crime. These included innovative policing strategies, increased imprisonment, changes in the market for cocaine, the aging of the population, tougher gun control laws, the stronger economy, and increases in the number of police.

Levitt (2004) analysed these explanations, looking at possible determinants that changed in some substantial way in the 1990s. He found that most of the explanations outlined above had little direct effect on crime rates, while four factors accounted for most of the observed decline: increases in the number of police, the rising prison population, the waning crack epidemic, and the legalisation of abortion.

Levitt (2004) also considered the extent to which these factors explained observed patterns of crime in the earlier period of 1973 to 1991. He found that growth in the prison population dominated all other factors in terms of their predicted impact on crime, with the remaining factors largely counterbalancing each other. Thus Levitt hypothesised a decline in crime over this earlier period. However, this decline did not eventuate, as crime increased across all categories over this period. Levitt (2004) concluded that the set of factors that appear to explain crime trends in the 1990s do not explain the substantial rise in crime from 1973 to 1991, and as a result there are a large number of unexplained residual factors that influence crime rates.

3.1.1 Deterrent effects on crime

In 1968, Gary Becker developed a theoretical economic framework to analyse illegal behaviour and to develop optimal public and private policies to combat this behaviour. Becker (1968) argued that criminal activity is a feature of rational behaviour, and the optimal amount of enforcement depends on (among other things) the cost of catching and convicting offenders, the nature of punishments, and the responses of offenders to changes in enforcement. Becker suggested that theories such as anomie, psychological inadequacies, or the inheritance of special traits can be dispensed with in favour of the economist's analysis of choice.

Becker's ideas were further developed in a paper by Ehrlich in 1973. Ehrlich (1973) developed a theory of participation in illegitimate activities and tested this against data on variations in index crimes across the United States. The paper

examined the interaction between crime and collective law enforcement and found a deterrent effect of law enforcement activity on all crime.

The empirical analysis confirmed Ehrlich's basic thesis that offenders respond to incentives in much the same way that those who engage in legitimate activities do as a group. Specific crimes were found to be positively related to estimates of relative gains and negatively related to estimates of costs associated with criminal activity.

3.1.2 Police numbers

Several studies have considered the impact of police numbers on crime, and many have concluded that police have little or no impact on crime. For example, Cook (1979) argued that criminals may commit illegal activities in another area where police numbers have not increased, or may switch to less risky crime types. Buck, Halkim and Spiegel (1985) claimed that police expenditure increases deterrence in the short-run, but crime returns to its 'natural rate' in the long-run. This is because there is a pool of criminals for whom the marginal benefits of illegal activity increase as time passes, as they are able to learn from their associations with other criminals.

Marvell and Moody (1996) also noted that most police work is not devoted to crime reduction and that large increases in police resources are needed to produce enough police presence on the streets to actually deter crime. They also noted that police tend to respond to emergency calls and rely on car patrols rather than walk the beat. Such practice does not tend to prevent crime before it happens.

Marvell and Moody (1996) reviewed 36 studies covering 78 crime regression analyses. Fourteen found significant negative coefficients on police variables, while 17 found significant positive correlations. However, many of the researchers did not take account of the endogenous relationship between police and crime, that is, police numbers are often determined in the context of crime levels in preceding years.

Marvell and Moody (1996) took a fresh look at the relationship between police and crime, with a particular focus on mitigating the specification problems. They found a statistically significant negative relationship between lagged police numbers and crime at the city level. They estimated that each additional officer at the city level results in 24 fewer crimes. They also found that police levels adjust to crime levels over the long term and are not very sensitive to changes in annual crime rates.

Levitt (1997) attempted to take account of the endogenous relationship between police and crime by using electoral cycles as an instrumental variable. This variable was used because police numbers tend to increase during election years for mayors and governors. He found that an increase in the size of police

forces during gubernatorial and mayoral election periods significantly reduced violent crimes, but had less of an effect on property crimes.

McCrary (2002) found programming and classification errors in Levitt's (1997) paper. Levitt (2002) acknowledged these errors and used the number of fire-fighters and other municipal workers as instruments for the number of police officers. Levitt (2002) found that police numbers had a large impact in reducing crime. Levitt (2004) also found that increases in the number of police partially explained the declines in crime in the United States during the 1990s.

3.1.3 Incapacitation and crime

Cameron (1988) considered whether punishment deters crime and noted a number of reasons why economists should not conclude that punishment will deter crime. His reasons included:

- An increase in public sector deterrence may decrease levels of self-protection, which could result in a higher level of crime.
- Greater deterrence efforts may simply shift crime to a different time, place or offence and this could lead to an increase in aggregate crime.
- Effective deterrence reduces the average expected return per crime, so more crime may be necessary to maintain a target income.
- In terms of organised crime, deterrence might encourage some "illegal firms" to leave the crime industry, making it possible for new entrants to enter the organised crime market. Or incumbent firms may absorb the cost of the increased risk due to their high profit margins.
- Very large changes in the probability of punishment are needed to deter criminals from committing an offence.

Cornwell and Trumbull (1994) presented empirical evidence suggesting that the ability of the criminal justice system to deter crime is much weaker than previous studies indicated. Lochner (2004, p.28) noted that "criminal returns to most property crimes need not be very high for low skill workers to engage in them (if they do not have a strong psychic aversion to prison)."

Johnson and Raphael (2006) found that breaking the simultaneity between incarceration and crime yields substantially larger estimates of the effects of incarceration on crime than those estimated using ordinary least squares models. They also found that the effect on crime rates of incarcerating one more inmate has declined over the last quarter century, indicating a substantial reduction in crime-prison elasticities. This suggests that the crime-reducing effects of incarceration decrease as the size of the prison population increases.

3.1.4 Economic factors associated with crime

Field (1990) analysed the effects of different factors on the growth rate of different types of crime in England and Wales in the post-war period. Field noted

that factors that have a dominant influence on crime rates in the short term may only play a marginal role in the long term, when different factors are more important. Field (1990) found that crime growth rates vary substantially from year to year, but not very much from decade to decade.

Field's key finding was that economic factors have a major influence on trends in both property and personal crime in the short term (while the relationship between long-run economic growth and growth in property crime was unclear). Field noted that "economic factors in general, and consumption growth in particular, appear to be among the most important determinants of fluctuations in the growth of property crime in industrialised countries"(1990, p.5).

Field (1990) also commented on the need to look past fluctuations in crime resulting from economic factors to the underlying trends in crime. Economically determined fluctuations in crime rates may not indicate a failure or success of crime policy and crime prevention.

In a follow-up study, Field (1999) analysed the long-term relationship between recorded thefts and burglaries and other factors. Field found that recorded thefts and burglaries are very strongly positively associated with two factors: the stock of crime opportunities, as measured by total personal consumption over the last four years; and, the number of young males in the population.

Allen (1996) estimated time series models for robbery, burglary and vehicle theft from annual national Uniform Crime Report data for the period 1959 to 1992. Allen found that macroeconomic stability and criminal justice system actions are important in reducing property crime activity. He found that a reduction in inflation decreases property crime and that the current unemployment rate was statistically significant and positive for robbery and burglary. He also found that decreases in absolute poverty and general income inequality are associated with increased criminal activity.

There is strong evidence in the literature that low human capital levels among young uneducated men partially explain why they are more likely to engage in property crimes. As Lochner (2004) noted, low skill levels imply low opportunity and incarceration costs for committing crimes.

Lochner (2004) also noted that depreciation in skills while in prison and the negative stigma associated with incarceration may reduce the returns to legitimate opportunities following release, and thus increase recidivism rates. There is a tension between the positive deterrent and incapacitation effects of imprisonment and the negative effects on skills and marketability.

3.1.5 *Demographic factors*

Marvell and Moody (1991) surveyed 90 studies that used regression equations to estimate the effect of the age distribution on crime rates. They found that only in a small minority of instances did the studies uncover significant relationships.

They noted that an age/crime relationship may exist, but forecasts based on demographic trends are not likely to be very robust.

Allen (1996) also noted that age/demographics appeared to have only a limited impact on property crime trends. This finding is also consistent with Levitt (1999) who found that changes in the age structure had a limited impact on aggregate crime rates. He noted that “even the dramatic transformation of the age distribution accompanying the baby boom shifted crime rates by no more than 1% per year” (Levitt, 1999, p. 581). Levitt concluded that the changing age distribution explained only 10 to 20% of the substantial increase in crime observed in the United States between 1960 and 1980.

3.1.6 Social factors

There are very few empirical studies examining the impact of social factors on crime rates. This is likely due to a lack of data. However, the impact of legalised abortion on crime has received some attention over the last decade.

Donohue and Levitt (2001) provided evidence that legalised abortion contributed significantly to crime reductions in the United States in the 1990s, with crime beginning to fall roughly 18 years after abortion was legalised. They found that the first states to legalise abortion experienced earlier reductions in crime compared with those states that legalised abortion at a later date. States with high abortion rates in the 1970s and 1980s experienced greater declines in crime in the 1990s. Donohue and Levitt (2001) estimated that legalised abortion accounted for as much as 50% of the drop in crime in the 1990s.

Donohue and Levitt (2001) noted that teenagers, unmarried women and poor women are more likely to have unwanted pregnancies, a large proportion of which will be terminated. Children born to these mothers are at a higher risk of committing crime in adolescence, and these children are often subject to social, health and economic disadvantage from an early age.

Donohue and Levitt's paper was critiqued by Foote and Goetz (2005). The authors noted that Donohue and Levitt's analysis of data on crime and abortion is defined on a state-year level. They observed that possible confounding effects at this level were not controlled for in Donohue and Levitt's paper. Foote and Goetz (2005) also criticised the paper for not analysing crime rates on a per capita basis.

After controlling for the possible confounding effects and producing results on a per capita basis, Foote and Goetz (2005) found no statistical evidence that hypothetical youths who were aborted would have been more likely to commit crimes had they reached maturity, than actual youths who were carried to full term. Foote and Goetz (2005) agree that abortion can lower the overall number of young people in the population (and hence lower crime), but the overall effect of abortion is likely to be much smaller than that claimed by Donohue and Levitt (2001).

More recently, Donohue, Grogger and Levitt (2009) noted that the legalisation of abortion in the 1970s changed the composition of young women at risk of bearing children out-of-wedlock 15 to 24 years later. This composition effect reduced out-of-wedlock teenage birth rates by 6%, accounting for roughly 25% of the observed decline in unmarried teenage births over the 1991 to 2002 period. The authors noted that “there are strong parallels between criminal activity among young males and out-of-wedlock births among teenage girls” (Donohue III, Grogger and Levitt, 2009, p.28).

3.2 New Zealand literature

The most exhaustive paper to date on interpreting trends in recorded crime in New Zealand was undertaken by Sue Triggs in 1997. Triggs (1997) examined the influences on aggregate levels of crime recorded by the Police from 1962 to 1995. Multiple regression techniques were used to determine which social, economic, demographic and justice variables were statistically associated with changes in the annual growth rates of recorded crime, by offence type, over this period.

Triggs (1997) noted that not all the variables could be quantified. Of those that were included, only the variables that were likely to have considerable effects could be distinguished with confidence due to statistical limitations.

Triggs (1997) found that short-term fluctuations in most recorded crime rates are associated with economic cycles. When business confidence is high, dishonesty offences tend to decrease, while violence and property damage are more likely to increase. Triggs noted that social changes are likely to influence long-term trends in crime, rather than short-term fluctuations. However, many of the social variables are difficult to quantify.

No significant deterrent effect was associated with the severity of punishment, as measured by the overall imprisonment rate and the average custodial sentence served per offence. There was a weak positive association between police numbers and violence and drug offences (Triggs, 1997).

In 2006, the New Zealand Police commissioned Axist Consulting NZ Ltd to provide an assessment of the reasons for the recent trends in recorded crime. Axist Consulting (2006) looked at changes in recorded crime for the 2004/05 and 2005/06 years. Recorded crime increased by 8% during 2005/06 compared to the 2004/05 year. The authors noted that, because of the complexity and the variety of causal factors, there are unlikely to be simple factors that can be correlated with the observed changes in recorded crime.

However, they did note some factors that may explain the increase in crime in 2005/06. These included an increase in New Zealand’s population, increased trust and confidence in the Police, and changes in police practices and resources. For example, the migration to a new computer system in July 2005 influenced the way crimes were recorded and counted. The change resulted in

an anomaly during July 2005 and an increase in the number of recorded crimes (Axist Consulting New Zealand Ltd, 2006).

Joanna Smith from the New Zealand Police produced a report in 2008 that explored trends in recorded violent crime in New Zealand. As noted in Section 2, she was unable to conclude that the actual level of violence in society is increasing, but was most likely the result of a concomitant change in public and Police attitudes to family violence, changes in Police recording practices, and changes in the decision-making around charging and prosecution.

4. METHODOLOGY

This paper investigates what demographic, economic, social and justice-related variables have influenced changes in recorded burglary rates in New Zealand from 1980 to 2008. These variables and their definitions are outlined in Appendix A. Recorded burglaries per 1,000 population are used to take account of the direct effect of population growth on changes in recorded burglary rates.

As detailed in Section 2.3, there is no evidence to suggest that the changes in victimisation prevalence rates were different from recorded crime rates for burglary over the period 1991 to 2003/04. This implies that the variables associated with changes in recorded burglary rates will be linked to changes in actual levels of burglary.

4.1 Univariate correlation analysis

As a first step, the univariate relationship (correlation) between changes in burglary rates and changes in each explanatory variable over the period 1980 to 2008 is explored.⁸ Examining the data in this way provides some insight into the relationship between each variable and changes in recorded burglary rates over time, without reference to any other variable.

The relationships are calculated using Pearson's correlation coefficient r .⁹ A moderate-strong correlation with changes in the recorded burglary rate suggests that the variable is related to changes in crime. This correlation may be because of its relationship with another variable but it does at least imply a relationship with changes in burglary.

In contrast, a low correlation implies that there is no one-to-one relationship between changes in a particular variable and changes in the recorded burglary rate. Although an explanatory variable, x_i , may not have a significant relationship with burglary by itself, it may be that it has a significant relationship with burglary once a number of other explanatory variables are included in the model. This would happen if the other explanatory variables explain much of the variation in changes in recorded burglary rates, but they principally explain the variation in a way that is complementary to what is captured by x_i . However, it is very unlikely that x_i would be a significant predictor of burglary without a number of other explanatory variables already being in the model. On this basis, it was decided to exclude these variables from any further analysis.¹⁰

As annual rates are auto-correlated for most measures (the current year's rate is strongly related to the previous years' figures), the univariate analysis uses

⁸ In effect, the annual changes between 1980/81 to 2007/08 are examined.

⁹ Henceforth, this is referred to as just the correlation coefficient.

¹⁰ Additional analysis shows that there is no evidence that any of the omitted variables had a significant impact on annual changes in burglary rates.

annual changes in rates.¹¹ This is the approach that was used by Field (1990) and Triggs (1997). Some variables may have a delayed impact on recorded burglary rates. Therefore, the first and second lags (and in some cases the third lags) of all explanatory variables, along with the current value, are tested in the univariate correlation analysis.

Calculating a correlation coefficient requires the data to be normally distributed. When the data is non-normal, the correlation coefficient will be inaccurate. Some of the changes in the explanatory variables are not normally distributed. Rather than carry out a transformation to normalise the data, Spearman's rank correlation coefficients have also been calculated between changes in burglary rates and changes in each explanatory variable from 1980 to 2008. Basically, Spearman's rank correlation coefficient converts the data to ranks before calculating the coefficient, and thus does not require the data to be normally distributed. Spearman's rank correlation coefficients, therefore, provide an additional check on the relationship between changes in burglary rates and changes in each explanatory variable.

4.2 Multivariate linear regression analysis

Once the explanatory variables that are significantly correlated with changes in recorded burglary rates are identified, multivariate linear regression analysis is used to model the relationship between recorded burglary rates and those explanatory variables. Multivariate linear regression analysis considers the dependence of one variable, the 'dependent variable', on one or more other variables, the 'explanatory variables', in order to estimate the average value of the former in terms of the known values of the latter.

The multivariate regression analyses are undertaken using both annual changes in rates and the actual rates. Analysing annual changes (using ordinary least squares) provides an indication of the variables that influence and predict changes or fluctuations in recorded burglary rates.

Marvell and Moody (1996) noted that using first differenced variables could mean that long-term relationships between a variable and crime are ignored. Co-integration could exist, where the variables move together because they are linked by a long-term equilibrium relationship. It is not possible to see this relationship using first differenced variables and it also tends to bias the results towards underestimating the true relationship.

Examining trends in actual rates provides an indication of the variables that influence the level of recorded burglary rates over the long term. However, as noted above, autocorrelation between the error terms is likely to occur when

¹¹ Annual changes in rates were calculated by subtracting the natural logarithm of the rate in the previous year from the natural logarithm of the rate for the current year. The natural logarithm is used to ensure annual changes reflect a normal distribution (that is, it removes the possible effects of outliers).

actual rates are used. As Triggs (1997, p.21) noted, “most economic and social time-series exhibit a marked, most often increasing, trend through time. For this reason, almost any of these variables will be highly correlated, even if there is no causal relationship.”

Analysis of burglary rates over the period 1980 to 2008 shows that there is a strong correlation between the current year’s rate and that in the preceding year. Therefore, using ordinary least squares regression will produce regression estimates that are unbiased but not efficient, as the sampling variances are underestimated, causing inferences from *t*- and *F*-tests to be invalid, and the R^2 for the model to be overestimated. To compensate for these auto-correlated residuals, the Yule-Walker method has been used for all regression analyses using actual rates. The Yule-Walker method estimates the autoregressive form of the error term and then estimates the coefficients via generalised least squares regression.

Variable selection methods are first used in order to choose a subset of predictive models for the dependent variable (recorded burglary rates) from the set of demographic, economic, social and justice-related explanatory variables.¹² The final model will be “over-fit” if all of the explanatory variables are included. The model will have explanatory variables that are too correlated with each other and their coefficients cannot be separately estimated.

In order to test the robustness, accuracy and predictive power of each of the specified models selected, and hence select the best model, each of the regressions are also run for two distinct periods: 1980 to 1992 (when burglary rates were generally increasing), and 1993 to 2008 (when burglary rates were predominantly declining). The final models selected are those that have estimates with reasonably consistent values over the two periods and across 1980 to 2008 in total, a good R^2 for 1980 to 2008 as a whole, as well as for each of the periods, statistically significant variables, and probably most important of all, the ability to forecast future burglary rates, based on trend data.¹³

For the analysis of changes in burglary rates, forecast changes in recorded burglary rates for the 1993 to 2008 period for each model are calculated using the regression coefficients from each model for the 1980 to 1992 period. In effect, this tests how good each model is at predicting the (predominant) reductions in burglary, based on a model that was used to predict changes in burglary rates for a period when there were mainly increases. This technique was also used for the analysis of actual burglary rates.

Given the complexities of the incidence and recording of crime, this study cannot provide a definitive explanation of what variables have *caused* changes

¹² A combination of Mallows *C_p* criterion and adjusted R^2 statistics were used to select a subset of good predictive models.

¹³ The coefficient estimates were statistically significant if they had a p-value of <0.05.

in recorded burglary rates since 1980. This could only be done using micro-level causal analysis.

However, by using statistical modelling on aggregate time-series data, this research can provide evidence about which demographic, economic, social and justice-related factors have the greatest associations with changes in recorded burglary rates over time, and what variables are likely to put pressures on aggregate burglary trends at a macro level. In addition, factors which appear to have little or no association with changes in recorded burglary rates can be identified.

4.3 Limitations of the study

A study of this nature has a number of methodological limitations, and therefore the results must be interpreted with caution.

4.3.1 Endogenous variables

Some of the explanatory variables included in the study may be endogenous. For example, many of the deterrence factors (such as additional police) are affected by crime, as they are often initiated in response to growing crime rates. As Marvell and Moody (1996, p.628) noted, "...there can be no doubt that studying the impact of police on crime encounters simultaneity problems." In such situations, ordinary least squares estimates are biased and inconsistent.

The most common method for addressing simultaneity is to use instrumental variables, usually with two-stage least squares regression. This procedure requires that a variable be identified that is known to affect, but not be affected by, the explanatory variable (e.g. police levels), but is known not to affect, or be affected by, crime rates. However, it is very difficult to find such an instrumental variable.

Another option is to use the lagged values of the criminal justice variables, as the current level of crime has no causal impact on past values of criminal justice variables. It has also been assumed (as in Field, 1990) that current levels of crime affect police strength in future years, but not the current year. However, as noted by Field (1990), such a model could suffer from missing variable bias by not including the current level of criminal justice factors. Correlation coefficients were calculated to test if there was any relationship between changes in current burglary rates and changes in the current levels of each of the justice factors. There was no evidence to suggest that annual changes in any of the justice variables, using current year values, had any relationship with changes in recorded burglary rates.¹⁴

Marvell and Moody (1996) noted that the assumption that lagging addresses simultaneity is incorrect if there is autocorrelation. This is likely to be the case as

¹⁴ This analysis is not presented in this report.

the current-year crime rate (the dependent variable) can affect lagged police levels through common correlation with lagged crime, which if not in the regression, is in the error term. This is not a problem in this study, however, as the analysis is based on annual changes in rates.

4.3.2 Omitted variable bias

Another specification problem is omitted variable bias. It is not possible to identify all the variables that should be included in the model and data is often not available for some of the variables suggested by theory. For example, consistent annual data is not available for many of the social variables that are likely to be associated with recorded burglary rates (such as impulsiveness, abuse, family disruption, the criminality of the parent and anti-social peer associations). And even if the data were available, many of these factors may not have an impact on criminal offending for several years. The use of inappropriate variables may also exacerbate specification problems.

The multivariate regression analyses are first run using annual changes. The statistically significant variables from these models are then included in the multivariate regression analyses using actual rates. This means that some variables may be excluded from the models that have a long-term relationship with recorded burglary rates, but not much effect in the short term.

Omitted variable bias may result in spurious correlations, where it appears burglary rates are correlated with a particular variable, but that variable may simply be correlated with another important factor that does have a direct effect on burglary, but cannot be included in the model.

To determine if any explanatory variables do have a long-term relationship, but were not identified to have any short-term impact, correlation coefficients between actual burglary rates and the actual rates for each explanatory variable were computed. There was no evidence to suggest that any of the omitted variables had any real long-term impact on burglary rates.¹⁵

4.3.3 Aggregate-level analysis

The analysis is at a macro level, based solely on aggregate rates. Ideally, as noted by Cornwell and Trumbell (1994), the analysis should be performed with individual-level data, since most models of crime describe the behaviour of individuals. However, as noted previously, the relationship between crime and demographic, economic, social and justice-related variables is very complex. Sample selection and the effects of omitted variables will make it difficult to perform a robust statistical analysis at an individual level.

Carrying out this type of analysis at a sub-macro level, by region for example, also has inherent problems. Estimating and matching regional inter-Census

¹⁵ This analysis is not presented in this report.

populations, numbers of offences committed by people in that region, and many explanatory variables at a regional level leads to inaccuracies of measurement. However, it may be possible to analyse certain variables (such as unemployment) at a regional level.

Both the problems with individual selection and omitted variables, plus the difficulties of carrying out the analysis at a sub-national level, can be ameliorated by using aggregate time series data. It must be stressed, however, that there are still problems with using aggregate data. Omitted variables may still exist, and there remains the problem of the ecological inference fallacy – attempting to apply the results from the average to everyone.

4.3.4 *Non-linear relationship between recorded burglary rates and explanatory variables*

It is assumed that the relationship between recorded burglary rates and the explanatory variables are linear. However, some variables may have a non-linear relationship with recorded burglary rates. For example, a variable may have an increasing effect on recorded burglary rates up to a certain point in time, after which point it has an exponential effect on recorded burglary rates. Alternatively, as the value of a variable increases so does the burglary rate, however, when the value of the same variable starts to decline it may take one or two years before the burglary rate begins to decline. Although applying a linear model in these instances will not lead to biased results, the true relationship will be underestimated.

4.4 Testing the robustness of the regression results

The regression results depend on the data used, the variables entered, and the form of the regression model used. Attempts have been made to mitigate specification problems, but some problems are still likely to exist.

Interpretations made from the analysis are not independent of the model that is specified. By only including variables in the final model if they demonstrated a moderate-strong correlation with changes in the recorded burglary rate, there is the risk that some variables may be wrongly included in the model, as some coincidental correlations could occur. This situation is minimised by testing a wide variety of models and forecasting (changes) in burglary rates for the 1993 to 2008 period for each model, using the regression coefficients from each model for the 1980 to 1992 period.

Robust regression models require a large number of data points compared to the explanatory variables. There are only 28 data points in the models analysing changes (29 in the models using rates). Triggs (1997) pointed out that when there are only a limited number of data points to fit, a relatively small number of explanatory variables may achieve a good fit by chance, especially when there are a large number of explanatory variables to choose from. This is a potential problem in this study.

It is very important that the data used to carry out the regression analysis has met the regression assumptions, otherwise the results will most likely be misleading. In this report the following assumptions have been tested.

Linearity: The relationships between the dependent variable and each explanatory variable should be linear. This is tested through univariate correlations and plots of recorded burglary rates against each explanatory variable.

Outliers and Influential Points: These are individual observations that exert undue influence on the regression model. These are identified through plots of studentised residuals versus predicted values and through the leverage scores for each observation.

Normality: The residuals should be normally distributed. Although normality is necessary only for tests of significance (t -tests) to be valid, estimation of the coefficients only requires that the residuals be identically and independently distributed. This is tested through normal quantile graphs, and the Shapiro-Wilk W test for normality.

Homoscedasticity (Homogeneity of Variance): The residual variance should be equal for all observations. This is tested through plots of residuals versus predicted values, and the White test for heteroscedasticity.

Multicollinearity: This occurs when two or more explanatory variables are highly correlated, which causes problems in estimating the regression coefficients. Variance inflation factors and tolerance statistics are used to check for multicollinearity.

Independence/Autocorrelation: The errors associated with one observation should not be correlated with the errors of any other observation. This is tested through the Durbin-Watson statistic.

5. POTENTIAL FACTORS INFLUENCING BURGLARY RATES IN NEW ZEALAND

This section examines a set of demographic, economic, social and justice-related factors that potentially influence burglary rates, showing the relationship between annual changes in each explanatory variable and recorded burglary rates from 1980 to 2008. It is important to note that a correlation between a particular factor and burglary does not imply *causation*. At this stage, the aim is to identify what variables appear to be related to changes in recorded burglary rates. It is not possible to determine whether the correlation is purely coincidental or whether it is explaining a true relationship.

The variables included in the analysis are those that are noted in the literature as being associated with crime. As noted in Section 4.3.2, it is not possible to include every variable that might be associated with recorded burglary rates. Data could not be obtained for a large number of social factors that are likely to be important for explaining burglary rates, particularly in the long term.

A summary of the analysis is provided here. The correlation coefficients and associated *t*-statistics and *p*-values are provided in Appendix B, along with graphical summaries of each of the variables analysed.

5.1 Changing demographics

New Zealand's total population increased by 11% between 1980 and 1992. However, as noted previously, the rate of recorded burglaries increased by 90% over the same period. Conversely, from 1992 to 2008, the total population grew by 21% while the overall burglary rate decreased by 38%.

To what extent, if any, can the changing age and ethnic structure of the population over the 1992 to 2008 period explain this dramatic turnaround in overall burglary rates? Apprehension rates for burglary are highest for those aged 14 to 16, with those aged 17 to 20 having the second highest apprehension rate.¹⁶ In contrast, apprehension rates for burglary are lowest for those aged under 10, and 51 and over. In 1995, after scaling apprehension rates by the ratio of recorded to apprehended offences, there were an estimated 150 burglaries per 1,000 committed by 14 to 16 year-olds, with 106 burglaries per 1,000 committed by 17 to 20 year-olds. This compares with only an estimated 0.3 burglaries per 1,000 committed by those aged 51 and over, 0.2% the rate of 17 to 20 year-olds.

From 1980 to 1992, the percentage of the total population aged 51 and over increased only marginally, from 22.1% to 23.4%. By 2008, however, 28.4% of New Zealand's population were aged 51 or older, as increasing numbers of the

¹⁶ Apprehension statistics use Police age groups.

baby boom bulge had turned 51. In contrast, the percentage of the total population aged 14 to 20 years-old decreased from 1980 to 1992, from 13.8% to 11.1%. By 2008, the percentage of the total population aged 14 to 20 had reduced slightly to 10.5%. The net impact of these demographic changes is that, with all other things being equal, the overall burglary rate should have declined fairly constantly since 1980.

However, burglary rates for Māori are substantially higher than those for non-Māori of the same ages.¹⁷ In 1995, for example, apprehension rates for burglary for Māori were 5.5, 5.2 and 6.1 times higher than for non-Māori, for 14 to 16 year-olds, 17 to 20 year-olds, and 21 to 30 year-olds respectively.

No population estimates are available for Māori before 1991, due to changes in the way the Census ethnicity question was worded, in particular about being Māori.¹⁸ From 1992 to 2008, the Māori population as a percentage of the total population increased from 13.6% to 15.1%. As a share of the total population aged 14 to 20 years old, 20.9% were Māori in 2008, compared with 18.9% in 1992. Given the large disparities in burglary rates between Māori and non-Māori, the increasing proportion of the population which is Māori, holding all other things equal, could be expected to have led to an increase in the overall burglary rate since 1992. However, this expected increase would have been negated to some extent by the ageing population.

To measure the exact impact of both an ageing population and increasing Māori population on overall burglary rates over time, indirect age-standardised and age/ethnic-standardised rates have been calculated. As burglary rates are highest for those aged 14 to 20 years and for Māori, standardising for age and ethnicity will remove any differences due to changes from year to year in the overall age and ethnic distribution of the population. As such, the standardised rate is an artificial measure, but it does provide an estimate of how rates by year might more fairly compare if there was the same age and ethnic distribution in each year. Age-standardised burglary rates are calculated by multiplying the ratio of actual to expected numbers of recorded burglaries by the overall national recorded burglary rate for 2006 to 2008.¹⁹

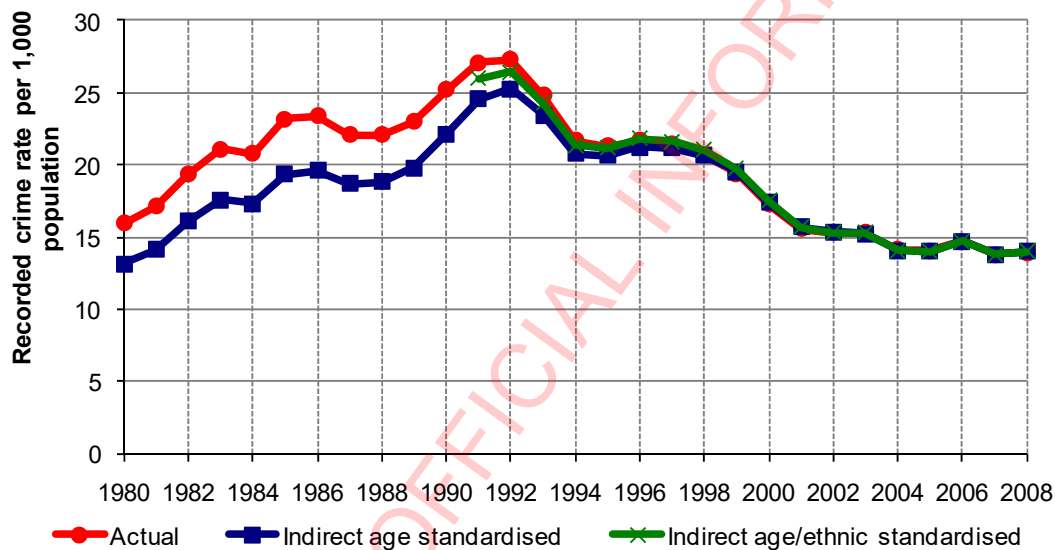
¹⁷ In Police crime records, people are only able to specify one ethnic group. In the Census, on which population estimates are based, ethnicity is self-perceived and people can belong to more than one ethnic group. For this analysis, non-Māori includes all people who do not identify as Māori as their sole ethnic group in the offence data, and have not identified as Māori as one of their ethnic groups in the Census data. Given these definitional differences, offence rates for Māori are very likely to be underestimates, but caution should be exercised when interpreting all offence rate statistics by ethnicity.

¹⁸ Statistical definitions of Māori have varied over time. Prior to the 1986 Census, definitions of Māori were generally based on biological criteria, such as 'half or more Māori blood'. From 1986 the emphasis of the census question on ethnicity changed to enable people to identify with the Māori ethnic group on the basis of cultural affiliation.

¹⁹ The expected number of recorded crimes for a particular year is calculated by multiplying the population in each year and age (and ethnic group) by the set of 2006-2008 age/ethnic-specific apprehension rates (scaled up to match the number of recorded crimes), for all New Zealand, and summing the results.

Age-standardised and age/ethnic-standardised recorded burglary rates are presented in Figure 7.²⁰ It is clear that during the 1980s, the overall burglary rate was approximately 20% higher than would have been expected given the age structure of the population. However, based on the age/ethnic-standardised rates from 1991 onwards, roughly half of that difference could be explained by the increasing Māori population as a proportion of the total. During the 1990s, the differences between the actual, age-standardised, and age/ethnic-standardised burglary rates reduced steadily with all rates converging in 2000, with no difference between the rates after 2000.

Figure 7: Actual and standardised burglary rates per 1,000 population: 1980 to 2008



Source: Derived from Statistics New Zealand and New Zealand Police data by the Ministry of Justice

Based on these results, it can be estimated that the changing age/ethnic structure was responsible for approximately 10% of the increase in the recorded burglary rate between 1980 and 1992. The overall burglary rate decreased by 49% from 1992 to 2008. This compares with a 47% reduction in the age/ethnic-standardised rate over the same period, meaning that the changing age/ethnic structure was responsible for approximately 4% of the reduction in the recorded burglary rate between 1992 and 2008. In conclusion, this implies that demographic change has had only a minor impact on overall changes in recorded burglaries over the period 1980 to 2008.

There is also no significant correlation between changes in the birth rate per 1,000 women aged 15 to 44 years and changes in the recorded burglary rate.

²⁰ Māori populations using a comparable definition of ethnicity can only be estimated back to 1991.

5.2 Economic factors

5.2.1 Unemployment rate

As shown in Figure 8, the unemployment rate increased substantially from 1980 to 1993 (from a rate of 1.9% to a rate of 10.3%). Apart from a small increase in the late 1990s, the unemployment rate has declined fairly constantly since 1993. By 2008 the unemployment rate was 4.0%. The changes in recorded burglary rates followed a similar pattern, generally increasing to a peak in 1992, then mainly declining thereafter. Overall, changes in the unemployment rate and recorded burglary rate have a significant positive correlation ($r = 0.56^{**}$),²¹ and there appears to be quite a strong long-term relationship between the two variables.

²¹ Correlations between changes in recorded burglary rates and a particular variable were considered to be statistically significant if they had a p-value less than 0.1. A * by the coefficient implies that the p-value is less than 0.05 and a ** means the p-value is less than 0.01.

APPENDIX A: EXPLANATORY VARIABLE DEFINITIONS

This appendix lists the definitions and sources for all the explanatory variables tested in the analysis. Unless otherwise stated, all variables were available for the 1980 to 2008 period.

Demographic factors

Youth population: The percentage of the total population aged 10 to 24 years old.

Source: Statistics New Zealand

Māori population: The percentage of the total population identifying as Māori in the Census. Consistent data was only available from 1991.

Source: Statistics New Zealand

Birth rate: Birth rate per 1,000 women aged 15 to 44 years.

Source: Statistics New Zealand

Economic factors

Unemployment rate: Number of registered unemployed persons as a percentage of the labour force.

Source: Department of Labour

Unemployment rate (young people): Number of registered unemployed persons aged 15 to 24 years as a percentage of the labour force aged 15 to 24 years. Consistent data was only available from 1986.

Source: Statistics New Zealand

Percent of female labour force participation: Percentage of the labour force that is female.

Source: Statistics New Zealand

Inflation rate: Annual average changes in consumer price index values, June 2006 base.

Source: Statistics New Zealand

General business confidence: The percentage of businesses who believe that the general business situation in New Zealand will improve in the next six months minus the percentage who believe the situation will deteriorate. Calculated as the average of the value for December in the preceding year and June in the current year.

Source: New Zealand Institute of Economic Research, Quarterly Survey of Business Opinion

GDP: Gross Domestic Product per 1,000 population in \$million in 2006 prices.

Source: Statistics New Zealand

Total benefit rate: The number of people on a benefit per 1,000 population aged 18 to 64 years.

Source: Ministry of Social Development

Household disposable income: Household disposable income per 1,000 population in \$million in 2006 prices.

Source: Statistics New Zealand

Personal consumption: Personal consumption per 1,000 population in \$million in 2006 prices.

Source: Statistics New Zealand

Income inequality: Measured using the Gini coefficient. The Gini coefficient gives a summary of the income differences between each person in the population and every other person in the population. Consistent data was only available biennially from 1984 to 1998, and triennially from 1998 to 2007, as well as for 2008.

Source: Derived from Statistics New Zealand's Household Economic Survey by the Ministry of Social Development

Poverty: The percentage of the population below 50% of the median household disposable income. Consistent data was only available biennially from 1982 to 1998, and triennially from 1998 to 2007, as well as for 2008.

Source: Derived from Statistics New Zealand's Household Economic Survey by the Ministry of Social Development

Net migration: The number of arrivals minus the number of departures from New Zealand per 100,000 population (three year moving average). This is calculated as the average number of net migrants (permanent arrivals – permanent departures), over the current and two preceding years, per 100,000 population

Source: Statistics New Zealand

Social and general factors

Alcohol consumption: Alcohol consumption per 1,000 population aged 15 years and older.

Source: Statistics New Zealand

Beer consumption: Beer consumption per 1,000 population aged 15 years and older.

Consistent data was only available from 1984.

Source: Statistics New Zealand

Spirits consumption: Consumption of spirits per 1,000 population aged 15 years and older.

Consistent data was only available from 1982.

Source: Statistics New Zealand

Effective teenage birth rate: Crime-weighted age-standardised percentage of all births born to females aged 11 to 19 years.

The effective teenage birth rate in year t ($ETBR_t$) is the crime-weighted age-standardised percentage of births to teenage mothers across all cohorts of apprehensions for burglary. This is calculated as:

$$ETBR_t = \sum_i STBR_{(t-i)} * w_i$$

where

$STBR_{(t-i)}$ = the age-standardised percentage of births to teenage mothers in year $(t - i)$

$$w_i = C_i / \sum_i C_i$$

and

C_i = the apprehension rate for burglary for those aged i years-old.

In essence, this measures the effect of the number of births born to teenage mothers compared to the total number births in each year on the criminal population. Hence, in the early 1990s, the effective teenage birth rates were highest as the percentages of births to teenage mothers were highest in the mid 1970s.

Source: Derived from Statistics New Zealand and New Zealand Police data by the Ministry of Justice

Effective abortion rate: Crime-weighted rate of abortions to total pregnancies per year.

The effective abortion rate in year t (EAR_t) is the crime-weighted abortion rate across all cohorts of apprehensions for burglary. This is calculated as:

$$EAR_t = \sum_i AR_{(t-i)} * w_i$$

where

$AR_{(t-i)}$ = the abortion rate in year $t - i$. (This equals the number of abortions divided by the total number of pregnancies (births + abortions))

$$w_i = C_i / \sum_i C_i$$

and

C_i = the apprehension rate for burglary for those aged i years-old.

In essence, this measures the effect of the abortion rate in each year on the criminal population. Hence in the 1980s, the effective abortion rate is very low as very few burglaries are committed by those aged under 13. From 1990, however, the effective abortion rate begins to rise steeply as those aged 13 and over begin to be affected by the introduction of legalised abortion, and the consequent rise in the rate of abortions.

Source: Derived from Statistics New Zealand and New Zealand Police data by the Ministry of Justice

School leavers: Three different measures were used. 1. The percentage of school leavers with little or no formal attainment. 2. The percentage of school leavers in Year 10 or below. 3. The percentage of school leavers in Year 11 or below.

Due to introduction of NCEA Level 1 in 2002, and the rapid reduction in the percentage of school leavers with little or no formal attainment thereafter, the percentages of school leavers with little or no formal attainment for 2003 onwards have been adjusted using the percent changes in the percentage of school leavers with less than NCEA Level 1.

Source: Ministry of Education

Justice factors

Sworn police: Sworn police officers per 1,000 population.

Source: New Zealand Police

Total police staff: Total police staff per 1,000 population.

Source: New Zealand Police

Prosecution rate: Number of cases for burglary per 1,000 population aged 15 years and older.

Source: Ministry of Justice

Conviction rate: Percentage of cases for burglary resulting in a conviction for that offence.

Source: Ministry of Justice

Imprisonment rate: Percentage of convictions for burglary resulting in a term of imprisonment for that offence.

Source: Ministry of Justice

Average custodial sentence imposed: Average custodial sentence imposed (in years) for each custodial sentence for burglary.

Source: Ministry of Justice

Prison population: Prison population per 1,000 population aged 17 years and older.

Source: Department of Corrections

Government expenditure on justice: Government appropriation allocated to Votes Justice, Police, Courts and Corrections combined, per 1,000 population (in \$million in 2008 prices).

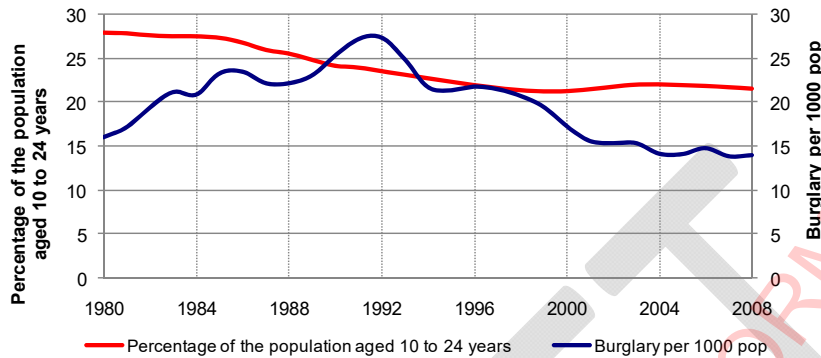
Source: Ministry of Justice

APPENDIX B: RESULTS OF THE UNIVARIATE CORRELATION ANALYSIS

This appendix provides detailed results of the univariate correlation analysis for each of the explanatory variables considered in this study. It shows changes in actual levels for each variable from 1980 to 2008 compared to changes in recorded burglary rates, and annual percentage changes in the variables from 1980/81 to 2007/08. The linear and Spearman's rank correlation coefficients are also provided, along with their statistical significance.

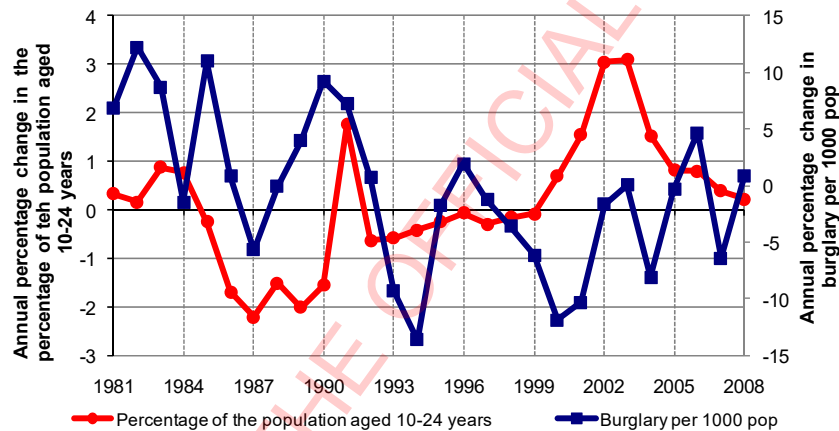
Percentage of the population aged 10 to 24 years

Figure 23: Trends in the percentage of the population aged 10 to 24 years and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Statistics New Zealand and New Zealand Police

Figure 24: Annual percentage changes in the percentage of the population aged 10 to 24 years and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



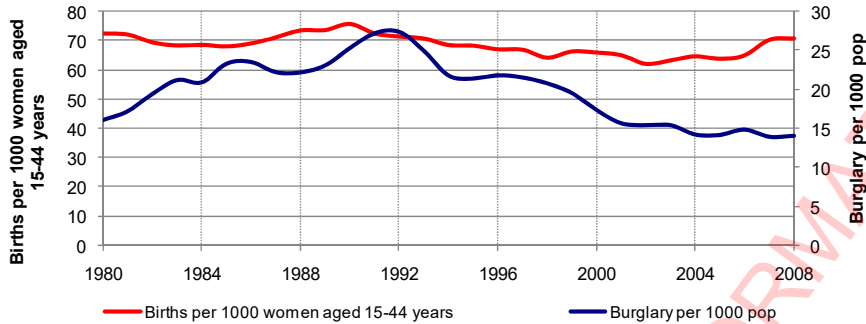
Source: Statistics New Zealand and New Zealand Police

Table 6: Correlation coefficients for the annual percentage changes in the percentage of the population aged 10 to 24 years and recorded burglary rates for 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	-0.07	-0.34	0.369
Correlation coefficient (lag 1)	-0.12	-0.59	0.281
Correlation coefficient (lag 2)	-0.21	-1.03	0.157
Spearman's rank correlation coefficient	-0.04	-0.22	0.415
Spearman's rank correlation coefficient (lag 1)	-0.08	-0.39	0.348
Spearman's rank correlation coefficient (lag 2)	-0.19	-0.96	0.174

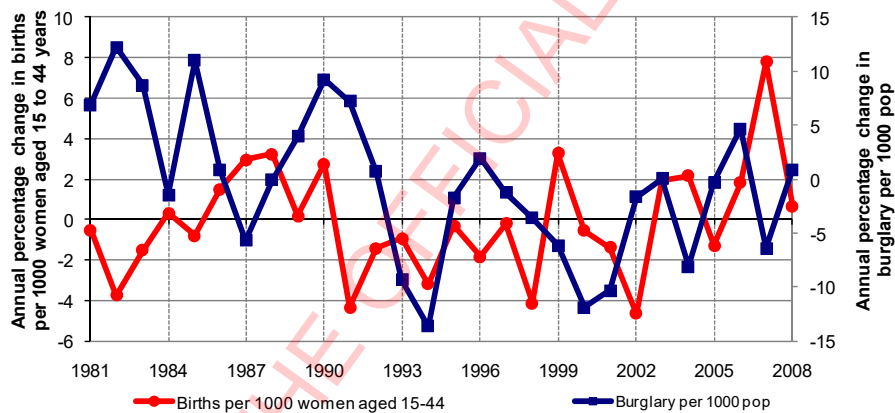
Births per 1,000 women aged 15 to 44 years

Figure 25: Trends in births per 1,000 women aged 15 to 44 years and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Statistics New Zealand and New Zealand Police

Figure 26: Annual percentage changes in births per 1,000 women aged 15 to 44 years and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



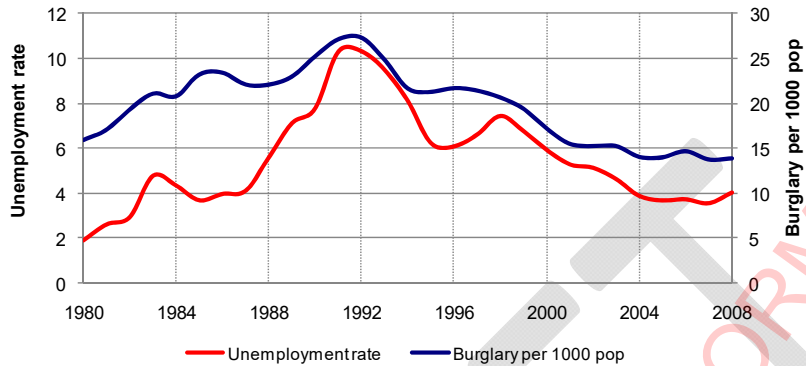
Source: Statistics New Zealand and New Zealand Police

Table 7: Correlation coefficients for annual percentage changes in births per 1,000 women aged 15 to 44 years and recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	-0.15	-0.80	0.216
Correlation coefficient (lag 1)	-0.02	-0.11	0.458
Correlation coefficient (lag 2)	0.41	2.18	0.020
Spearman's rank correlation coefficient	-0.12	-0.61	0.275
Spearman's rank correlation coefficient (lag 1)	0.02	0.08	0.470
Spearman's rank correlation coefficient (lag 2)	0.37	1.97	0.030

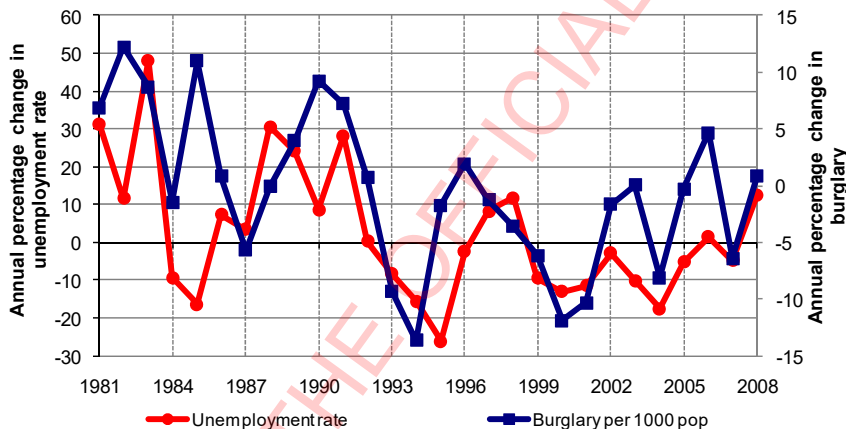
Unemployment rate

Figure 27: Trends in the unemployment rate and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Department of Labour and New Zealand Police

Figure 28: Annual percentage changes in the unemployment rate and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



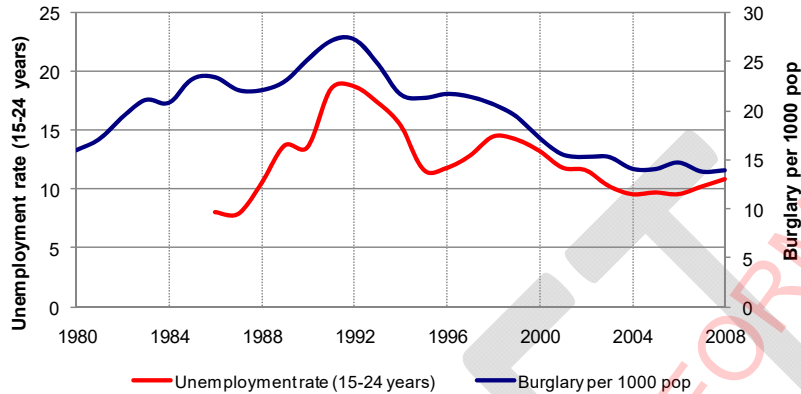
Source: Department of Labour and New Zealand Police

Table 8: Correlation coefficients for annual percentage changes in the unemployment rate and changes in recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	0.56	3.42	0.001
Correlation coefficient (lag 1)	0.37	2.01	0.028
Correlation coefficient (lag 2)	0.40	2.22	0.018
Spearman's rank correlation coefficient	0.59	3.76	0.000
Spearman's rank correlation coefficient (lag 1)	0.33	1.78	0.043
Spearman's rank correlation coefficient (lag 2)	0.25	1.31	0.101

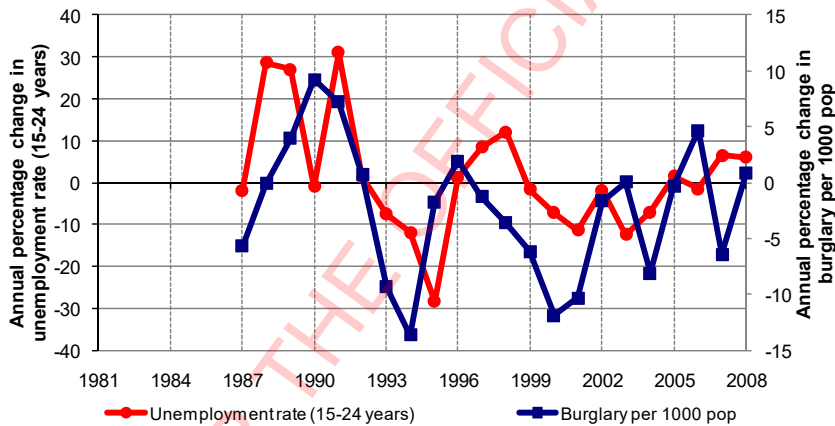
Unemployment rate (15 to 24 year olds)

Figure 29: Trends in the unemployment rate for 15 to 24 year olds and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Statistics New Zealand and New Zealand Police

Figure 30: Annual percentage changes in the unemployment rate for 15 to 24 year olds and recorded burglary rates per 1,000 population: 1986/87 to 2007/08



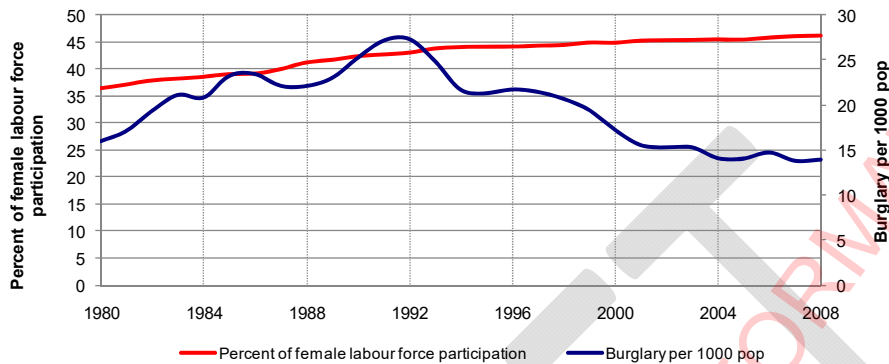
Source: Statistics New Zealand and New Zealand Police

Table 9: Correlation coefficients for annual percentage changes in the unemployment rate for 15 to 24 year olds and recorded burglary rates per 1,000 population: 1986/87 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	0.48	2.43	0.012
Correlation coefficient (lag 1)	0.35	1.61	0.062
Correlation coefficient (lag 2)	0.01	0.03	0.487
Spearman's rank correlation coefficient	0.54	2.88	0.005
Spearman's rank correlation coefficient (lag 1)	0.34	1.55	0.068
Spearman's rank correlation coefficient (lag 2)	-0.38	-1.76	0.048

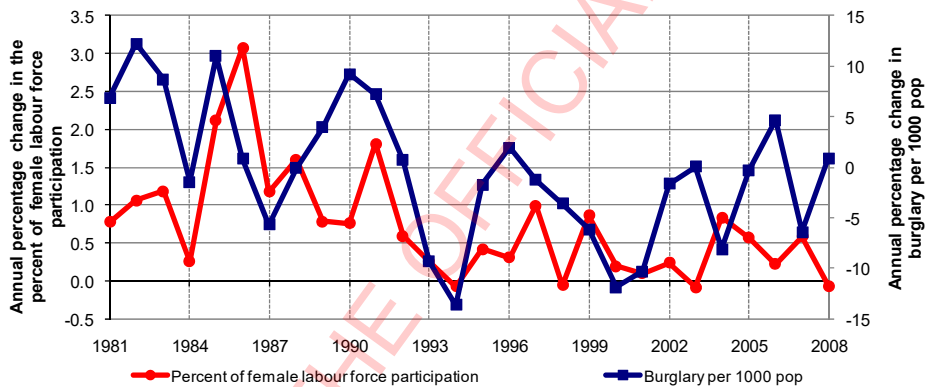
Percent of female labour force participation

Figure 31: Trends in the percent of female labour force participation and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Department of Labour and New Zealand Police

Figure 32: Annual percentage changes in the percent of female labour force participation and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



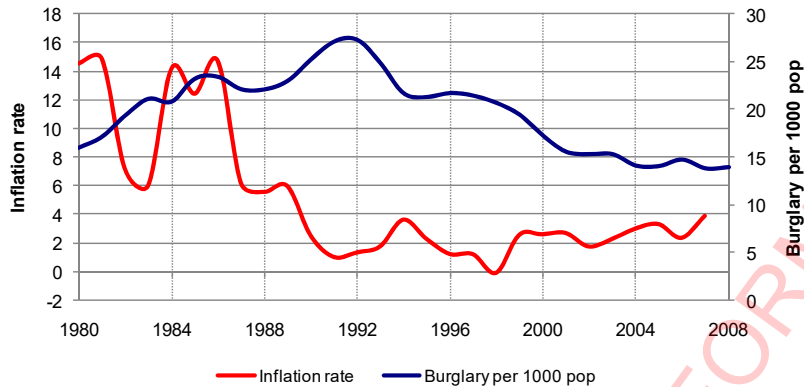
Source: Department of Labour and New Zealand Police

Table 10: Correlation coefficients for annual percentage changes in the percent of female labour force participation and recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	0.43	2.45	0.011
Correlation coefficient (lag 1)	0.19	1.01	0.160
Correlation coefficient (lag 2)	0.22	1.16	0.128
Spearman's rank correlation coefficient	0.46	2.62	0.007
Spearman's rank correlation coefficient (lag 1)	0.34	1.87	0.037
Spearman's rank correlation coefficient (lag 2)	0.26	1.37	0.092

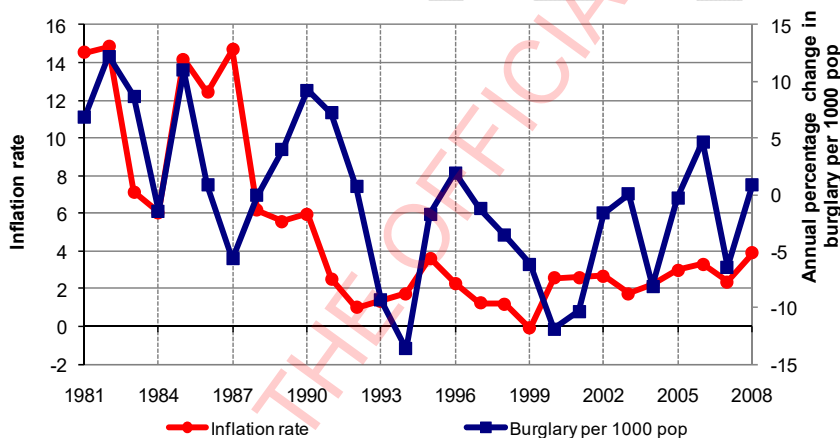
Inflation rate (change in CPI)

Figure 33: Trends in the inflation rate and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Statistics New Zealand and New Zealand Police

Figure 34: Inflation rates and annual percentage changes in recorded burglary rates per 1,000 population: 1980/81 to 2007/08



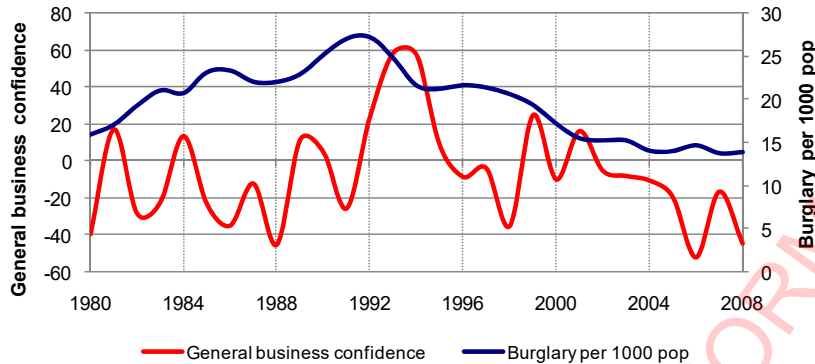
Source: Statistics New Zealand and New Zealand Police

Table 11: Correlation coefficients for the inflation rate and annual percentage changes in recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	0.53	3.16	0.002
Correlation coefficient (lag 1)	0.54	3.31	0.001
Correlation coefficient (lag 2)	0.54	3.24	0.002
Spearman's rank correlation coefficient	0.53	3.21	0.002
Spearman's rank correlation coefficient (lag 1)	0.69	4.82	0.000
Spearman's rank correlation coefficient (lag 2)	0.63	4.14	0.000

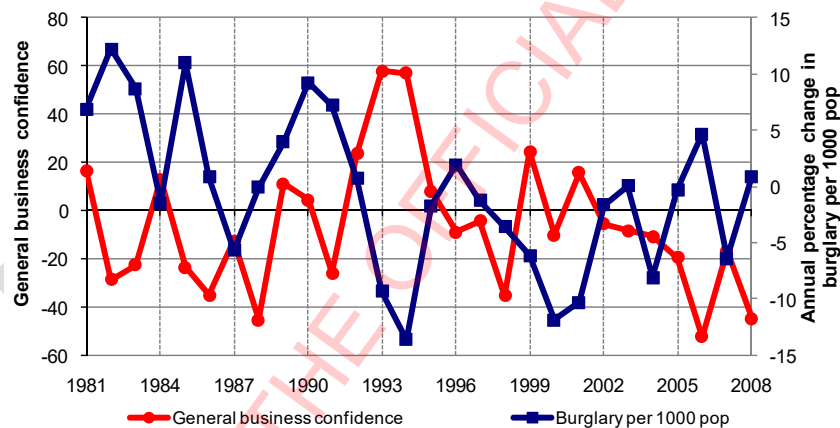
General business confidence

Figure 35: Trends in general business confidence and recorded burglary rates per 1,000 population: 1980 to 2008



Source: New Zealand Institute of Economic Research and New Zealand Police

Figure 36: General business confidence and annual percentage changes in recorded burglary rates per 1,000 population: 1980/81 to 2007/08



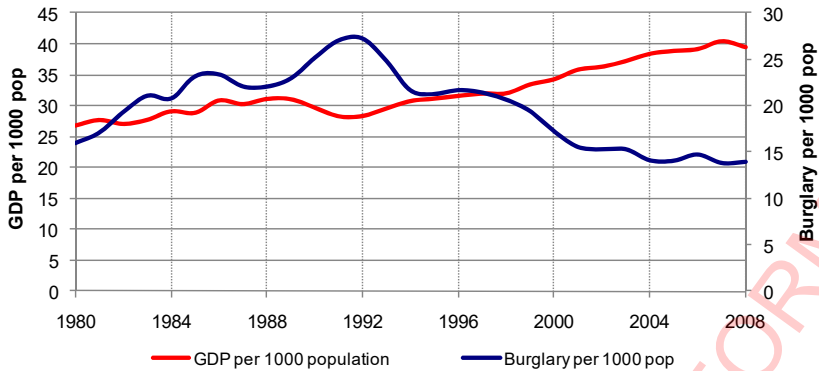
Source: New Zealand Institute of Economic Research and New Zealand Police

Table 12: Correlation coefficients for general business confidence and annual percentage changes in recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	-0.45	-2.56	0.008
Correlation coefficient (lag 1)	-0.17	-0.88	0.195
Correlation coefficient (lag 2)	-0.15	-0.80	0.216
Spearman's rank correlation coefficient	-0.40	-2.24	0.017
Spearman's rank correlation coefficient (lag 1)	-0.15	-0.75	0.230
Spearman's rank correlation coefficient (lag 2)	-0.17	-0.90	0.188

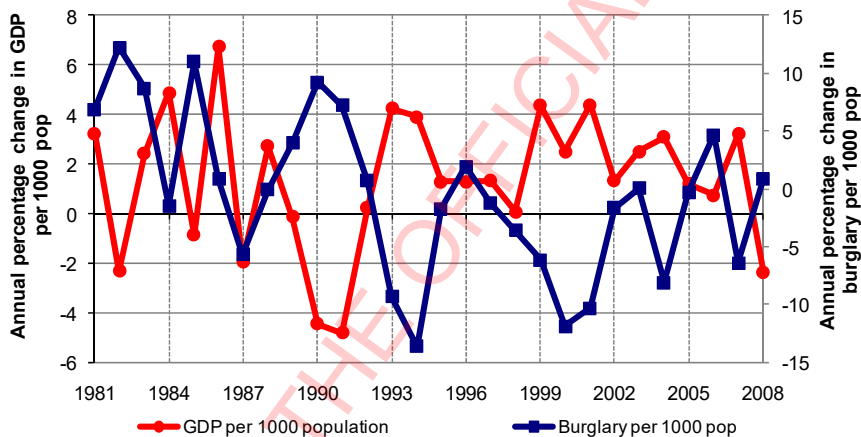
Gross Domestic Product per 1,000 population

Figure 37: Trends in GDP per 1,000 population and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Statistics New Zealand and New Zealand Police

Figure 38: Annual percentage changes in GDP per 1,000 population and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



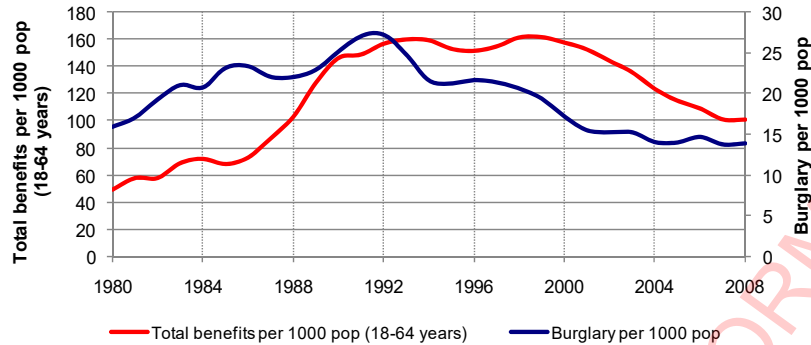
Source: Statistics New Zealand and New Zealand Police

Table 13: Correlation coefficients for annual percentage changes in GDP per 1,000 population and recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	-0.55	-3.35	0.001
Correlation coefficient (lag 1)	-0.31	-1.66	0.055
Correlation coefficient (lag 2)	0.14	0.73	0.235
Spearman's rank correlation coefficient	-0.57	-3.52	0.001
Spearman's rank correlation coefficient (lag 1)	-0.30	-1.58	0.063
Spearman's rank correlation coefficient (lag 2)	0.15	0.77	0.224

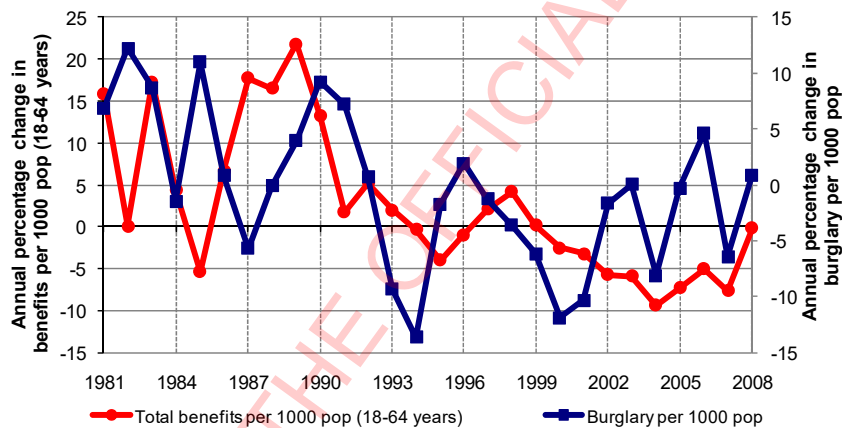
Total benefit rates

Figure 39: Trends in benefit numbers per 1,000 population (aged 18 to 64 years) and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Ministry of Social Development and Statistics New Zealand

Figure 40: Annual percentages changes in benefit numbers per 1,000 population (aged 18 to 64 years) and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



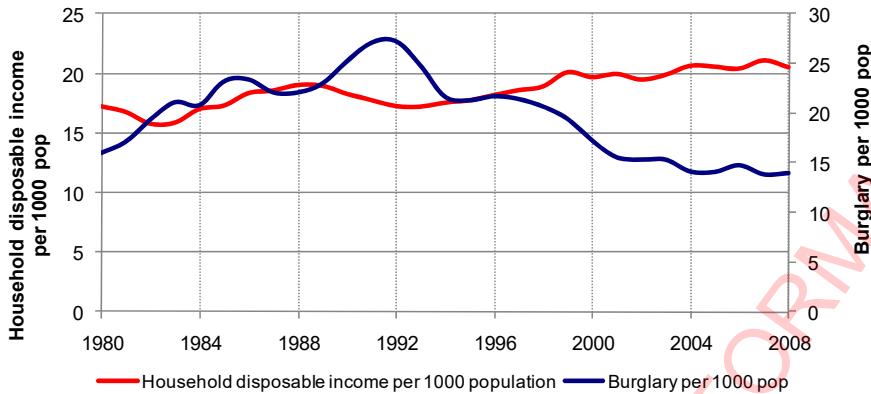
Source: Ministry of Social Development and Statistics New Zealand

Table 14: Correlation coefficients for annual percentage changes in benefit numbers per 1,000 population aged (18 to 64 years) and recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	0.31	1.66	0.054
Correlation coefficient (lag 1)	0.34	1.82	0.041
Correlation coefficient (lag 2)	0.52	3.00	0.003
Spearman's rank correlation coefficient	0.30	1.58	0.063
Spearman's rank correlation coefficient (lag 1)	0.14	0.70	0.246
Spearman's rank correlation coefficient (lag 2)	0.33	1.69	0.052

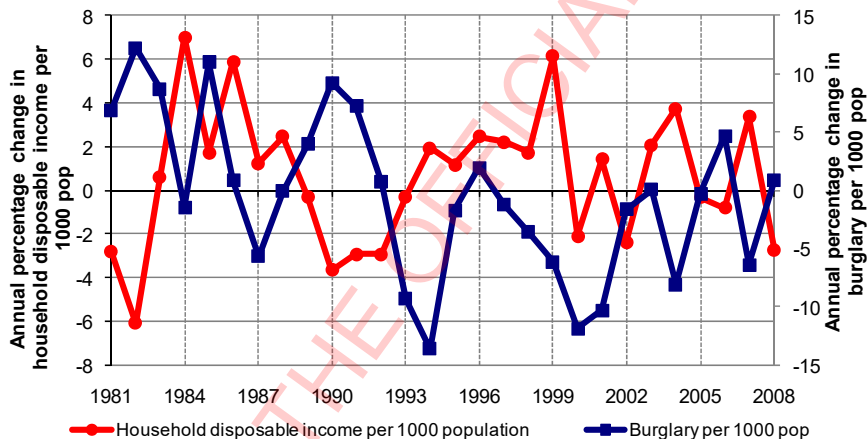
Household disposable income per 1,000 population

Figure 41: Trends in household disposable income per 1,000 population and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Statistics New Zealand and New Zealand Police

Figure 42: Annual percentage changes in household disposable income per 1,000 population and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



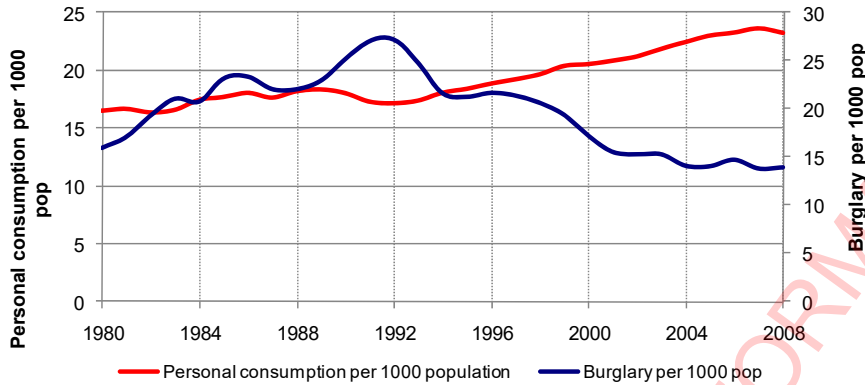
Source: Statistics New Zealand and New Zealand Police

Table 15: Correlation coefficients for annual percentage changes in household disposable income per 1,000 population and recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	-0.42	-2.33	0.014
Correlation coefficient (lag 1)	-0.18	-0.95	0.175
Correlation coefficient (lag 2)	0.09	0.46	0.324
Spearman's rank correlation coefficient	-0.44	-2.51	0.009
Spearman's rank correlation coefficient (lag 1)	-0.19	-1.00	0.164
Spearman's rank correlation coefficient (lag 2)	0.12	0.60	0.276

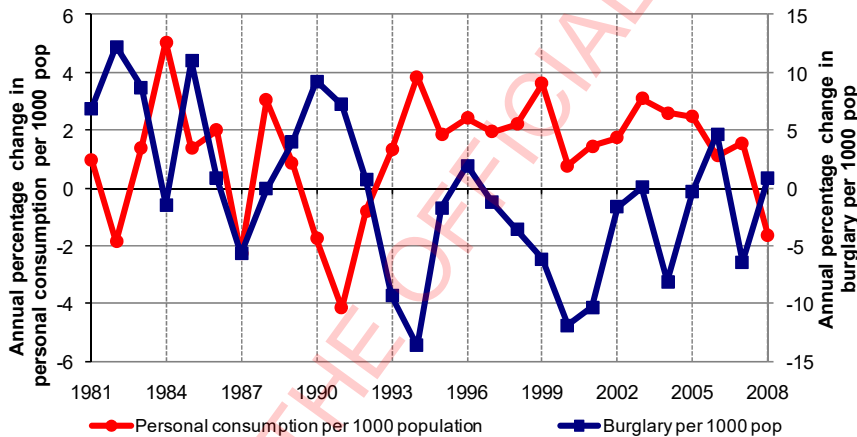
Personal consumption per 1,000 population

Figure 43: Trends in personal consumption per 1,000 population and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Statistics New Zealand and New Zealand Police

Figure 44: Annual percentage changes in personal consumption per 1,000 population and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



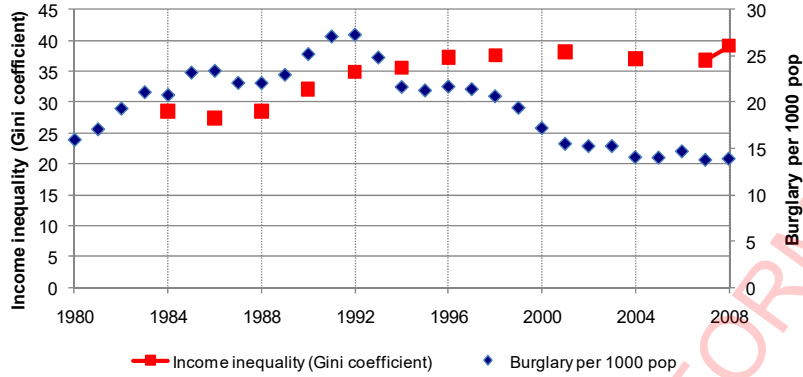
Source: Statistics New Zealand and New Zealand Police

Table 16: Correlation coefficients for annual percentage changes in personal consumption per 1,000 population and recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	-0.42	-2.33	0.014
Correlation coefficient (lag 1)	-0.14	-0.72	0.239
Correlation coefficient (lag 2)	0.06	0.32	0.375
Spearman's rank correlation coefficient	-0.42	-2.39	0.012
Spearman's rank correlation coefficient (lag 1)	-0.17	-0.88	0.195
Spearman's rank correlation coefficient (lag 2)	-0.02	-0.09	0.464

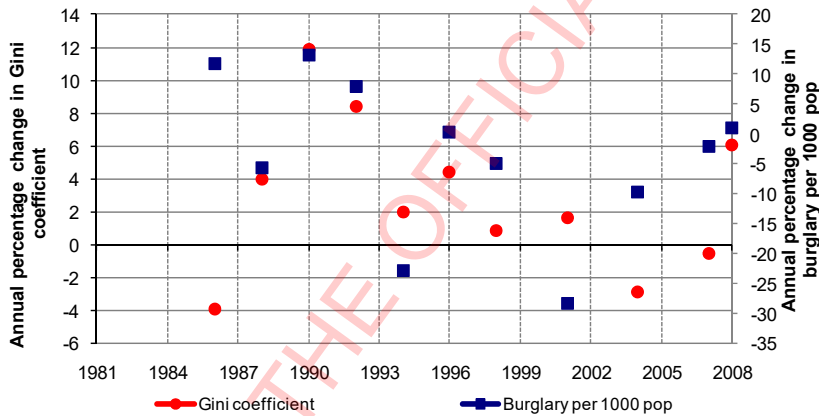
Income inequality

Figure 45: Trends in income inequality and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Derived from Statistics New Zealand's Household Economic Survey by the Ministry of Social Development

Figure 46: Percentage changes in income inequality and recorded burglary rates per 1,000 population: 1984/86 to 2007/08



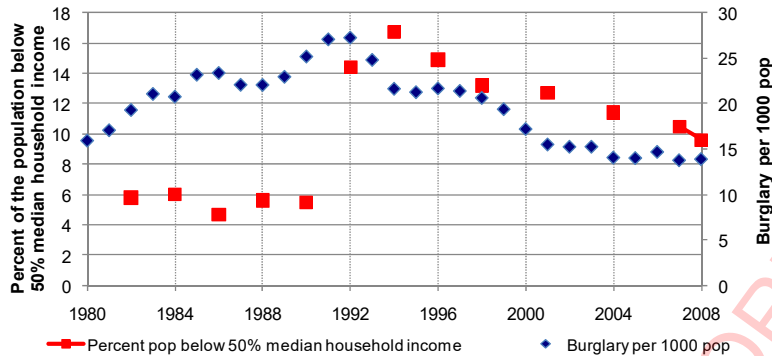
Source: Derived from Statistics New Zealand's Household Economic Survey by the Ministry of Social Development

Table 17: Correlation coefficients for percentage changes in income inequality and recorded burglary rates per 1,000 population: 1984/86 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	0.34	1.08	0.155
Spearman's rank correlation coefficient	0.39	1.26	0.120

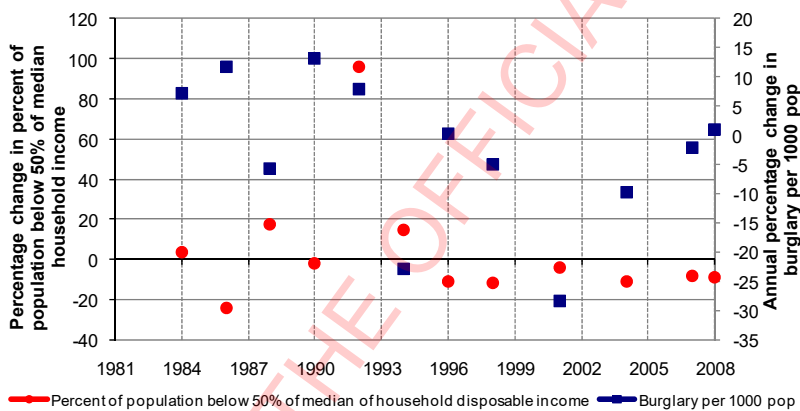
Percentage of the population below 50% of the median household income

Figure 47: Trends in the percentage of the population below 50% of the median household income and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Derived from Statistics New Zealand's Household Economic Survey by the Ministry of Social Development

Figure 48: Percentage changes in the percentage of the population below 50% of the median household income and recorded burglary rates per 1,000 population: 1982/84 to 2007/08



Source: Derived from Statistics New Zealand's Household Economic Survey by the Ministry of Social Development

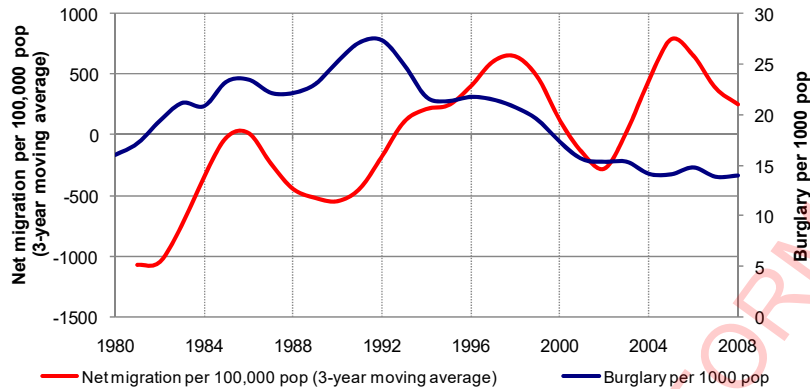
Table 18: Correlation coefficients for percentage changes in the percentage of the population below 50% of the median household income and recorded burglary rates per 1,000 population: 1982/84 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	0.10	0.32	0.377
Correlation coefficient (excluding 1992) ³⁵	-0.39	-1.25	0.121
Spearman's rank correlation coefficient	-0.06	-0.18	0.431
Spearman's rank correlation coefficient (excluding 1992)	-0.24	-0.73	0.242

³⁵ 1992 was excluded as it was a significant outlier in terms of changes in the percentage of the population below 50% of the median household income.

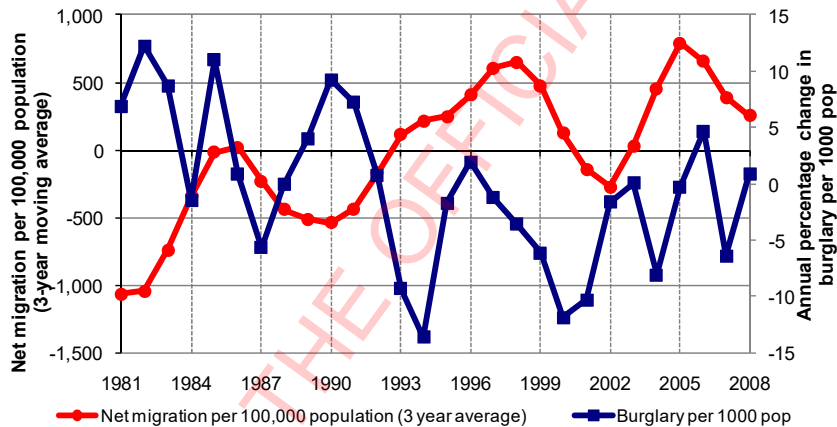
Net migration (three-year moving average)

Figure 49: Trends in net migration per 100,000 population (three-year moving average) and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Statistics New Zealand and New Zealand Police

Figure 50: Net migration per 100,000 population (three-year moving average) and annual percentage changes in recorded burglary rates per 1,000 population: 1980/81 to 2007/08



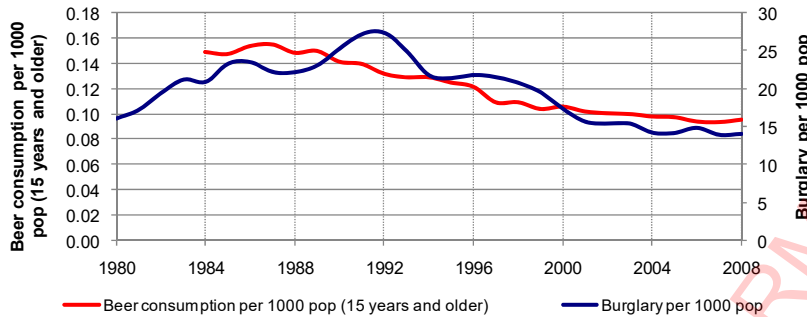
Source: Statistics New Zealand and New Zealand Police

Table 19: Correlation coefficients for net migration per 100,000 population (three-year moving average) and annual percentage changes in recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	-0.51	-3.03	0.003
Correlation coefficient (lag 1)	-0.58	-3.59	0.001
Correlation coefficient (lag 2)	-0.54	-3.23	0.002
Spearman's rank correlation coefficient	-0.46	-2.65	0.007
Spearman's rank correlation coefficient (lag 1)	-0.56	-3.42	0.001
Spearman's rank correlation coefficient (lag 2)	-0.51	-2.99	0.003

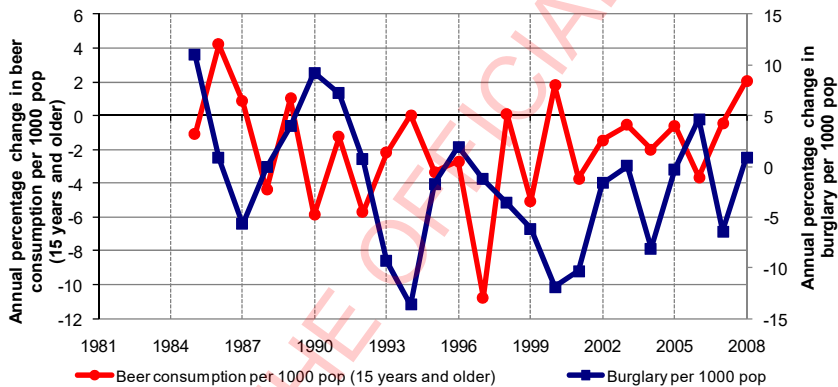
Beer consumption per 1,000 population aged 15 years and older

Figure 51: Trends in beer consumption per 1,000 population aged 15 years and older and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Statistics New Zealand and New Zealand Police

Figure 52: Annual percentage changes in beer consumption per 1,000 population aged 15 years and older and recorded burglary rates per 1,000 population: 1984/85 to 2007/08



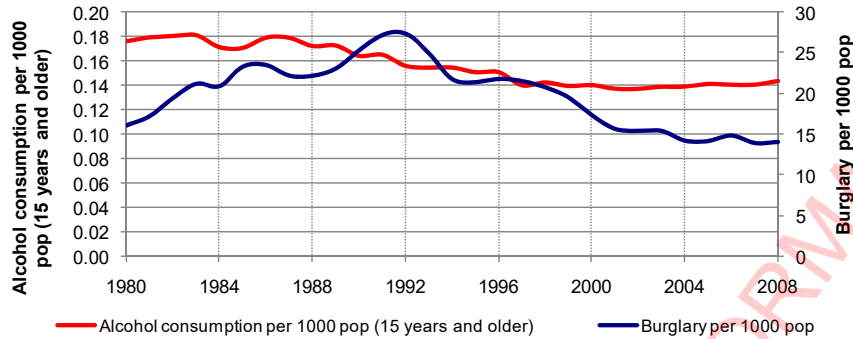
Source: Statistics New Zealand and New Zealand Police

Table 20: Correlation coefficients for annual percentage changes in beer consumption per 1,000 population aged 15 years and older and recorded burglary rates per 1,000 population: 1984/85 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	-0.13	-0.63	0.268
Correlation coefficient (lag 1)	0.03	0.14	0.446
Correlation coefficient (lag 2)	0.22	0.14	0.446
Spearman's rank correlation coefficient	-0.09	-0.44	0.333
Spearman's rank correlation coefficient (lag 1)	0.02	0.11	0.455
Spearman's rank correlation coefficient (lag 2)	0.08	0.37	0.357

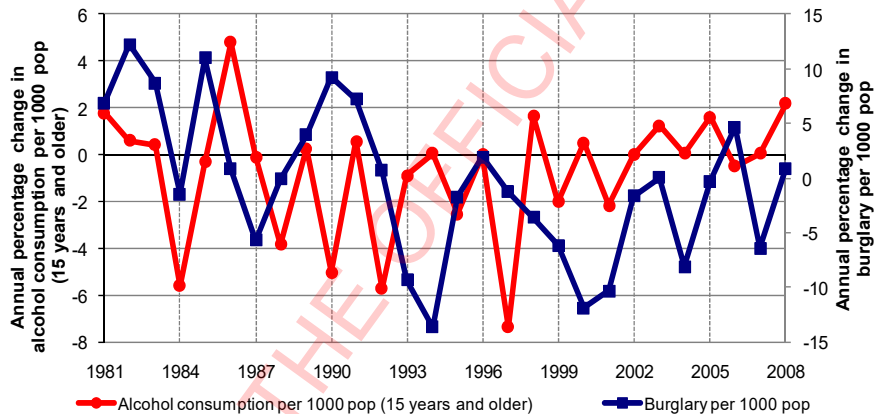
Alcohol consumption per 1,000 population aged 15 years and older

Figure 53: Trends in alcohol consumption per 1,000 population aged 15 years and older and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Statistics New Zealand and New Zealand Police

Figure 54: Annual percentage changes in alcohol consumption per 1,000 population aged 15 years and older and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



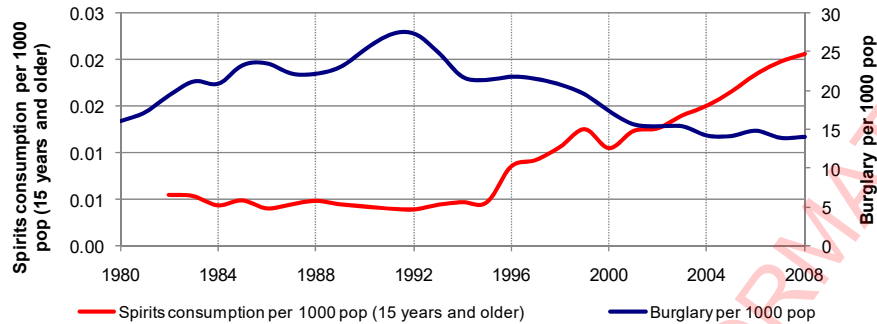
Source: Statistics New Zealand and New Zealand Police

Table 21: Correlation coefficients for annual percentage changes in alcohol consumption per 1,000 population aged 15 years and older and recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	0.04	0.21	0.419
Correlation coefficient (lag 1)	-0.06	-0.28	0.390
Correlation coefficient (lag 2)	0.14	0.70	0.246
Spearman's rank correlation coefficient	0.18	0.92	0.183
Spearman's rank correlation coefficient (lag 1)	0.02	0.10	0.459
Spearman's rank correlation coefficient (lag 2)	0.00	-0.01	0.497

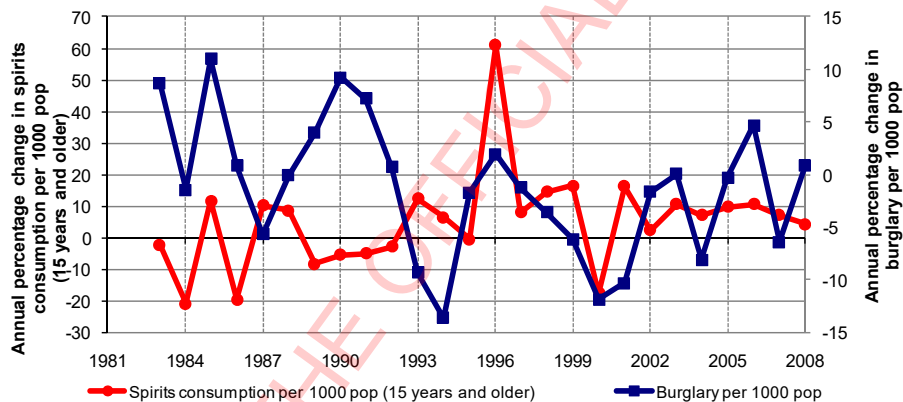
Spirits consumption per 1,000 population aged 15 years and older

Figure 55: Trends in spirits consumption per 1,000 population aged 15 years and older and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Statistics New Zealand and New Zealand Police

Figure 56: Annual percentage changes in spirits consumption per 1,000 population aged 15 years and older and recorded burglary rates per 1,000 population: 1982/83 to 2007/08



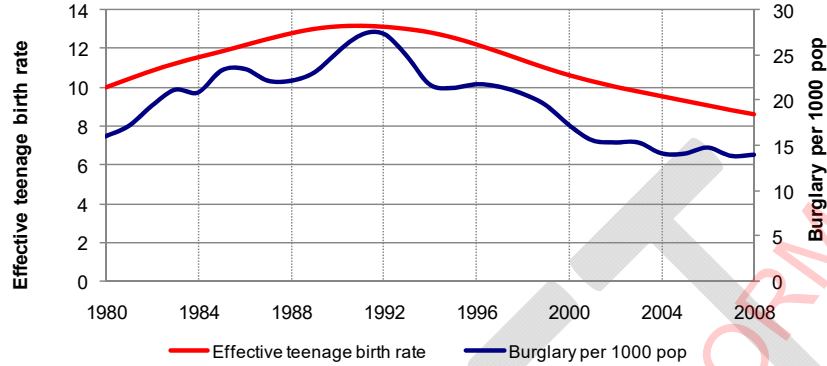
Source: Statistics New Zealand and New Zealand Police

Table 22: Correlation coefficients for annual percentage changes in spirits consumption per 1,000 population aged 15 years and older and recorded burglary rates per 1,000 population: 1982/83 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	-0.06	-0.30	0.384
Correlation coefficient (lag 1)	-0.19	-0.95	0.176
Correlation coefficient (lag 2)	-0.16	-0.78	0.222
Spearman's rank correlation coefficient	-0.20	-0.98	0.169
Spearman's rank correlation coefficient (lag 1)	-0.40	-2.08	0.024
Spearman's rank correlation coefficient (lag 2)	-0.37	-1.89	0.036

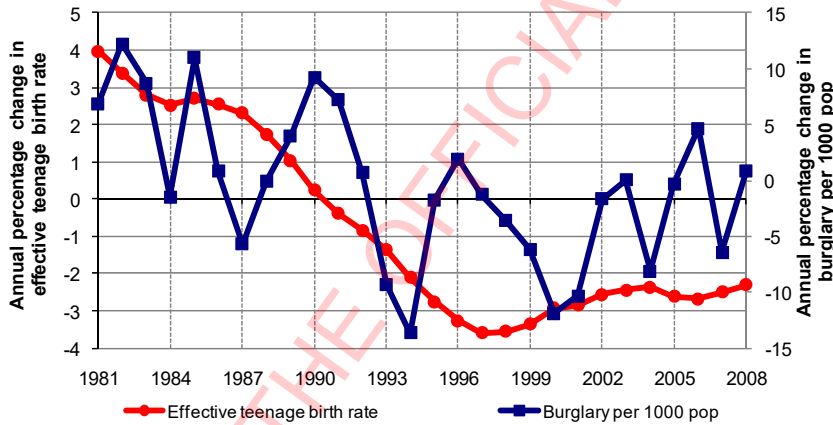
Effective teenage birth rate

Figure 57: Trends in effective teenage birth rates and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Derived from Statistics New Zealand and New Zealand Police data by the Ministry of Justice

Figure 58: Annual percentage changes in effective teenage birth rates and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



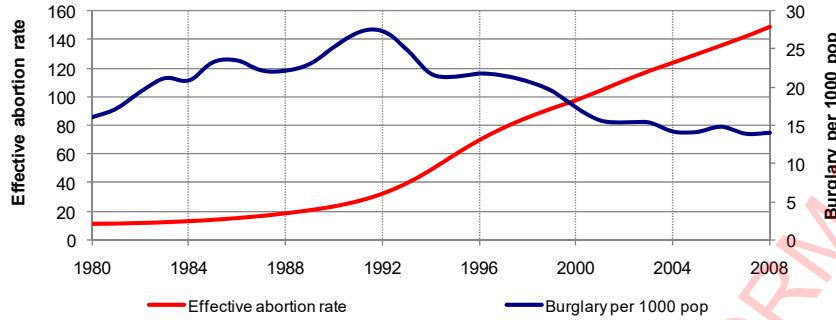
Source: Derived from Statistics New Zealand and New Zealand Police data by the Ministry of Justice

Table 23: Correlation coefficients for annual percentage changes in effective teenage birth rates and recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	0.57	3.55	0.001
Correlation coefficient (lag 1)	0.56	3.37	0.001
Correlation coefficient (lag 2)	0.52	2.96	0.003
Spearman's rank correlation coefficient	0.54	3.25	0.002
Spearman's rank correlation coefficient (lag 1)	0.50	2.88	0.004
Spearman's rank correlation coefficient (lag 2)	0.47	2.64	0.007

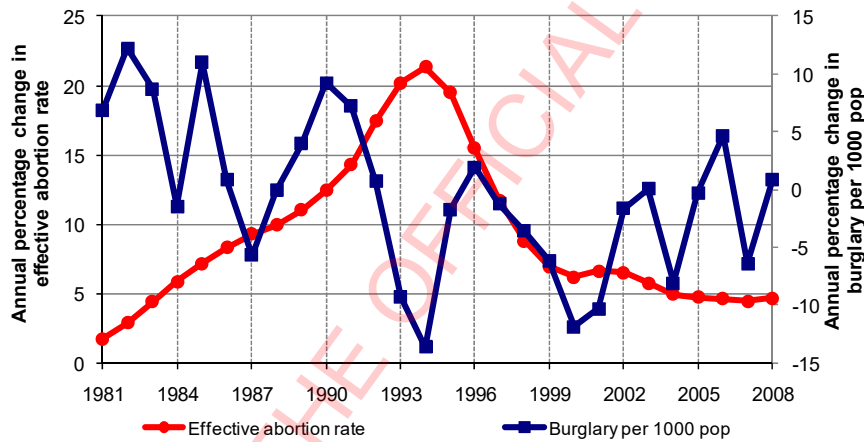
Effective abortion rates

Figure 59: Trends in effective abortion rates and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Derived from Statistics New Zealand and New Zealand Police data by the Ministry of Justice

Figure 60: Annual percentage changes in effective abortion rates and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



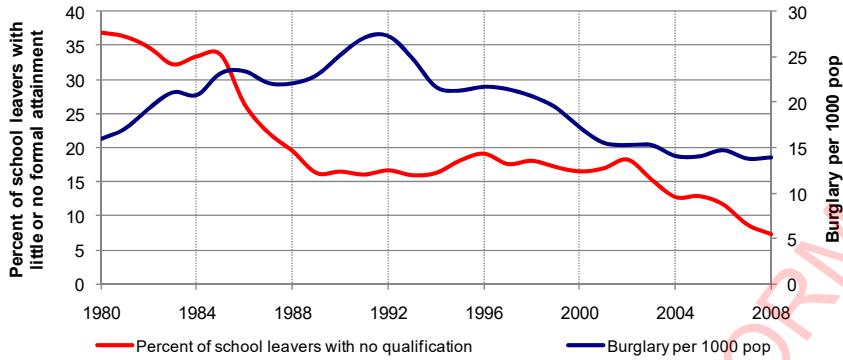
Source: Derived from Statistics New Zealand and New Zealand Police data by the Ministry of Justice

Table 24: Correlation coefficients for annual percentage changes in effective abortion rates and recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	-0.26	-1.37	0.091
Correlation coefficient (lag 1)	-0.28	-1.43	0.082
Correlation coefficient (lag 2)	-0.24	-1.20	0.121
Spearman's rank correlation coefficient	-0.22	-1.13	0.134
Spearman's rank correlation coefficient (lag 1)	-0.29	-1.49	0.074
Spearman's rank correlation coefficient (lag 2)	-0.34	-1.76	0.045

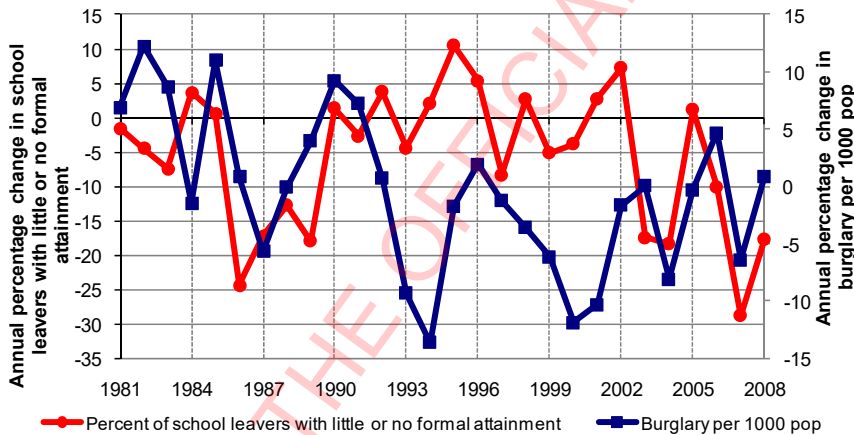
Percent of school leavers with little or no formal attainment

Figure 61: Trends in the percent of school leavers with little or no formal attainment and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Ministry of Education and New Zealand Police

Figure 62: Annual percentage changes in the percent of school leavers with little or no formal attainment and recorded burglary rates per 1,000 population: 1980/81 and 2007/08



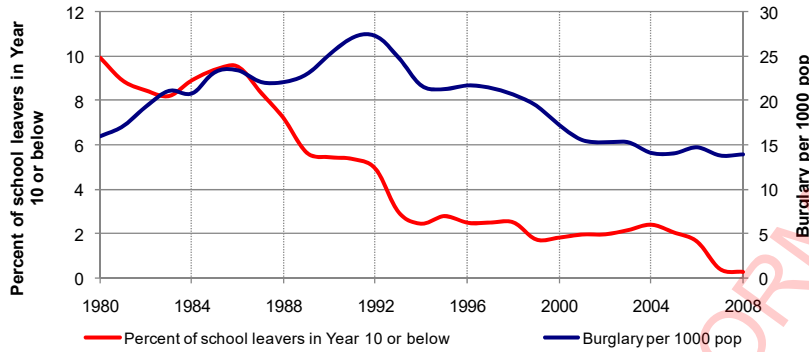
Source: Ministry of Education and New Zealand Police

Table 25: Correlation coefficients for annual percentage changes in the percent of school leavers with little or no formal attainment and recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	0.06	0.30	0.385
Correlation coefficient (lag 1)	0.07	0.38	0.353
Correlation coefficient (lag 2)	-0.44	-2.50	0.009
Spearman's rank correlation coefficient	-0.05	-0.26	0.397
Spearman's rank correlation coefficient (lag 1)	0.07	0.37	0.356
Spearman's rank correlation coefficient (lag 2)	-0.36	-1.95	0.031

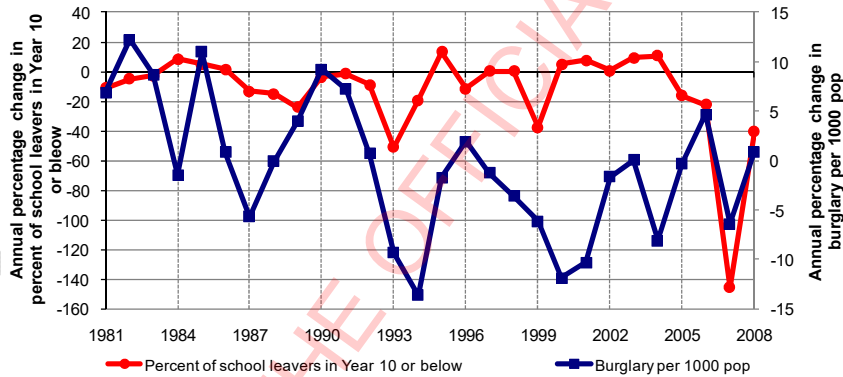
Percent of school leavers in Year 10 or below

Figure 63: Trends in the percent of school leavers in Year 10 or below and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Ministry of Education and New Zealand Police

Figure 64: Annual percentage changes in the percent of school leavers in Year 10 or below and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



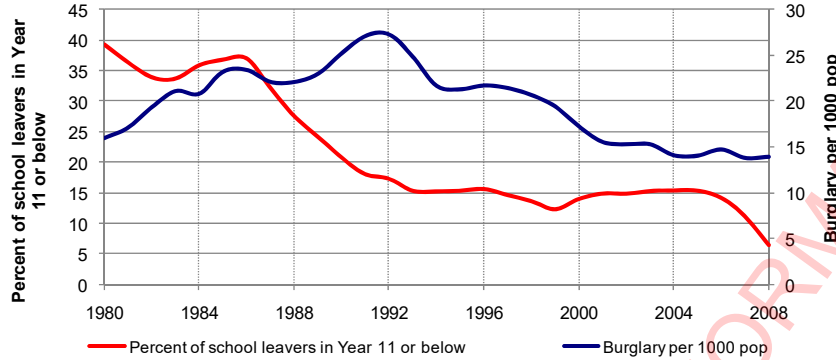
Source: Ministry of Education and New Zealand Police

Table 26: Correlation coefficients for annual percentage changes in the percent of school leavers in Year 10 or below and recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	0.20	1.04	0.155
Correlation coefficient (lag 1)	0.08	0.41	0.341
Correlation coefficient (lag 2)	-0.03	-0.13	0.448
Spearman's rank correlation coefficient	-0.02	-0.09	0.464
Spearman's rank correlation coefficient (lag 1)	0.01	0.06	0.476
Spearman's rank correlation coefficient (lag 2)	-0.03	-0.15	0.442

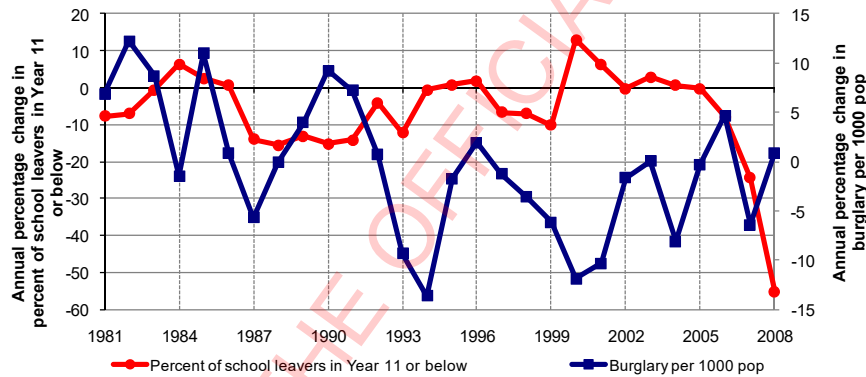
Percent of school leavers in Year 11 or below

Figure 65: Trends in the percent of school leavers in Year 11 or below and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Ministry of Education and New Zealand Police

Figure 66: Annual percentage changes in the percent of school leavers in Year 11 or below and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



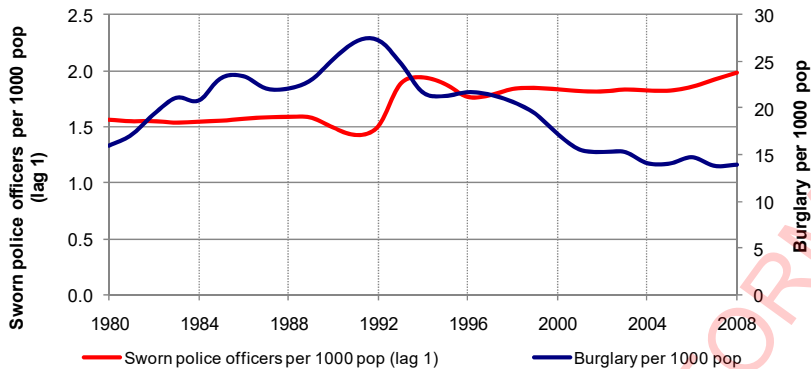
Source: Ministry of Education and New Zealand Police

Table 27: Correlation coefficients for annual percentage changes in the percent of school leavers in Year 11 or below and recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient	-0.15	-0.78	0.220
Correlation coefficient (lag 1)	-0.17	-0.88	0.192
Correlation coefficient (lag 2)	-0.13	-0.65	0.259
Spearman's rank correlation coefficient	-0.20	-1.02	0.158
Spearman's rank correlation coefficient (lag 1)	-0.19	-0.98	0.167
Spearman's rank correlation coefficient (lag 2)	-0.10	-0.49	0.314

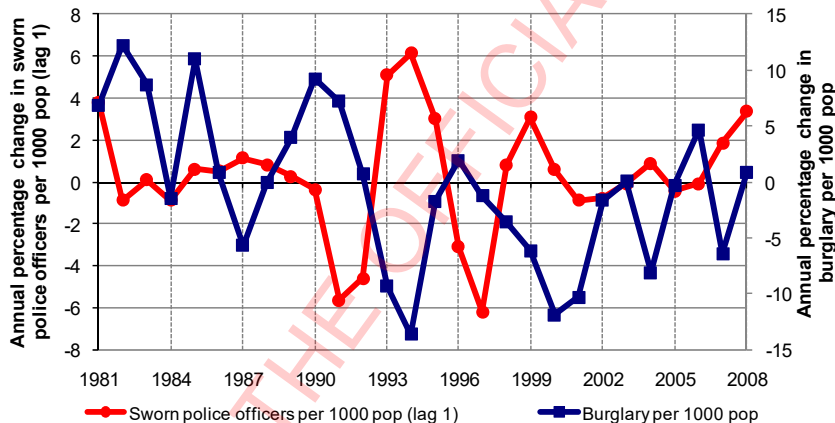
Sworn police officers per 1,000 population (lag 1)

Figure 67: Trends in sworn police officers per 1,000 population (lag 1) and recorded burglary rates per 1,000 population: 1980 to 2008



Source: New Zealand Police

Figure 68: Annual percentage changes in sworn police officers per 1,000 population (lag 1) and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



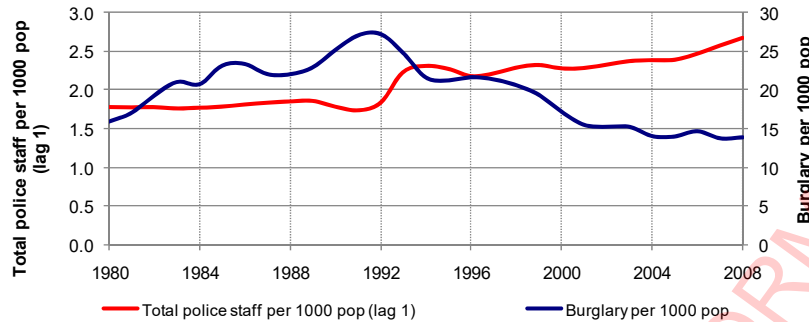
Source: New Zealand Police

Table 28: Correlation coefficients for annual percentage changes in sworn police officers per 1,000 population and recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient (lag 1)	-0.37	-2.01	0.028
Correlation coefficient (lag 2)	-0.04	-0.21	0.416
Correlation coefficient (lag 3)	0.39	2.09	0.024
Spearman's rank correlation coefficient (lag 1)	-0.37	-2.05	0.025
Spearman's rank correlation coefficient (lag 2)	-0.14	-0.70	0.244
Spearman's rank correlation coefficient (lag 3)	0.29	1.47	0.077

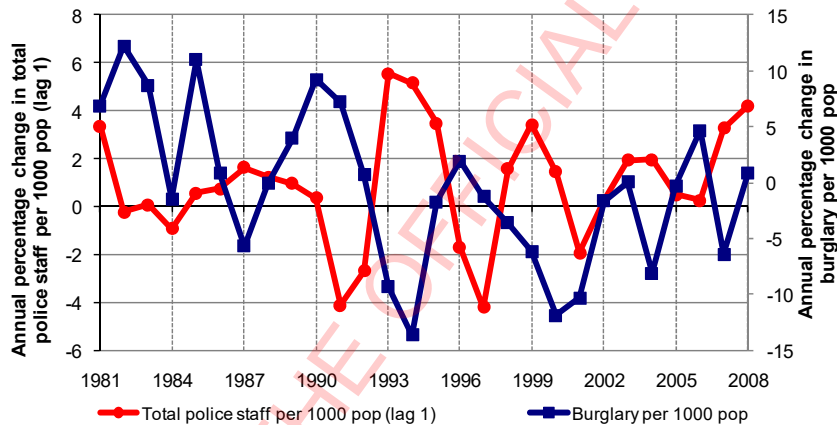
Total police staff per 1,000 population (lag 1)

Figure 69: Trends in total police staff per 1,000 population (lag 1) and recorded burglary rates per 1,000 population: 1980 to 2008



Source: New Zealand Police

Figure 70: Annual percentage changes in total police staff per 1,000 population (lag 1) and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



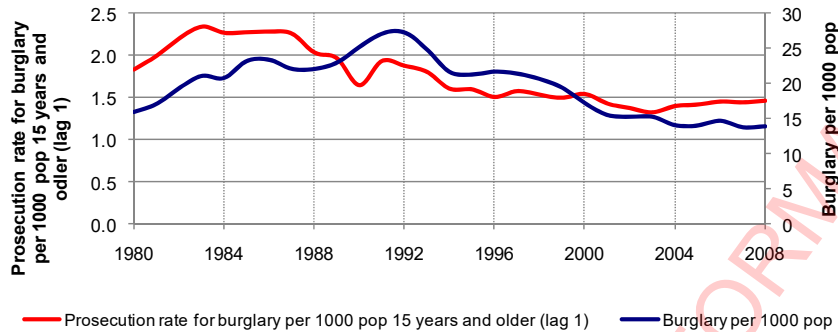
Source: New Zealand Police

Table 29: Correlation coefficients for annual percentage changes in total police staff per 1,000 population and recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient (lag 1)	-0.38	-2.09	0.023
Correlation coefficient (lag 2)	-0.13	-0.64	0.265
Correlation coefficient (lag 3)	0.32	1.64	0.057
Spearman's rank correlation coefficient (lag 1)	-0.42	-2.39	0.012
Spearman's rank correlation coefficient (lag 2)	-0.17	-0.84	0.204
Spearman's rank correlation coefficient (lag 3)	0.20	1.00	0.163

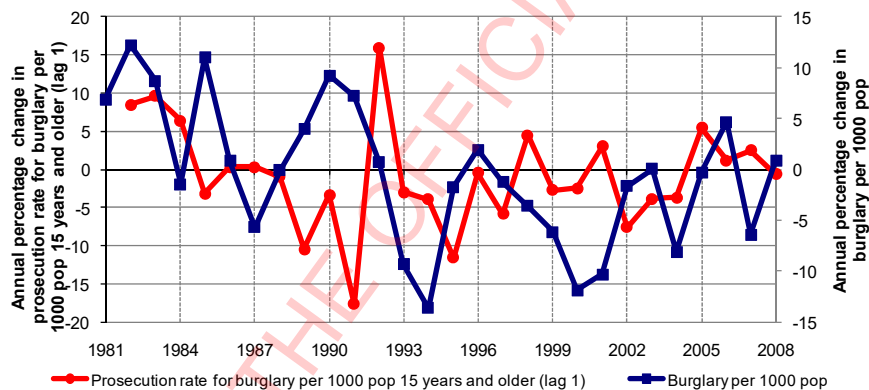
Prosecution rate for burglary per 1,000 population aged 15 years and older (lag 1)

Figure 71: Trends in prosecution rates for burglary per 1,000 population aged 15 years and older (lag 1) and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Ministry of Justice and New Zealand Police

Figure 72: Annual percentage changes in prosecution rates for burglary per 1,000 population aged 15 years and older (lag 1) and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



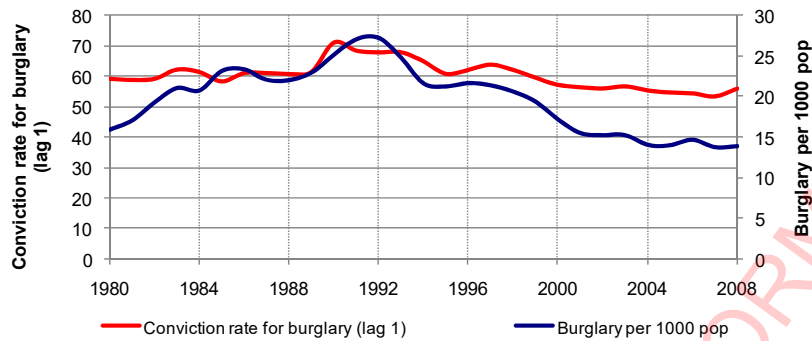
Source: Ministry of Justice and New Zealand Police

Table 30: Correlation coefficients for annual percentage changes in prosecution rates for burglary per 1,000 population aged 15 years and older and recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient (lag 1)	0.06	0.28	0.391
Correlation coefficient (lag 2)	-0.06	-0.28	0.391
Correlation coefficient (lag 3)	-0.02	-0.10	0.460
Spearman's rank correlation coefficient (lag 1)	0.05	0.27	0.394
Spearman's rank correlation coefficient (lag 2)	-0.10	-0.48	0.318
Spearman's rank correlation coefficient (lag 3)	-0.09	-0.44	0.331

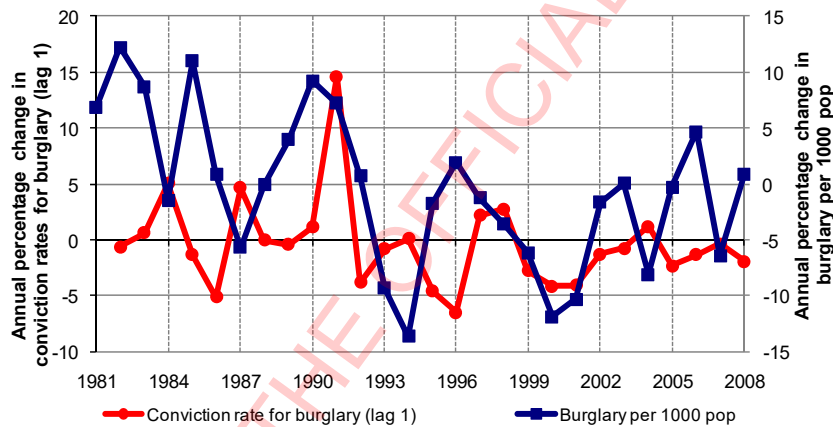
Conviction rate for burglary (lag 1)

Figure 73: Trends in conviction rates for burglary (lag 1) and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Ministry of Justice and New Zealand Police

Figure 74: Annual percentage changes in conviction rates for burglary (lag 1) and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



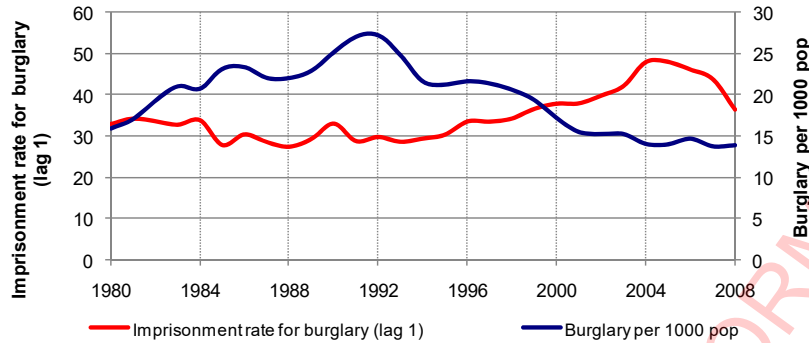
Source: Ministry of Justice and New Zealand Police

Table 31: Correlation coefficients for annual percentage changes in conviction rates for burglary and recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient (lag 1)	0.18	0.94	0.179
Correlation coefficient (lag 2)	0.28	1.42	0.085
Correlation coefficient (lag 3)	-0.02	-0.09	0.465
Spearman's rank correlation coefficient (lag 1)	0.01	0.05	0.482
Spearman's rank correlation coefficient (lag 2)	0.26	1.33	0.098
Spearman's rank correlation coefficient (lag 3)	0.15	0.70	0.244

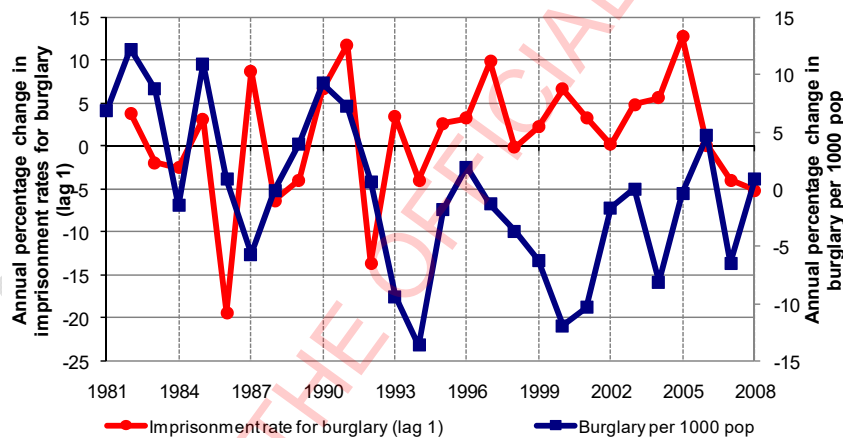
Imprisonment rate for burglary (lag 1)

Figure 75: Trends in imprisonment rates for burglary (lag 1) and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Ministry of Justice and New Zealand Police

Figure 76: Annual percentage changes in imprisonment rates for burglary (lag 1) and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



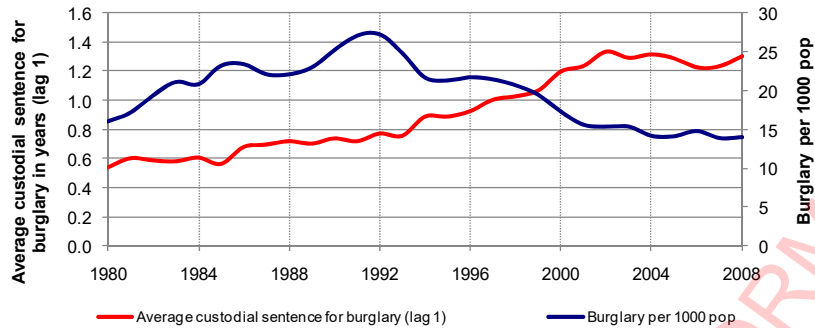
Source: Ministry of Justice and New Zealand Police

Table 32: Correlation coefficients for annual percentage changes in imprisonment rates for burglary and recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient (lag 1)	0.00	0.01	0.496
Correlation coefficient (lag 2)	0.11	0.54	0.298
Correlation coefficient (lag 3)	-0.12	-0.60	0.278
Spearman's rank correlation coefficient (lag 1)	-0.05	-0.27	0.395
Spearman's rank correlation coefficient (lag 2)	-0.03	-0.13	0.451
Spearman's rank correlation coefficient (lag 3)	-0.37	-1.89	0.036

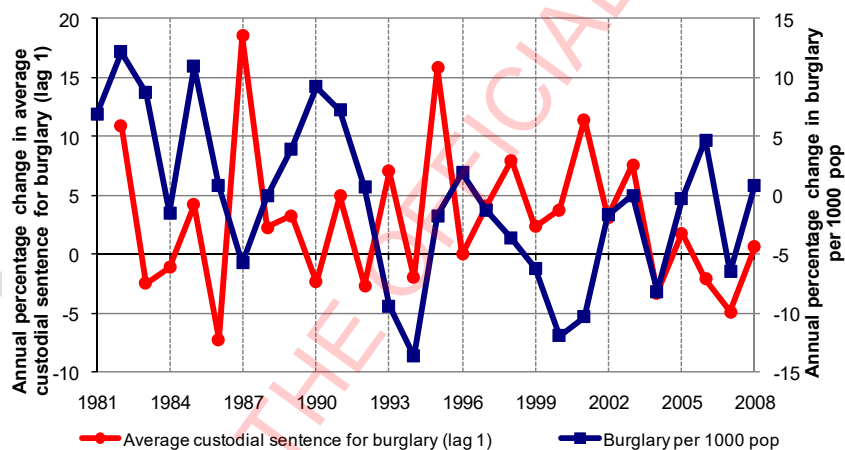
Average custodial sentence imposed for burglary in years (lag 1)

Figure 77: Trends in average custodial sentences imposed for burglary in years (lag 1) and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Ministry of Justice and New Zealand Police

Figure 78: Annual percentage changes in average custodial sentences imposed for burglary in years (lag 1) and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



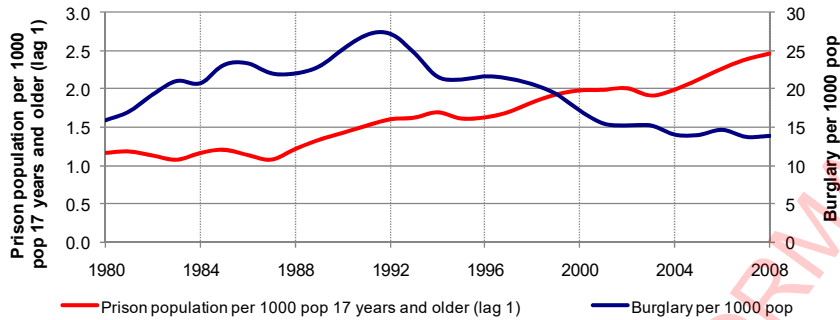
Source: Ministry of Justice and New Zealand Police

Table 33: Correlation coefficients for annual percentage changes in average custodial sentences imposed for burglary in years and recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient (lag 1)	-0.09	-0.45	0.327
Correlation coefficient (lag 2)	0.03	0.14	0.446
Correlation coefficient (lag 3)	-0.07	-0.32	0.378
Spearman's rank correlation coefficient (lag 1)	-0.16	-0.81	0.211
Spearman's rank correlation coefficient (lag 2)	-0.06	-0.29	0.386
Spearman's rank correlation coefficient (lag 3)	-0.36	-1.82	0.041

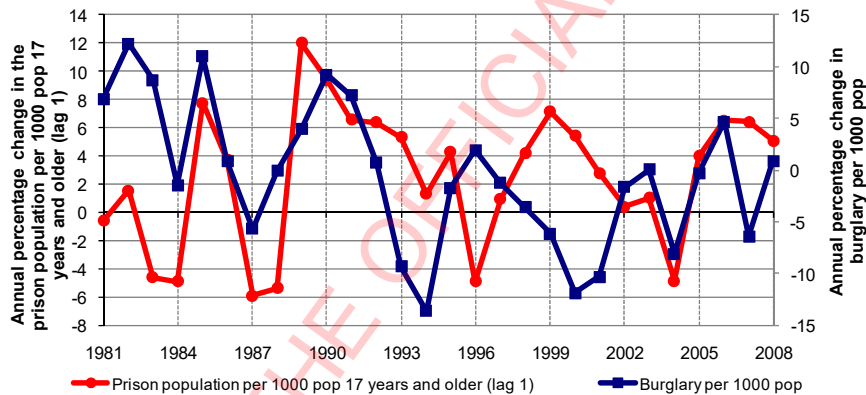
Prison population per 1,000 population aged 17 years and older (lag 1)

Figure 79: Trends in the prison population per 1,000 population aged 17 years and older (lag 1) and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Department of Corrections and New Zealand Police

Figure 80: Annual percentage changes in the prison population per 1,000 population aged 17 years and older (lag 1) and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



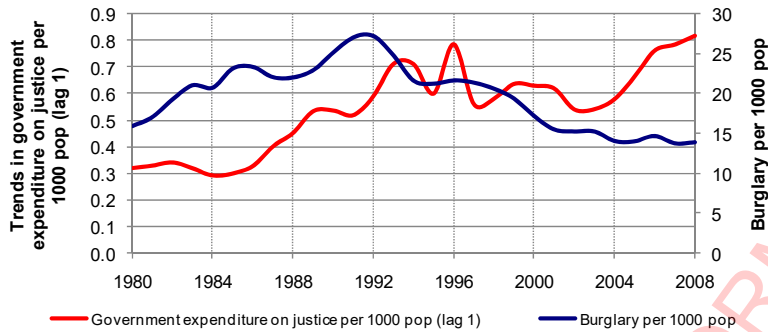
Source: Department of Corrections and New Zealand Police

Table 34: Correlation coefficients for annual percentage changes in the prison population per 1,000 population aged 17 years and older and recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient (lag 1)	0.13	0.66	0.257
Correlation coefficient (lag 2)	-0.18	-0.93	0.182
Correlation coefficient (lag 3)	-0.42	-2.24	0.017
Spearman's rank correlation coefficient (lag 1)	0.18	0.93	0.180
Spearman's rank correlation coefficient (lag 2)	-0.18	-0.90	0.188
Spearman's rank correlation coefficient (lag 3)	-0.48	-2.65	0.007

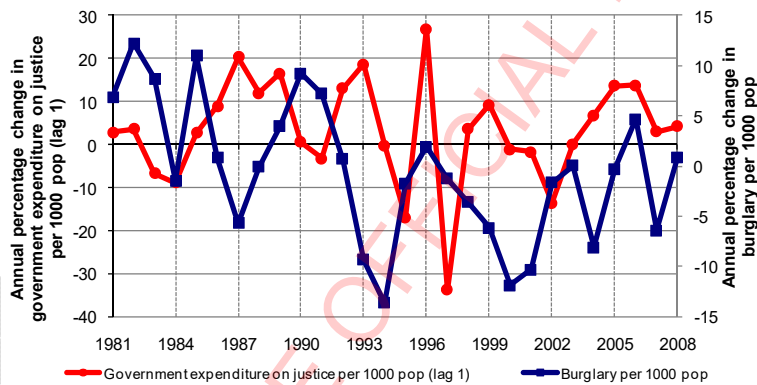
Government expenditure on justice per 1,000 population (lag 1)

Figure 81: Trends in government expenditure on justice per 1,000 population (lag 1) and recorded burglary rates per 1,000 population: 1980 to 2008



Source: Ministry of Justice and New Zealand Police

Figure 82: Annual percentage changes in government expenditure on justice per 1,000 population (lag 1) and recorded burglary rates per 1,000 population: 1980/81 to 2007/08



Source: Ministry of Justice and New Zealand Police

Table 35: Correlation coefficients for annual percentage changes in government expenditure on justice per 1,000 population and recorded burglary rates per 1,000 population: 1980/81 to 2007/08

	Value	t-statistic	p-value
Correlation coefficient (lag 1)	-0.02	-0.08	0.467
Correlation coefficient (lag 2)	-0.12	-0.59	0.280
Correlation coefficient (lag 3)	0.11	0.54	0.298
Spearman's rank correlation coefficient (lag 1)	0.07	0.33	0.371
Spearman's rank correlation coefficient (lag 2)	-0.16	-0.82	0.209
Spearman's rank correlation coefficient (lag 3)	0.00	0.02	0.494

APPENDIX C: SUMMARY OF THE MULTIPLE REGRESSION RESULTS

Table 36: Summary of regression models using annual changes in the variables for the period 1980 to 2008³⁶

Variable	Value of Coefficient in 1980-2008 Model																	
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8		Model 9	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Effective teenage birth rate					1.52	4.69**												
Unemployment rate							0.00	0.06										
Inflation rate	5.22	4.53**	6.27	6.12**			5.18	3.71**	5.67	5.40**	6.28	6.15**	6.05	5.45**	6.22	6.01**	4.56	3.90**
GDP	-1.10	-3.77**	-2.22	-5.26**	-2.18	-4.47**	-1.10	-3.52**	-2.25	-5.54**	-2.13	-4.98**	-2.14	-4.77**	-2.13	-4.83**	-1.93	-4.64**
GDP (lag 1)	-1.07	-3.59**	-1.38	-5.14**	-0.81	-2.70*	-1.05	-2.52*	-1.40	-5.41**	-1.39	-5.18**	-1.35	-4.91**	-1.30	-4.49**	-1.30	-5.06**
Personal consumption			1.97	3.26**	1.58	2.31*			1.93	3.32**	2.27	3.42**	1.91	3.08**	1.93	3.15**	1.45	2.25*
General business confidence													-0.02	-0.57				
Household disposable income											-0.35	-1.07						
Total police staff (lag 1)															-0.24	-0.78		
Effective abortion rate									-0.21	-1.66								
Prison population (lag 3)																	-0.32	-2.01
R²	0.68		0.78		0.70		0.68		0.80		0.79		0.78		0.79		0.81	

³⁶ Note that in the table a * by the t-statistic means that the p-value is less than 0.05 and a ** means the p-value is less than 0.01.

Table 37: Summary of regression models using annual changes in the variables for the period 1980 to 1992

Variable	Value of Coefficient in 1980-1992 Model																	
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8		Model 9	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Effective teenage birth rate					3.54	2.70*												
Unemployment rate							-0.03	-0.27										
Inflation rate	6.51	1.88	8.64	2.53*			7.01	1.70	3.81	0.71	7.07	1.98	9.62	2.36	11.39	2.59*	4.02	0.95
GDP	-0.96	-2.12	-2.20	-2.53*	-2.24	-2.66*	-0.99	-2.00	-2.04	-2.36	-1.67	-1.75	-2.27	-2.44	-2.22	-2.55*	-1.68	-2.01
GDP (lag 1)	-1.06	-1.75	-1.57	-2.47*	-1.19	-2.36	-1.21	-1.44	-1.26	-1.85	-1.18	-1.67	-1.70	-2.37	-1.64	-2.56*	-1.29	-1.96
Personal consumption			1.84	1.62	1.32	1.27			1.36	1.15	2.06	1.84	1.89	1.57	2.08	1.79	1.12	0.97
General business confidence													0.04	0.52				
Household disposable income											-0.71	-1.19						
Total police staff (lag 1)															-1.15	-0.99		
Effective abortion rate									-0.66	-1.15								
Prison population (lag 3)																	-0.46	-1.65
R²	0.43		0.58		0.61		0.43		0.66		0.66		0.60		0.64		0.75	

Table 38: Summary of regression models using annual changes in the variables for the period 1993 to 2008

Variable	Value of Coefficient in 1993 to 2008 Model																	
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6 ³⁷		Model 7		Model 8		Model 9	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Effective teenage birth rate					0.52	0.29												
Unemployment rate							-0.18	-1.28										
Inflation rate	2.72	0.90	5.60	1.93			1.59	0.52	5.61	1.88	5.25	1.75	5.29	1.64	5.09	1.73	5.80	1.90
GDP	-2.13	-3.80**	-2.67	-4.94**	-2.93	-4.26**	-3.01	-3.42**	-2.62	-4.69**	-2.62	-4.73**	-2.51	-3.17**	-2.56	-4.67**	-2.85	-4.09**
GDP (lag 1)	-1.74	-2.36*	-2.07	-3.16**	-1.37	-2.19	-2.21	-2.74*	-2.02	-2.98*	-2.35	-3.09*	-1.98	-2.64*	-1.95	-2.96*	-2.25	-2.85*
Personal consumption			1.89	2.25*	1.28	1.36			1.98	2.26*	2.33	2.25*	1.86	2.11	1.71	2.00	2.14	2.07
General business confidence													-0.01	-0.28				
Household disposable income											-0.45	-0.77						
Total police staff (lag 1)															-0.31	-1.05		
Effective abortion rate									-0.09	-0.64								
Prison population (lag 3)																	0.14	0.45
R²	0.67		0.77		0.70		0.71		0.78		0.79		0.78		0.80		0.78	

³⁷ Note that Model 9 has the highest value of R^2 for the whole period, and for 1980 to 1992, while the R^2 for 1993-2008 is also high, so it appears to be the best model without further investigation. However, the prison population (lagged three years) is not significant for either the whole period, or for 1980 to 1992 and 1993 to 2008. And although the coefficients for the other variables are consistent across the two time periods, prison population (lagged three years) is not. For 1980 to 1992, the coefficient is negative. However, for 1993 to 2008, the coefficient is positive. Similarly, there are problems with Model 5, which has the 2nd highest value of R^2 for the whole period. Firstly from 1980 to 1992, the effective abortion rate is not significant for either the whole period, or for 1980 to 1992 and 1993 to 2008, while no variable is significant in the 1980 to 1992. As a result, this model has an R^2 of 0.36 for the 1993 to 2008 period, when predicted values are calculated using regression coefficients from 1980 to 1992 data.

Table 39: Summary of regression models using actual rates for the period 1980 to 2008

Variable	Value of Coefficient in 1980 to 2008 Model													
	Model 10		Model 11		Model 12		Model 13		Model 14		Model 15		Model 16	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Effective teenage birth rate	2.52	9.10**	2.09	8.04**	2.58	11.09**	2.16	9.36**	1.64	4.77**	1.81	5.70**	3.44	11.16**
Unemployment rate			0.51	3.17**			0.56	3.80**	0.62	3.80**	0.57	3.48**		
Log (inflation rate)					-0.75	-1.91								
General business confidence							-0.01	-2.20*						
Household disposable income											-0.37	-1.43		
Log (GDP)													-18.48	-3.43**
Effective abortion rate													0.12	5.42**
Log (total police staff (lag 1))									-5.62	-1.85			-14.68	-3.50**
R²	0.76		0.85		0.83		0.89		0.88		0.86		0.91	

Table 40: Summary of regression models using actual rates for the period 1980 to 1992

Variable	Value of Coefficient in 1980 to 1992 Model													
	Model 10		Model 11		Model 12		Model 13		Model 14		Model 15		Model 16	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Effective teenage birth rate	3.31	4.69**	1.92	2.34*	2.68	3.95**	1.94	2.26*	2.94	3.40**	3.13	3.46**	6.06	5.06**
Unemployment rate			0.60	2.27*			0.63	2.28*	0.39	1.60	0.38	1.51		
Log (inflation rate)					-1.31	-1.52								
General business confidence							-0.01	-0.78						
Household disposable income											-1.07	-2.06		
Log (GDP)													-35.89	-2.74*
Effective abortion rate													-0.13	-1.11
Log (total police staff (lag 1))									-39.73	-1.83			-48.49	-2.67*
R²	0.69		0.82		0.80		0.82		0.91		0.89		0.96	

Table 41: Summary of regression models using actual rates for the period 1993 to 2008

Variable	Value of Coefficient in 1993 to 2008 Model													
	Model 10		Model 11		Model 12		Model 13		Model 14		Model 15		Model 16	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Effective teenage birth rate	2.46	9.49**	1.61	3.44**	2.37	10.29**	1.96	5.63**	1.58	3.42**	1.46	2.20*	6.93	3.32**
Unemployment rate			0.75	2.17*			0.85	2.96*	0.48	1.22	0.73	2.02		
Log (inflation rate)					-0.87	-1.35								
General business confidence							-0.03	-2.83*						
Household disposable income											-0.21	-0.34		
Log (GDP)													-28.51	-3.46**
Effective abortion rate													0.30	3.44**
Log (total police staff (lag 1))									-6.74	-1.27			-14.74	-3.85**
R²	0.87		0.89		0.91		0.97		0.90		0.89		0.98	