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What caused the recent drop in property crime?

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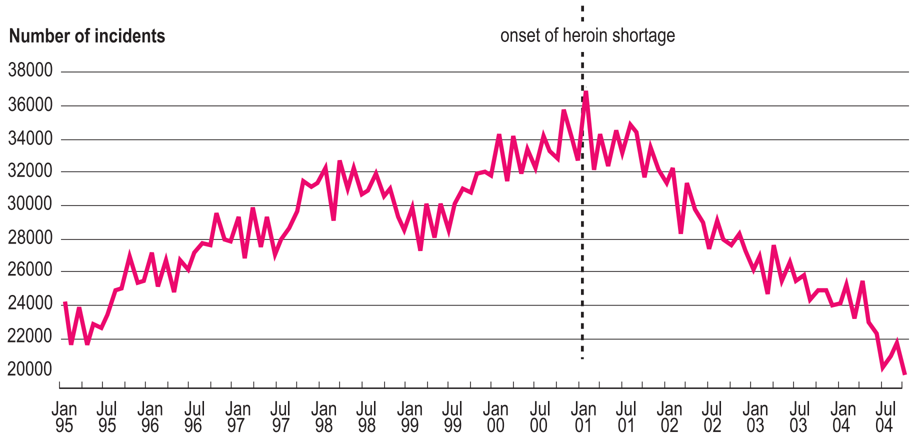
Early in 2001, Australia experienced an acute heroin shortage that forced the price of heroin up and the purity of heroin down. The result was an immediate drop in the rate of fatal heroin overdose and a slower but nonetheless substantial drop in levels of property crime. The fall in property crime has been widely attributed to a fall in heroin use. One problem with this explanation, however, is that property crime rates continued to fall long after heroin use had stabilised, albeit at a lower level. This bulletin reports the results of a systematic analysis of a number of crime-relevant factors that changed over the same period that property crime rates fell. The results indicate that the downward trend in property crime was assisted by the fall in heroin consumption, but other factors also played an important role. These include a real increase in average weekly earnings, an increase in the number of heroin users returning to treatment, an increase in the imprisonment rate for convicted burglars and, possibly, a fall in long-term unemployment.

INTRODUCTION

Around Christmas 2000, reports began to surface in the media of a significant heroin shortage in New South Wales (NSW). Between late 2000 and early 2001, in NSW the nominal price of heroin rose by 75 per cent, from $218/gram to $381/gram (Weatherburn, Jones, Freeman & Makkai 2003). Over the same period, the purity of street heroin fell from around 70 per cent to around 30 per cent (Australian Crime Commission 2004, p. 17). Thus the real price of heroin in Australia rose by about 400 per cent. A substantial drop in crime accompanied these changes. Between January 2001 and September 2004 in NSW, property crime (including robbery) fell by 46 per cent. As can be seen from Figure 1[1], overall levels of property crime in NSW are now below what they were in the mid-1990s.

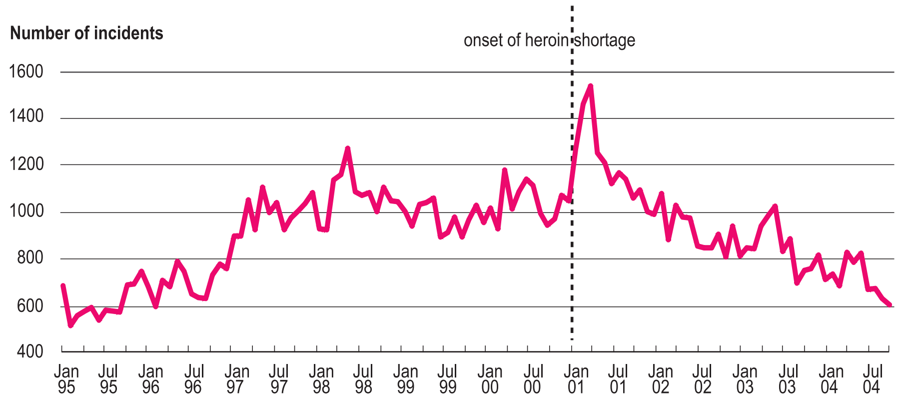
It is important to note that, although the general pattern shown in Figure 1 suggests a smooth reduction in crime after the onset of the heroin shortage, the trend for robbery was actually somewhat different. As can be seen from Figure 2, in the months immediately following the heroin shortage there was a sharp spike in the number of robberies[2] (mirroring an earlier spike in the early months of 1998).

It is also important to note that the fall in property crime was not limited to NSW. Between 2002 and 2003, every State and Territory experienced a fall in recorded rates of burglary, every State and Territory except Western Australia and the ACT experienced a drop in motor vehicle theft, every State and Territory except Queensland and Western Australia experienced a fall in robbery and every State and Territory except the ACT experienced a drop in 'other theft' (Australian Bureau of Statistics 2004(a), p. 11). The fact that property crime in Australia fell after the onset of the heroin shortage raises the suspicion that the two processes are



Source: NSW Bureau of Crime Statistics and Research

Figure 2: Trends in recorded incidents of robbery NSW: Jan 95 - Sep 04



Source: NSW Bureau of Crime Statistics and Research

causally related. This suspicion is strengthened (a) by the fact that heroin users often resort to property crime (particularly robbery) to fund their purchases of heroin, (b) by the fact that heroin users are known to have responded to the shortage by reducing their consumption of heroin (Weatherburn *et al*. 2003), (c) by research showing that the fall in crime began soon after the heroin shortage began (Degenhardt, Conroy & Gilmour 2004) and (d) by the fact that the drop in property crime has been concentrated in urban areas where heroin dependence is most prevalent (Moffatt & Goh 2004).

By themselves, however, these considerations do not justify the conclusion that the drop in property crime shown in Figure 1 is attributable solely to the heroin shortage. Firstly, such a conclusion fails to take into account the possibility that factors other than heroin consumption may account for the drop in property crime. Secondly, it is hard to reconcile with the fact that property crime rates continued to fall long after most key indicators of heroin consumption had stabilised[3]. Thirdly, it provides no explanation for the transient jump in robbery in the months immediately after the heroin shortage began. To make a considered assessment of how the heroin shortage influenced trends in property crime over the last few years we need to see whether there is any association between heroin consumption and property crime, after controlling for other factors that might explain the downward trend in crime and the upward spike in robberies. In the next section we consider some of these factors. We then present the results of a regression analysis examining their influence.

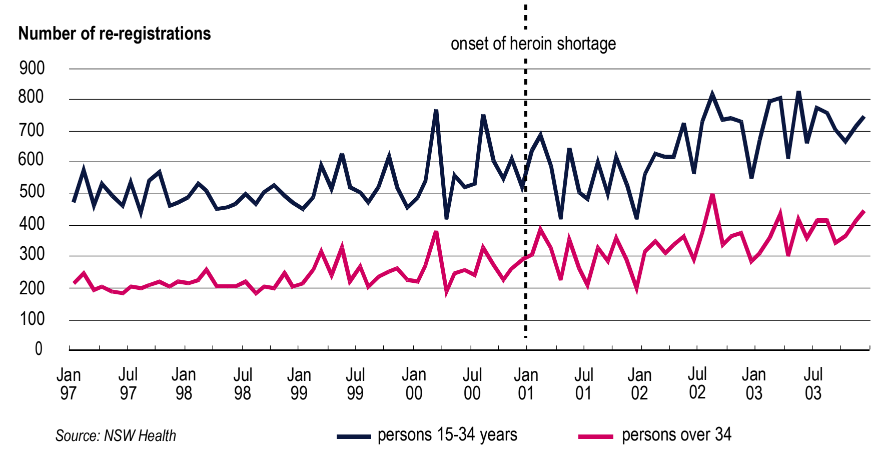
OTHER POSSIBLE INFLUENCES ON PROPERTY CRIME TRENDS

Drug treatment

Heroin users are known to offend at a lower rate when they are in methadone maintenance treatment (MMT) than when they are not (Lind, Chen, Weatherburn & Mattick 2005). The number of new entrants to MMT fell immediately after the onset of the heroin shortage[4], probably because the number of dependent users began to f all. Some time after the shortage, however, the number of heroin users who re-registered for a further course of MMT, after previously enrolling in treatment, began to increase. Figure 3 shows the trend in re-registrations for opioid pharmacotherapy[5] between January 1997 and December 2003 for persons aged 15-34 and over 34.

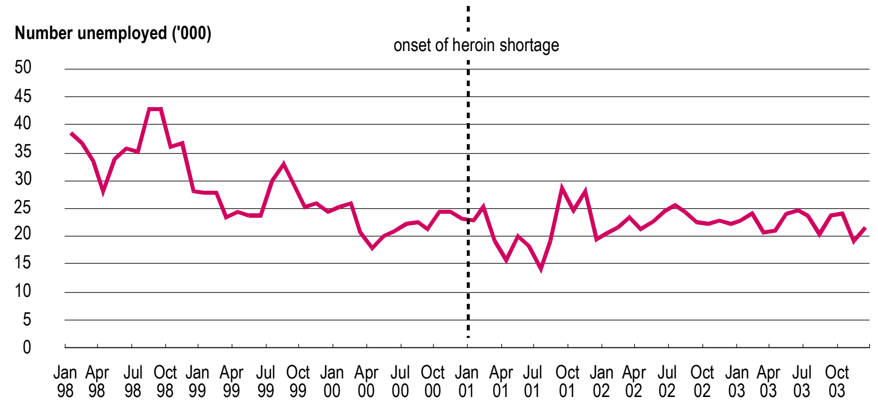
As can be seen from Figure 3, about a year after the heroin shortage began, the number of re-registrations for pharmacotherapy increased significantly. It is possible that the reduction in property crime is partly attributable to the fact that many heroin users who had previously been in treatment eventually decided to return to

Figure 3: Re-registrations for pharmacotherapy by age group NSW: Jan 97 - Dec 03



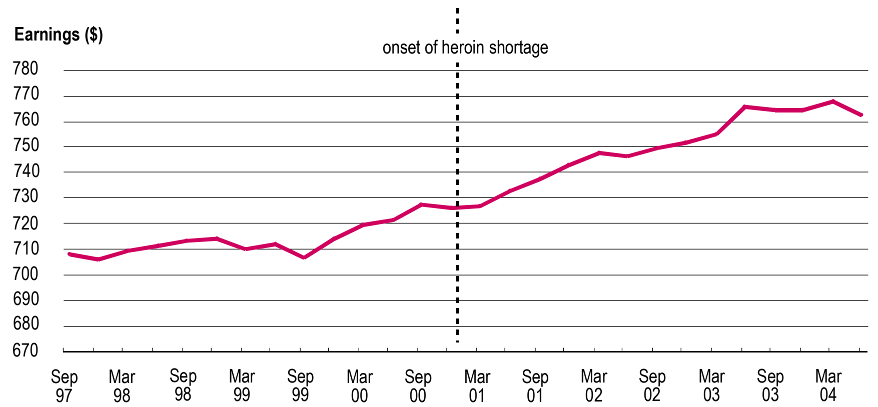
Source: NSW Health

Figure 4: Trend in long-term unemployment NSW: Males 15-34 unemployed more than 26 weeks



Source: Australian Bureau of Statistics 2004 (b)

Figure 5: Trend in real average weekly earnings Australia: Sep 97 - Jun 04: 1997 prices



Source: Australian Bureau of Statistics 2004 (c)

treatment in the face of higher heroin prices and lower heroin purity.

Unemployment

A number of studies have found a close relationship between long-term unemployment among young males and trends in property crime (Chamblin & Cochran 1998; Greenberg 2001; Chapman, Weatherburn, Kapuscinski, Chilvers & Roussel 2002). Research by Farrington, Gallagher, Morley, St Ledger and West (1986) has shown that young people from low socioeconomic status families tend to commit property crime at a higher rate during periods of unemployment than when they are employed. Figure 4 shows the trend between January 1998 and December 2003 in the number of 15-34 year old males unemployed for more than 26 weeks in NSW.

It is clear from Figure 4 that the rate of long-term unemployment amongst this group declined substantially since 1998. The decline in long-term unemployment might therefore have contributed to the downward trend in property crime.

Average real earnings

Conventional economic theories of crime assume that offenders allocate their time between legitimate and illegitimate income earning activities, according to the expected earnings from each (Becker 1968). Grogger (1998) found evidence consistent with this thesis in the United States. This is of some significance because, during the period in the lead up to the heroin shortage and thereafter, real average weekly earnings for Australian workers were increasing.

Figure 5 shows that the increase in real average weekly earnings was quite substantial, particularly in the period after the onset of the heroin shortage. Increased earnings are therefore another factor that may have helped reduce levels of involvement in property crime.

Trends in arrest and imprisonment

Several studies have found a significant inverse relationship between rates of offending and measures of police enforcement activity, such as the rate of arrest (Nagin 1998). Research has also revealed evidence of a negative relationship between imprisonment rates and crime, although the relationship in this instance does not appear to be particularly strong (Spelman 2000) and its interpretation has been the subject of some dispute (see, for example, von Hirsch, Bottoms, Burney & Wikstrom 1999). The drop in crime experienced since the heroin shortage is not likely to have been caused by rising arrest rates because, as can be seen from Figure 6, the number of suspected offenders charged with robbery or burglary remained relatively stable throughout the period leading up to and after the onset of the heroin shortage.

There have, however, been some changes in the use of imprisonment in relation to burglary and robbery offenders. Figure 7 shows the proportion of convicted robbery and burglary offenders who were given a prison sentence over the period January 1998 to December 2003. To make the two trends easier to distinguish, the imprisonment rate for robbery has been divided by a factor of two (i.e. the true rate of imprisonment for robbery is double the rate shown).

There is no evidence of any change in the percentage of robbery offenders imprisoned, but there does appear to be an increase in the percentage of convicted burglars given a prison sentence.

Figure 8 shows the trend in the average prison sentence imposed on convicted burglars and robbers.

There is no notable change in the average prison term imposed on burglars and robbers in the period

Figure 6: Robbery and burglary charges finalised in NSW Criminal Courts - NSW: Jan 98 - Dec 03

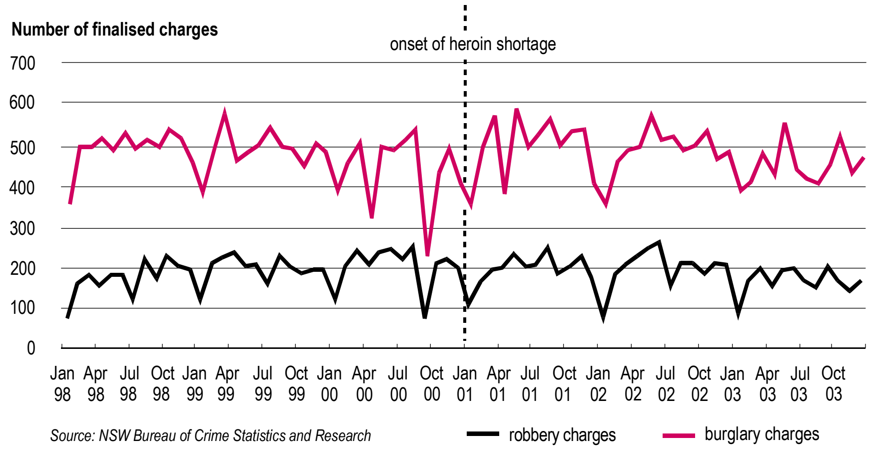


Figure 7: Imprisonment rate (%) for persons found guilty of robbery and burglary - NSW: Jan 98 - Dec 03

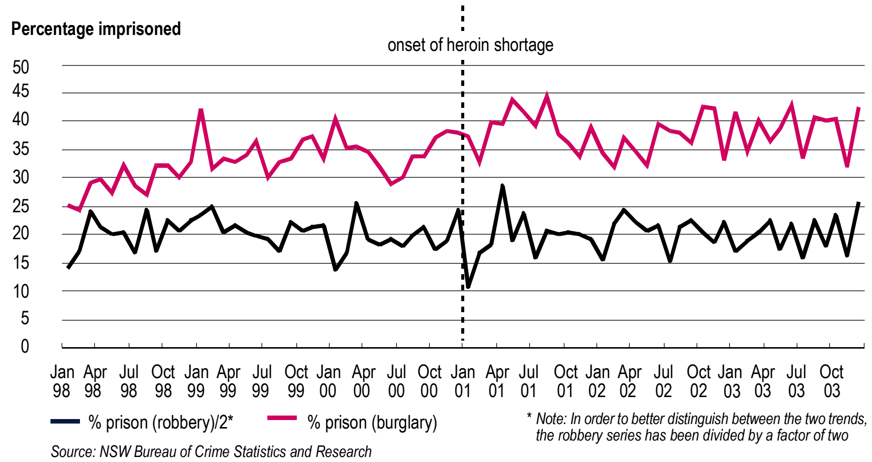
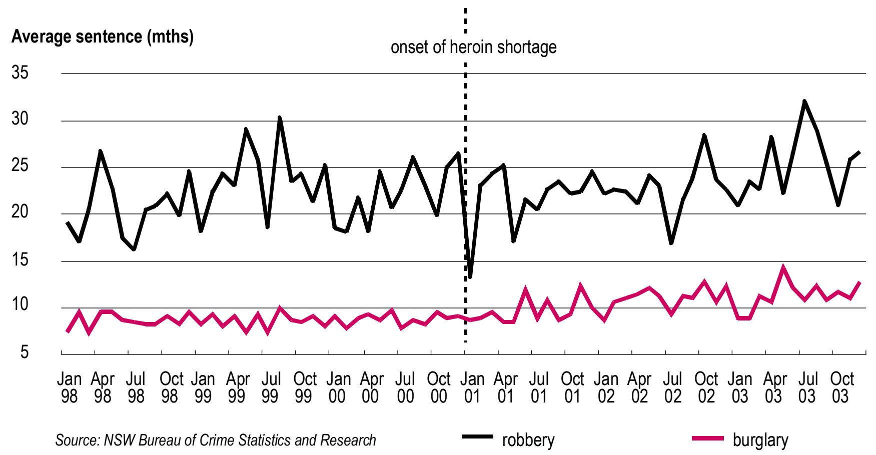


Figure 8: Average prison sentence (mths) for robbery and burglary NSW: Jan 98 - Dec 03



before the heroin shortage but there is clear evidence of an increase in the average prison term for burglary following the shortage. There is also some evidence of an increase in the average prison term for robbery from about July 2002 onwards.

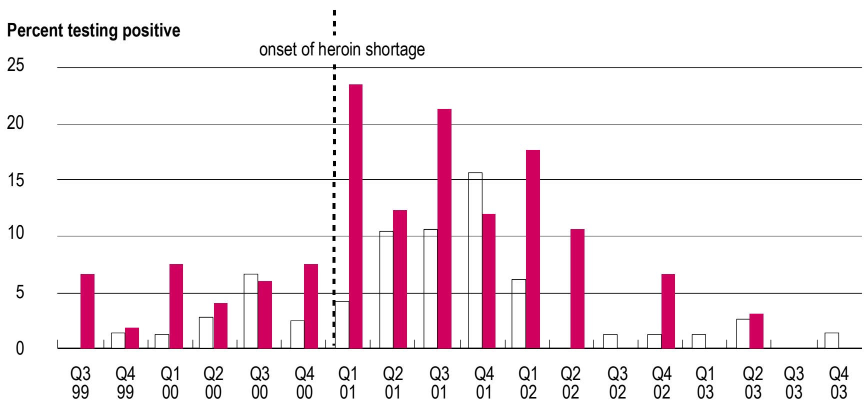
The spike in use of cocaine

The discussion so far has been concerned with factors that might explain the fall in crime shown in Figure 1. However, as we have already noted in connection with Figure 2, immediately following the onset of the heroin shortage, robbery rates temporarily but sharply increased. This sudden jump in robbery mirrored a previous spike in robbery in early 1998. That spike coincided with a sharp jump in the percentage of suspected overdose fatalities in inner and western Sydney involving people who tested positive for cocaine (McKetin, Darke & Godycka-Cwirko 1999). The spike in robberies after the heroin shortage also occurred during a period in which heroin users in Cabramatta reported an increase in their consumption of cocaine (Weatherburn *et al*. 2003; Degenhardt *et al*. 2004). This can be seen in Figure 9, which shows the percentage of police detainees in Bankstown and Parramatta Local Area Commands (LAC) who tested positive to cocaine during routine drug testing carried out as part of the DUMA program (Makkai 1999).

Immediately prior to the shortage, three percent of detainees in Parramatta LAC and eight per cent of detainees in Bankstown LAC tested positive to cocaine. By the third quarter of 2001, the percentage of detainees testing positive to cocaine in Bankstown LAC had nearly tripled, while the percentage testing positive to cocaine in Parramatta LAC had more than tripled. By the third quarter of 2002, however, the percentage of police detainees testing positive to cocaine had dropped to zero in Bankstown LAC and near zero in Parramatta LAC. The onset of the threefold increases coincided with the temporary jump in robbery seen in Figure 2.

Cocaine is a drug that tends to be injected much more frequently than heroin, and cocaine habits are for this reason much more expensive to maintain. Prolonged and frequent use of cocaine also tends to make users of the drug more violent (van Beek *et al*. 2001; Jones *et al.* 2005). It is possible, therefore, that the jump in robbery seen in Figure 3 is attributable to a temporary increase in consumption of, and expenditure on, cocaine.

Figure 9: Percentage of police detainees testing positive to cocaine Bankstown and Parramatta: Jan 99 - Dec 03



Source:Australian Institute of Criminology

DATA AND METHODS

In this section of the bulletin we present the results of a formal assessment of the influence of the above-mentioned factors on property crime in NSW. Our general strategy is to regress crime against measures of the factors using Autoregressive Moving Average (ARMA) regression techniques[6]. These techniques allow us to determine whether each factor influences crime when the effects of other relevant factors are held constant. Since, however, some of the variables we employ in our regression analyses differ from those we have been discussing, a few comments about our choice of independent variables is in order.

Figure 1 is made up of a number of component trends for different offences, all of which (except robbery) mirror the broad pattern shown in Figure 1 (see Table A1, Appendix 1), but each of which differs somewhat in its precise form. Rather than model a group of offences that may not be entirely homogeneous in their time series properties, we model two separate trends. The first is the trend for household burglary, which we take to be broadly illustrative of trends in non-violent property crime. The second is the trend for robbery. We model this trend separately because, as noted earlier, it does not follow the same pattern as the non-violent forms of property crime. Data on these offences were drawn from the NSW Police crime information system (COPS).

The short time period that has elapsed since the heroin shortage and the need for at least 30 observations in order to conduct a time series analysis force us to model the monthly trend in both of these offences, rather than the quarterly or annual trend. We use the monthly number of non-fatal heroin overdoses as a proxy measure of heroin use. Data on this variable were obtained from NSW Health. We use the monthly data on the number of re-registrations (aged 15-34) for pharmacotherapy to measure re-entry into treatment. These data were also supplied by NSW Health. To measure long-term unemployment we use monthly data on the number of males, aged less than 25, who had been unemployed in NSW for more than 52 weeks. These data were obtained from the Australian Bureau of Statistics (2004(b)).

Unfortunately, because the DUMA data shown in Figure 9 are only compiled quarterly we have no direct measure of monthly trends in cocaine use. As a proxy measure we use the monthly number of police recorded incidents for cocaine use/possession. Data on this variable were obtained from COPS. Average weekly earnings data are also only compiled quarterly, and it is therefore impossible to include this variable in models of monthly trends in burglary and robbery. To get around this problem we use the Consumer Sentiment Index (CSI). The CSI is a monthly series compiled by the Melbourne Institute of Applied Economic and Social Research for the Westpac Bank. It is used to measure short-run changes in Australian consumers' willingness to buy and is closely correlated with changes in average weekly earnings. According to Loundes and Scutella (2000), the CSI is a useful indicator of total consumption, predominantly through its ability to explain discretionary consumption. Data on the CSI were obtained from the Reserve Bank of Australia.

It is possible to obtain monthly data on the percentage of offenders given a prison sentence and on the average prison sentence length. Rather than include both these variables in our analysis, however, we use a composite measure of imprisonment that reflects both the number of offenders imprisoned and the average sentence length. The composite measure for burglary is constructed in the following way. First we identify each person appearing in a NSW court each month whose principal offence was burglary and record the length of the prison term (if any) imposed on the offender for that specific principal offence. To obtain a measure of aggregate imprisonment for burglary for each month we then sum these sentences. The aggregate measure of imprisonment for robbery is obtained in a similar way. The data on court appearances required for these measures were obtained from databases maintained by the NSW Bureau of Crime Statistics and Research.

Though it might seem prudent to do so, we do not include measures of police activity in our models. There are two reasons for this. Firstly, as can be seen from Figure 6, there is no obvious change in the number of persons arrested for burglary and robbery over the time period of interest. Secondly, past experience suggests that the inclusion of arrest and imprisonment would have resulted in serious problems of multicollinearity. Similar problems, it should be noted, prevented Chilvers and Weatherburn (2004) including measures of arrest and imprisonment in their model of the long-term trends in robbery.

Using the monthly data we have just described, two separate models were estimated[7]. These are shown in equations one and two below[8]. The first model (see equation 1) regressed the number of burglaries against the number of heroin overdoses, the number of re-registrations for pharmacotherapy, our measure of aggregate prison time (for burglary), the number of males aged less than 25 who have been unemployed in NSW for more than 52 weeks and the value of the CSI.

$$BED = b_0 + b_1 OD + b_2 Reregphar + b_3 PrisSentB + b_4 NLTU + b_5 CSI + e^*_t \qquad (1)$$

Where:

- **BED** = *recorded incidents of break and enter (dwelling)*
- **OD** = *non-fatal heroin overdoses*
- **Reregphar** = *re-registrations for pharmacotherapy*
- **PrisSentB** = *aggregate prison time given for burglary offences*
- **NLTU** = *number of long term unemployed males NSW (15-24yrs)*
- **CSI** = *consumer sentiment index*
- b_i = *model parameters*
- e^*_t = *random error process including ARMA(0,2) terms*

where $e^*_t = e_t + \phi_1 e_{t-1} + \phi_2 e_{t-2}$ *and* e_t *is white noise.*

The second model (see equation 2) was identical in form[9] but included our proxy measure of cocaine/use possession:

$$Robb = b_0 + b_1 OD + b_2 Reregphar + b_3 PrisSentR + b_4 NLTU + b_5 CSI + b_6 CocCh + e^*_t \qquad (2)$$

Where:

- **Robb** = *recorded incidents of robbery*
- **OD** = *non-fatal heroin overdoses*
- **Reregphar** = *re-registrations for pharmacotherapy*
- **PrisSentR** = *aggregate prison time given for robbery offences*
- **NLTU** = *number of long term unemployed males NSW (15-24yrs)*

CSI = *consumer sentiment index*

CocCh = *recorded incidents of posess/use cocaine*

b_i = *model parameters*

e^*_t = *random error process including ARMA (0,2) terms*

where $e^*_t = e_t + \phi_1 e_{t-1} + \phi_2 e_{t-2}$ *and* e_t *is white noise.*

RESULTS

ESTIMATING THE MODEL FOR BREAK AND ENTER (DWELLING)

Table 1 gives the parameter estimates for the burglary model (descriptive statistics for variables are provided in the Table A2 of the Appendix). The signs associated with the parameters are all in the expected direction[10]. Lower rates of burglary are associated with: lower levels of heroin use (as indicated by lower heroin overdose rates), lower levels of long-term unemployment for young males, higher rates of re-registration for pharmacotherapy (after a time lag[11] of four months), higher levels of consumer sentiment (i.e. higher real wages) and higher levels of imprisonment.

Figure 10 shows the trend in home burglary, together with the fitted values from equation (1). The overall test of significance for the modelled relationship is strong and significant ($F = 25.15$, $p < 0.0001$) and the model explains more than 70% of the variation in burglary (adjusted Rsq. = 0.72).

ESTIMATING THE MODEL FOR ROBBERY

Table 2 gives the parameter estimates for the robbery model[12]. The coefficients are all in the expected direction apart from long-term male unemployment. Lower levels of robbery are associated with lower levels of heroin and cocaine

Table 1: Estimates of regression coefficients for burglary model

Variable	*Coefficient*	*Standard Error*	*T-Statistic*	*Prob.*
Non-fatal heroin overdoses (lag3)	1.60	0.70	2.28	0.026
Re-registrations for pharmacotherapy (lag4)	-2.14	0.39	-5.43	0.000
Aggregate prison sentence time for burglary	-0.63	0.23	-2.79	0.007
Long-term unemployed males (15-24 years)	0.05	0.03	1.95	0.056
Consumer sentiment (lag1)	-32.48	10.12	-3.21	0.002
Constant	10,837	1,170	9.26	0.000

See Table A3 in the Appendix for information on unit root tests and Table A4 for model diagnostics

Figure 10: Recorded incidents of burglary Actual and predicted values

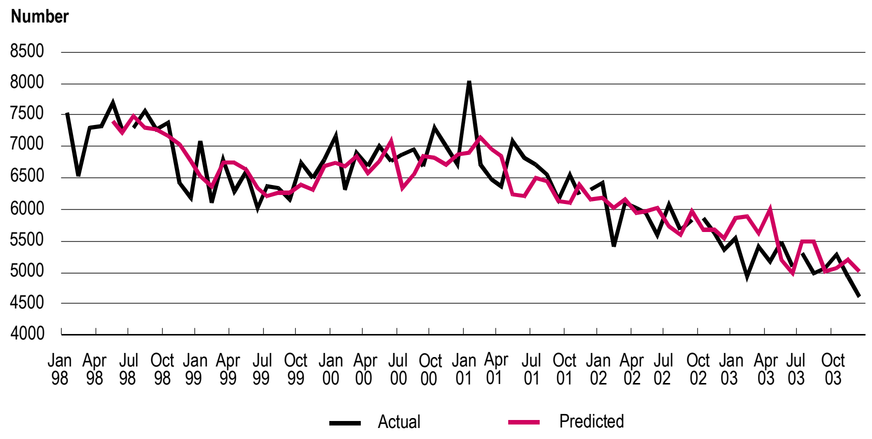
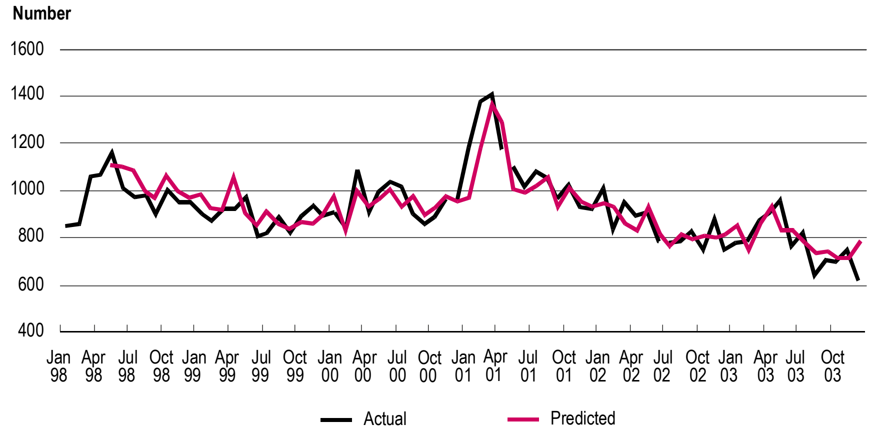


Table 2: Estimates of regression coefficients for robbery model

Variable	*Coefficient*	*Standard Error*	*T-Statistic*	*Prob.*
Non-fatal heroin overdoses (lag3)	0.43	0.13	3.21	0.002
Re-registrations for pharmacotherapy (lag4)	-0.19	0.10	-2.01	0.050
Possess/use cocaine incidents	4.35	1.10	3.94	0.000
Aggregate prison sentence time for robbery	-0.14	0.09	-1.60	0.116
Long term unemployed males (15-24 years)	-0.003	0.01	-0.53	0.598
Consumer sentiment (lag1)	-5.50	1.89	-2.91	0.005
Constant	1,614	255	6.34	0.000

See Table A3 of the Appendix for unit root tests and Table A5 for model diagnostics

Figure 11: Recorded incidents of robbery Actual and predicted values



use (as measured by overdoses and cocaine possession incidents), higher rates of re-registration for pharmacotherapy and higher levels of discretionary income (as measured by consumer confidence). Long-term unemployment was found not to contribute any explanatory information for the level of robbery. On closer inspection of the series it can be seen that long-term unemployment is much more closely correlated with burglary than robbery over the period of the model. The prison sentence time variable for robbery had the correct sign but was not significant (p-value = 0.116).

Figure 11 shows the trend in robbery, together with the fitted values from equation (2). As with burglary, the overall test of significance for the modelled relationship is strong and significant ($F = 22.2$, $p < 0.0001$) and explained more than 70% of the variation in robbery (adjusted Rsq. = 0.72).

CONCLUSION

Before discussing the findings it is important to emphasise the fact that the existence of a correlation between variables can never be taken as conclusive evidence that they are causally linked, even in an analysis that attempts (as this one does) to take other factors into account. Criminology has not advanced to the point where the choice of control variables can be determined by theoretical considerations alone. We have attempted to analyse most of the main factors that past research suggests are important and which have changed over the relevant study period. It is always possible, however, that some factor not included in our analysis is responsible for the effects we have observed. Such uncertainties plague all forms of research that have to rely on non-experimental methods to test conjectures about causal relationships.

The results of our analysis are nonetheless very interesting. It has been conventional wisdom to assume that the fall in property crime in New South Wales (and Australia) is attributable to the drop in heroin consumption that accompanied the heroin shortage (see, for example, Degenhardt *et al*. 2004). The present analysis suggests that falling rates of heroin consumption have undoubtedly contributed to the drop in burglary and robbery but factors other than heroin consumption appear to have played an important role in sustaining these downward trends. In the case of burglary, these factors include an increase in the number of heroin users re-entering treatment, a rise in the rate of imprisonment for burglary and (judging from the significant coefficient on the CSI variable) an increase in average weekly earnings. The fall in long-term unemployment amongst young males may have also made a contribution, but the coefficient on this variable did not quite reach the standard threshold for statistical significance. The initial jump in robbery following the heroin shortage appears to have come about as a result of a temporary shift to cocaine use immediately following the onset of the heroin shortage. The subsequent decline has been influenced by the increase in average weekly earnings and rising rates of re-entry into drug treatment.

Unlike burglary, prison does not seem to have contributed to the downward trend in robbery. Why would imprisonment influence the fall in burglary, but not the fall in robbery? There are two possible explanations. Firstly, the robbery series is of much lower volume and higher relative volatility, a factor that would have made it difficult to detect a significant effect even if there was one. Secondly, and perhaps more importantly, unlike burglary, there was little change over the relevant time period in either the number of convicted robbers imprisoned (they are nearly always imprisoned) or the length of time for which they were imprisoned. Thus even if the current imprisonment rate of convicted robbers were keeping the robbery rate lower than it would otherwise be, there is no reason to expect prison to have made a significant contribution to the observed fall in robbery.

Some will be surprised to see evidence that prison exerted an effect on burglary, given the doubts that have so frequently been expressed about the effectiveness of prison in controlling crime (e.g. Doob & Webster 2003). However while there are quite legitimate concerns about the cost-effectiveness of prison as a crime control tool it would be unwise to dismiss the possibility that rising imprisonment rates have reduced burglary. Studies of incapacitation consistently show a positive effect, even if the size of that effect varies widely from study to study (Chan 1995; Weatherburn 2004). Many of the methodological objections levelled at early research on the correlation between imprisonment and crime (see Nagin 1978) have now been overcome (Nagin 1998)[13]. The present results do not conclusively show that higher rates of imprisonment for burglary have reduced its prevalence but they are consistent with several rigorously conducted studies showing a modest but consistently negative association between imprisonment rates and crime (Spelman 2000).

The discovery that favourable economic conditions in Australia helped produce a fall in income-generating property crime is hardly surprising. Yet it does help explain why property crime rates in New South Wales continued to fall long after most key indicators of heroin consumption had stabilised. It may at first blush seem odd to suppose that heroin-dependent offenders (only a small proportion of whom are employed) could be influenced by changes in the wider economy. Media and political preoccupation with drug-related crime, however, tends to obscure the fact that many offenders become involved in property crime, not because they need money to buy drugs but simply because crime provides a useful source of supplementary income. This is particularly true of burglary, which attracts a large number of casual opportunists (Baker 1998). Our findings provide a timely reminder that not all crime is drug related, and that economic policy has an important role to play in crime prevention and control.

The significant coefficient on the variable measuring re-registration for pharmacotherapy is consistent with past research showing the effectiveness of MMT as a strategy for reducing drug-related crime (Lind *et al*. 2005). What makes this variable interesting, however, is the fact that it is significant even in the presence of a variable measuring the rate of heroin overdose. The puzzle here is that one would expect the fall in heroin overdoses and the rise in treatment entry to be reflections of the same process (viz. reduced heroin consumption). One reason these two variables may have exerted independent effects, however, is that the benefits (on crime) of a drop in heroin consumption may have been initially constrained by the earlier-mentioned tendency among many NSW heroin users to compensate for the shortage of heroin by consuming more cocaine (Weatherburn *et al*. 2003). When this drug became expensive and harder to get (about a year after the onset of the shortage), many of these drug users may have entered MMT and reduced their overall expenditure on both heroin and cocaine. This would have produced a further round of reductions in crime.

We conclude this bulletin by sounding two cautionary notes about the significance of our findings for drug law enforcement policy. Firstly, while the heroin shortage has justifiably given those involved in supply-side drug law enforcement[14] renewed confidence in the value of their work, the temporary jump in robbery after the heroin shortage gives some inkling of what could have happened to crime if cocaine use had become as widespread after the heroin shortage as heroin use had been prior to the shortage. Australia was spared this outcome because the purity of cocaine fell in the later stages of 2000 and the drug itself became somewhat harder to obtain in 2002 (Roxburgh et al 2003, p. 34). These two factors would have acted to reduce overall consumption of and expenditure on cocaine. This in turn would have helped forestall a growth in crime. It is also important to note that the benefits of the heroin shortage were probably secured at least in part because heroin users wanting to leave the heroin market had no difficulty doing so. The effect of the heroin shortage on crime may well have been quite different if those wishing to leave the heroin market had had more difficulty finding a path out of drug use into treatment.

REFERENCES

Australian Bureau of Statistics 2004(a), *Recorded Crime - Victims Australia 2003*, Australian Bureau of Statistics, Cat. No. 4510.0, Canberra.

Australian Bureau of Statistics 2004(b), *Labour force status by State, Sex and Duration of unemployment* , Australian Bureau of Statistics, Cat. No. 6291.0.55.001, Canberra.

Australian Bureau of Statistics 2004(c), *National Economic Indicators*, Australian Bureau of Statistics, Cat. No. 1350.0 Full-time adult ordinary time earnings, Canberra.

Australian Crime Commission 2004, *Illicit Drug Data Report*, Australian Crime Commission, Commonwealth of Australia, Canberra.

Baker, J. 1998, *Juveniles in Crime: Participation Rates and Risk Factors*, NSW Bureau of Crime Statistics and Research, Sydney.

Becker, G. S. 1968, 'Crime and punishment: An economic approach', *Journal of Political Economy*, vol. 76, pp. 169-217.

Chamblin M.B. & Cochran, J.K. 1998, 'Causality, Economic Conditions, and Burglary', *Criminology*, 36, p. 425-440.

Chan, J. 1995, *The Limits of Incapacitation as a Crime Control Strategy*, Crime and Justice Bulletin No 25, NSW Bureau of Crime Statistics and Research, Sydney.

Chapman, B. Weatherburn, D., Kapuscinski, C.A., Chilvers, M. & Roussel, S. 2002, *Unemployment duration, schooling and property crime*, Crime and Justice Bulletin No 74, NSW Bureau of Crime Statistics and Research, Sydney.

Chilvers, M. & Weatherburn, D. 2004, 'The New South Wales "Compstat" process: Its impact on crime', *Australian and New Zealand Journal of Criminology*, 37(1), pp. 22-48.

Degenhardt, L., Conroy, E. & Gilmour, S. 2004, 'Changes in the health effects of drug use', in Degenhardt, L. & Day, C. (eds), *The Course and Consequences of the Heroin Shortage in Australia*, National Drug and Alcohol Research Centre, University of New South Wales, Sydney, pp. 51-66.

Doob, A.N. & Webster, C.M. 2003, 'Sentence Severity and Crime: Accepting the Null Hypothesis', *in Crime and Justice: An Annual Review of Research*, vol. 30, M. Tonry (ed.), University of Chicago Press, Chicago, pp. 143-195.

Donnelly, N., Weatherburn D. & Chilvers M. 2004, *The impact of the Australian heroin shortage on robbery in NSW*, Bureau Brief, NSW Bureau of Crime Statistics and Research, Sydney.

Farrington, D. P., Gallagher, B., Morley, L., St. Ledger, R. J. & West, D. J. 1986, 'Unemployment, school leaving, and crime', *British Journal of Criminology*, vol. 26, no. 4, pp. 335-356.

Greenberg, D.F. 2001, 'Time Series Analysis of Crime Rates', *Journal of Quantitative Criminology*, 17, pp. 291-327.

Grogger, J. 1998, 'Market Wages and Youth Crime', *Journal of Labor Economics*, 16, pp. 756-791.

Jones, C., Weatherburn, D., Freeman, K. & Matthews, R. 2005, *Psychostimulant use, health and criminal activity*, NSW Bureau of Crime Statistics and Research, Sydney, *in press*.

Lind, B., Chen, S., Weatherburn, D. & Mattick, R. 2005, 'The effectiveness of ethadone maintenance treatment in controlling crime: An Australian aggregate-level analysis', *British Journal of Criminology*, *in press*.

Loundes, J. & Scutella R., 2000, *Consumer Sentiment and Australian Consumer Spending*, Melbourne Institute of Applied Economic and Social Research Working Paper Series, no. 21/00, University of Melbourne.

Makkai, T. 1999, *Drug Use Monitoring in Australia (DUMA): A Brief Description*, Research and Public Policy Series No. 21, Australian Institute of Criminology, Canberra.

Makkai, T., & McGregor, K. 2003, *Drug Use Monitoring in Australia, 2002 Annual Report on Drug Use Among Police Detainees*, Research and Public Policy Series No. 47, Australian Institute of Criminology, Canberra.

McKetin, R., Darke, S. & Godycka-Cwirko, K. 1999, *NSW Drug Trends 1998: Findings from the Illicit Drug Reporting System (IDRS)*, National Drug and Alcohol Research Centre, Technical Report 72, University of New South Wales, Sydney.

Moffatt, S., & Goh J. 2004, *New South Wales Recorded Crime Statistics 2003: Regional analysis of crime trends*, Crime and Justice Statistics, Bureau Brief, NSW Bureau of Crime Statistics and Research, Sydney.

Nagin, D. 1978, 'General deterrence: A review of the empirical evidence', in *Deterrence and Incapacitation: Estimating the Effects of Criminal Sanction on Crime Rates*, A. Blumstein, J. Cohen, & D. Nagin, (eds). National Academy Press, Washington D.C.

Nagin, D.S., 1998, 'Criminal Deterrence Research at the Outset of the Twenty-First Century', in M. Tonry (ed.) *Crime and Justice: A Review of Research*, vol. 23, University of Chicago Press, Chicago.

Roxburgh, A., Degenhardt, L., Breen, C. & Barker, B. 2003, *NSW Drug Trends 2002: Findings from the Illicit Drug Reporting System*, National Drug and Alcohol Research Centre, Technical Report No. 144, University of New South Wales, Sydney.

Spelman, W. 2000, 'What recent studies do (and don't) tell us about imprisonment and crime', in *Crime and Justice: A Review of Research* vol. 27, M. Tonry, (ed). University of Chicago Press, Chicago, pp. 419-494.

van Beek, I., Dwyer, R. & Malcolm, A. 2001, 'Cocaine injecting: The sharp end of drug-related harm!' *Drug and Alcohol Review*, vol. 20, pp. 333-342.

von Hirsch, A., Bottoms, A.E., Burney, E. & Wikstrom, P. O. 1999, *Criminal Deterrence and Sentence Severity: An Analysis of Recent Research*, Hart Publishing, Oxford, pp. 25-26.

Weatherburn, D., 2004, 'Law and order in Australia: Rhetoric and Reality', Federation Press, pp. 123-125.

Weatherburn, D., Jones, C., Freeman, K. & Makkai, T. 2003, 'Supply control and harm reduction: Lessons from the Australian heroin drought', *Addiction*, 98, pp. 83-91.

LIST OF APPENDICES

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NOTES

1 Figure 1 is a plot of all incidents of recorded crime in the categories of robbery, burglary, motor vehicle theft, stealing from a motor vehicle, stealing from a dwelling, stealing from the person, and other theft.

2 Note that this spike was not evident for robbery with a firearm, but this is by far the least frequent form of robbery. It was evident for unarmed robbery and robbery with a weapon other than a firearm.

3 Virtually all of the fall in both heroin overdoses and the percentage of detainees testing positive to heroin in the DUMA program occurred between January 2001 and July 2001. See Degenhardt *et al* (2004, p. 54) and Makkai & McGregor (2003). Interviews with key informants also indicate little change in the availability of heroin between 2002 and the present (Roxburgh *et al* 2003, p. 10). Yet as can be seen from Figure 1, the incidence of property crime continued to fall after this and is still on the decline.

4 Unpublished data supplied to the second author by NSW Health.

5 The overwhelming majority of heroin users in opioid pharmacotherapy at the time of this study were in methadone maintenance treatment.

6 As expected, the monthly burglary and robbery series are significantly autocorrelated (to more than 10 lags). However, since the presence of unit roots can be rejected in the series used in the models (see Appendix Table A3), differencing was not necessary and models are analysed in levels.

7 The statistical software E-Views4 uses Non Linear Least Squares for ARMA models (which is asymptotically equivalent to maximum likelihood estimates) to estimate the models and to produce model diagnostics (see Appendix Tables A4 and A5).

8 The validity of the least squares regression models described by equations (1) and (2) depends upon stationarity of series, error terms being independent and identically distributed *(iidN(0,δ^2))*, homoscedastic, serially uncorrelated, normal random variables with zero mean.

9 Due to the volatility in the series for robbery prison time (particularly over summer months), exponential smoothing was applied to the series.

10 Granger testing was carried out for a range of different lags of the burglary variable. In some cases this testing was indicative of bi-directional temporal causality between dependent and independent variables.

11 Where a regressor was considered capable of exerting a stronger non-contemporaneous effect on burglaries and robberies, a lag selection was made upon inspection of cross correlations and regression diagnostics of F value and Akaike Information Criterion (AIC).

12 Granger testing was carried out for a range of different lags of the robbery variable. In some cases this testing was indicative of bi-directional temporal causality between dependent and independent variables

13 It is worth observing in this connection that the NSW Police have been engaged for some time in a policy of targeting repeat offenders for arrest. Targeting of recidivist offenders by police may have made imprisonment more effective as a crime control tool than it has been in the past (see, for example, Spelman 2000).

14 Enforcement directed at the producers, manufacturers, distributors or sellers of illegal drugs.

Table A1: Pearson Correlations for recorded incidents of property crime (monthly series January 1995 - August 2004)

		Robbery	Motor vehicle theft	Steal from motor vehicle	Steal from dwelling	Steal from person	Other theft
Burglary	Pearson Correlation	0.715	0.860	0.757	0.664	-0.182	0.712
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.050	0.000
Robbery	Pearson Correlation		0.521	0.755	0.596	0.239	0.741
	Sig. (2-tailed)		0.000	0.000	0.000	0.009	0.000
Motor vehicle theft	Pearson Correlation			0.549	0.345	-0.436	0.469
	Sig. (2-tailed)			0.000	0.000	0.000	0.000
Steal from motor vehicle	Pearson Correlation				0.710	0.236	0.879
	Sig. (2-tailed)				0.000	0.010	0.000
Steal from dwelling	Pearson Correlation					0.376	0.767
	Sig. (2-tailed)					0.000	0.000
Steal from person	Pearson Correlation						0.247
	Sig. (2-tailed)						0.007

Table A1 shows the extent to which there are common trends across the property offences that make up Figure 1. As can be seen from the table, there is a very high degree of association between the different series.

Table A2: Descriptive statistics for model variables NSW 1998-2003 monthly data

	Mean	Median	Maximum	Minimum	Std. Dev.	Coeff of Var.	obsvns.
Burglary (dwellings)	6,362.3	6,424	8,056	4,627	767.21	12.1%	72
Non-fatal heroin overdoses	253.5	208.5	545	96	117.59	46.4%	72
Reregistrations for pharmacotherapy	589.8	560.5	826	419	111.27	18.9%	72
Consumer sentiment	106.6	107.9	118.1	87.3	6.83	6.4%	72
Long term unemployed males (15-24 years)	6,643.1	6,150	12,200	2,400	2,130.72	32.1%	72
Aggregate prison sentence time for burglary	904.2	867.2	1,677.4	330.7	244.91	27.1%	72
Robbery	926.3	912.0	1,418	620	143.43	15.5%	72
Possess/use cocaine incidents	20.6	19.5	64	3	12.04	58.4%	72
Aggregate prison sentence time for robbery	1,192.7	1,251.0	1,527.4	305.1	245.75	20.6%	72
Robbery without a weapon	572.2	563.0	854	402	78.75	13.8%	72
Robbery with a weapon not a firearm	290.5	294.5	513	149	79.65	27.4%	72

Table A2: Descriptive statistics for variables used in the models show that in any month home burglary is around seven times more frequent than robbery offences. A check of the coefficients of variation suggests that the three series with the highest relative variation over this period are possess/use cocaine, non-fatal heroin overdose and long-term male unemployment.

Table A3: Phillips-Perron tests for presence of a unit root on series in the models

Using trend and intercept with 3 lag difference terms (default)

1% Critical Value*	**-4.104**
5% Critical Value	**-3.479**
10% Critical Value	**-3.167**

	PP Test Statistic	*10% critical value*	*5% critical value*
Recorded incidents of burglary	-5.035	-3.167	-3.479
Non-fatal heroin overdoses	-3.504	-3.167	-3.479
Re-registrations for pharmacotherapy	-7.830	-3.167	-3.479
Aggregate prison sentence time for burglary	-8.192	-3.167	-3.479
Long term unemployed males (15-24 years)	-4.020	-3.167	-3.479
Consumer sentiment[#]	-3.218	-2.913	-2.592
Recorded incidents of robbery	-3.238	-3.167	-3.479
Possess/use cocaine incidents	-3.323	-3.167	-3.479
Aggregate prison sentence time for robbery	-3.722	-3.167	-3.479

** MacKinnon critical values for rejection of hypothesis of a unit root.*

[#] For consumer sentiment series no trend was used

Table A3: The Phillips-Perron unit root tests for series used in the models show that a unit root can be rejected at the 10% level and at the 5% level for all monthly series except robbery and possess/use cocaine (for more discussion on these see: Donnelly et al. 2004).

Table A4: Burglary model results and diagnostics

Variable	*Coeff.*	*Std. Err.*	*t-Stat*	*Prob.*
Non-fatal heroin overdoses (lag3)	1.60	0.70	2.28	0.026
Reregistrations for pharmacotherapy (lag4)	-2.14	0.39	-5.43	0.000
Aggregate prison sentence time for burglary	-0.63	0.23	-2.79	0.007
Long term unemployed males (15-24 years)	0.05	0.03	1.95	0.056
Consumer sentiment (lag1)	-32.48	10.12	-3.21	0.002
Constant	10837	1170	9.26	0.000
MA(1)	0.24	0.11	2.07	0.043
MA(2)	0.50	0.12	4.22	0.000

R-squared	0.75	F-statistic	25.15
Adjusted R-squared	0.72	Prob(F-statistic)	0.000
Durbin-Watson stat	2.00		
Jarque-Bera Normality residsuals	0.961(prob=0.62)		

Q-Stats for residuals of burglary model

Lag	*AC*	*PAC*	*Q-Stat*	*Prob.*
3	0.05	0.05	0.18	0.67
6	0.03	0.03	1.83	0.77
9	0.08	0.06	2.83	0.90
12	0.23	0.25	10.36	0.41
15	-0.01	-0.09	15.67	0.27
18	0.03	0.01	19.05	0.27

Unit Root tests for residuals

ADF test of residuals for burglary model		(no constant or trend)	
ADF Test Statistic	**-4.27**	1% Critical Value*	-2.60
		5% Critical Value	-1.95
		10% Critical Value	-1.62

** MacKinnon critical values for rejection of hypothesis of a unit root.*

Table A4: Burglary model diagnostics show that the ARMA(0,2) model is appropriate and that the residual term is stationary, normally distributed and free of autocorrelation. The E-Views 4 option of White Heteroscedasticity-Consistent Standard Errors and Covariance was used for this model.

Table A5: Robbery model results and diagnostics

Variable	*Coeff.*	*Std. Err.*	*t-Stat*	*Prob.*
Non-fatal heroin overdoses (lag3)	0.43	0.13	3.21	0.002
Re-registrations for pharmacotherapy (lag4)	-0.19	0.10	-2.01	0.050
Possess/use cocaine incidents	4.35	1.10	3.94	0.000
Aggregate prison sentence time for robbery	-0.14	0.09	-1.60	0.116
Long term unemployed males (15-24 years)	-0.003	0.01	-0.53	0.598
Consumer sentiment (lag1)	-5.50	1.89	-2.91	0.005
Constant	1614	255	6.34	0.000
MA(1)	0.28	0.13	2.18	0.033
MA(2)	0.54	0.12	4.66	0.000

R-squared	0.75	F-statistic	22.20
Adjusted R-squared	0.72	Prob(F-statistic)	0.000
Durbin-Watson stat	1.84		
Jarque -Bera Test for Normality of residuals	4.416 (prob=0.11)		

Q-stats of residuals for robbery model

Lag	*AC*	*PAC*	*Q-Stat*	*Prob.*
3	0.07	0.06	0.54	0.46
6	0.20	0.20	4.72	0.32
9	-0.13	-0.17	9.73	0.20
12	0.03	-0.01	11.19	0.34
15	0.00	0.03	17.76	0.17
18	0.04	-0.02	21.45	0.16

ADF test of residuals for robbery model		(no constant or trend)	
ADF Test Statistic	**-4.07**	1% Critical Value*	-2.60
		5% Critical Value	-1.95
		10% Critical Value	-1.62

** MacKinnon critical values for rejection of hypothesis of a unit root.*

Table A5: Robbery model shows that an ARMA (0,2) model is appropriate and that the residuals are stationary, normally distributed and free of autocorrelation.

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