

# The long-term effect of routine police activity on property and violent crime in NSW, Australia

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**Aim:** To examine the long-term effect of two routine police activities on property and violent crime in NSW.

**Method:** Police move-on directions and person searches as well as property and violent crimes were extracted from the NSW Police Force's Computerised Operational Policing System. We investigate the relationship between police activity and crime using panel of 17 Local Area Commands (LACs) over the period 2001 to 2013. To estimate the long-run relationship, panel models of Pooled Mean Group and Mean Group were applied to allow for differing effects between LACs.

**Results:** We estimated a significant and strongly negative long-run relationship between both indices of police activity (move-on directions and person searches) and each of break and enter, motor vehicle theft and robbery. The person search activity is negatively related to assault, but the effect is weak; with a 10 per cent increase in person searches only producing a 0.29 per cent fall in assaults. No significant long-run relationship was found between assault and move-on directions.

**Conclusion:** Sustained increases in police activity, whether in the form of move-on directions or person searches, do appear to help suppress break and enter, motor vehicle theft and robbery but do not appear to help in reducing assault.

**Keywords:** police activity, violent crime, property crime, panel cointegration, pooled mean group estimator.

## INTRODUCTION

Australian Governments spend approximately \$11.6 billion every year on policing services (SCRGSP, 2019) but little research has been conducted in Australia on the marginal effectiveness<sup>1</sup> of the tactics and strategies employed by police to prevent and control crime. Evidence from studies conducted overseas indicates that the effectiveness of different policing tactics varies considerably. Strategies that are known to have a significant suppression effect on crime include patrols in crime hotspots, focussed deterrence and DNA testing (Telep & Weisburd, 2012). Strategies that do not appear to have any measurable effect include random patrols, rapid response to emergency calls and generalised increases in arrests (Centre for Evidence Based Crime Policy, 2019; Weisburd & Eck, 2004).

Two of the more common policing strategies employed by New South Wales (NSW) Police (and many other state police services) are move-on directions and person searches. Under Section 197 of the *Law Enforcement (Powers and Responsibilities) Act 2002* (NSW), police can direct a person to move on if they have reasonable grounds to believe that the person is about to: commit an offence; is obstructing traffic or another person; engaging in behaviour that is considered harassment or intimidation to another person (or people); engaging in behaviour that is causing or likely to cause fear to a reasonable person; or loitering in a place in order to unlawfully supply or cause another person to unlawfully supply drugs. The same legislation allows police to conduct person searches if they hold a 'genuine suspicion or belief' that certain specified circumstances apply (e.g. that the person to be searched has stolen goods, drugs or a dangerous weapon in their

possession). These searches can be performed without warrant either before and/or after a person's arrest. Similar powers exist in other States and Territories.

NSW police rely heavily on the move-on and search powers created in the Law Enforcement (Powers and Responsibilities) Act, conducting more than 170,000 person searches and issuing more than 67,000 move-on directions every year (NSW Bureau of Crime Statistics and Research, 2019, unpublished data available on request from the first author). As with any legislation limiting civil liberty, police move-on and person search powers come under considerable criticism. Punter (2011, p. 395), for example, has argued that "the legislative safeguards and restrictions intended to guide and limit the application of move-on powers [in Queensland] have largely failed to prevent misuse [of the powers]". Farrell (2009, p. 26) has argued that police move-on powers in Victoria "are exercised in a discriminatory fashion across Australian jurisdictions, and young people, Indigenous Australians, and other minority groups are massively over-represented in the exercise of 'move-on' powers, relative to both their representation in the population and their participation in criminal activity." The UK Equality and Human Rights Commission (2019) described police 'stop and search' powers in that country as "unlawful, disproportionate, discriminatory and damaging to relations between communities" (UK Equality and Human Rights Commission 2019, p. 12). Similarly, a number of studies have examined the potential negative effects of stop and frisk in the US context (Gelman, Fagan & Kiss, 2007; Sewell, Jefferson & Lee, 2016; White & Fradella, 2016).

Although the principal object of police move-on and search powers is to enhance public safety, no attempt has been made in Australia so far to evaluate the effectiveness of the powers in achieving this goal. The purpose of the present report, therefore, is to examine their effectiveness. It should be emphasised at the outset that the present study only examines the marginal effectiveness of the move-on and search powers, not their absolute effect. The difference is important. The marginal effect is the additional crime reduction obtained for a given percentage increase in the number of police move-on directions and/or person searches. The absolute effect would be the change in crime rates if police had no power to move-on or search people, and therefore issued no move-on directions and conducted no person searches.

## PAST RESEARCH

The effect of police on crime is the subject of an extremely large research literature. Most of the research in this area, however, has focused either on the ethics of police stop and search powers, the effect of police numbers on crime (e.g. Cheng & Long, 2018; Di Tella & Schargrodsky, 2004; Lee, Eck & Corsaro, 2016; Levitt, 1997; Machin & Marie, 2011; Marvell & Moody, 1996; Yeong 2019)

or the effect of specific police tactics, such as targeting crime hotspots (Braga, 2001; Weisburd, 2018) or focussed deterrence (e.g. Kennedy, 1997; Braga, Weisburd & Turchan, 2018). This literature has left no doubt that some police tactics can have a significant effect on crime. Most of the time, however, police are engaged in routine activities, such as interviewing suspected offenders, searching for illegal weapons or drugs and checking compliance with bail and parole orders. Surprisingly few methodologically rigorous studies have examined the question of whether increases in these routine forms of police activity have any effect on crime.

There are two primary challenges in any analysis of policing activity on crime rates. The first is known as the simultaneity problem. Simultaneity refers to the fact that policing activity might have a direct impact on crime rates, but crime rates can also have a direct and simultaneous impact on policing activity. Failure to deal with this can create a quite misleading impression of the effect of police on crime. If police activity increases in response to an increase in crime, it will appear that increased police activity results in increased crime. There are three main ways to get around this problem. The first is to conduct an experiment where police activity is varied, and all other factors are held constant. The second is to find a factor that influences police activity, but which has no direct effect on crime and is not affected by it. The third is to examine the effect of police activity at one point in time on crime at a later point in time. Since the future cannot influence the past, any association between police activity and crime in this situation counts as evidence that police activity affects crime rather than vice versa.

The second challenge is known as omitted variable bias. Omitted variable bias refers to the bias that occurs when some factors that should have been included in the analysis are left out. For example, we might find that crime rates are lower where police are more active and this might, indeed, reflect a causal relationship between the two variables. It is also possible, however, that some other unmeasured third factor, such as an improvement in the economy is responsible for both the increase in police activity and the fall in crime. During good economic times, for example, governments might invest some of their increased taxation revenue in recruiting more police. This increased investment might result in an increase in police activity. Good economic times, however, might also result in lower crime rates as more people find employment and have higher income. Rather than police activity causing crime to fall, economic conditions in this situation would be jointly responsible for the increase in police activity and the fall in crime.

One of the earliest studies of the effect of police activity on crime was that conducted by Chaiken, Lawless and Stevenson (1974). They examined the impact of an increase in police patrols on robbery in the New York subway system and found that the

increase was followed by a dramatic fall in robbery. Since robbery rates were rising rapidly prior to the increase in police patrols this finding cannot be attributed to a pre-existing downward trend. Nor can it be sensibly argued that the fall in robbery was the cause of the increase in police activity. It remains possible, however, that the effect observed by Chaiken, Lawless and Stevenson (1974) was due to other factors or events coinciding with the increase in police activity on the subway system (e.g. increased police numbers in other parts of New York City).

Wilson and Boland (1978) conducted one of the earliest studies on the relationship between police activity and crime that explicitly addressed the problems of simultaneity and omitted variable bias. Their study concerned the impact of police activity on robbery. Because robbery rates affect the level of police activity, they employed moving [viz. traffic] violations as a proxy measure of police activity, arguing that while it was correlated with such activity, it had no direct causal effect on the robbery rate, which in turn had no effect on moving violations. In other words, moving violations allowed them to identify variation in police activity that was not affected by the robbery rate. Their results suggested that higher levels of street level law enforcement were associated with lower levels of robbery. Sampson and Cohen (1988) later replicated Wilson and Boland's (1978) study, using arrests per officer as a measure of police activity, and obtained similar results.

Sherman and Rogan (1995) is one of very few studies to have examined the effectiveness of police searches in reducing crime. They persuaded police in Kansas City to conduct intensive patrols and searches over a six-month period in a ten-by-eight-block area with a homicide rate 20 times higher than the national average. The patrols (and associated searches) produced a 65 percent increase in firearms seized by police. Gun crimes declined in the target area by 49 percent, with no significant displacement to any patrol beat surrounding the target area. Sherman and Rogan (1995) also found no evidence that gun crimes or guns seized changed significantly in the comparison beat several miles away. Subsequent evaluations have found similar results from directed police patrols (McGarrell et al. 2001). While there is little doubt that police reduced gun crime in this study, it is not entirely clear whether police searches were the active ingredient or whether any form of increased enforcement activity would have had the same effect (see Koper & Mayo-Wilson, 2006).

Miller, Bland and Quinton (2000) examined the impact of police searches on arrests and crime in the United Kingdom. They found no significant relationship between the annual number of searches per 1,000 population and annual rates of robbery, burglary, drugs and car crime (combined) for each of the five pilot areas they examined. The study unfortunately suffered from a number of weaknesses. It is possible that increases in police searches had effects on one of the categories of crime

included in the study but not on others, a fact that would have been obscured by bundling them all together. The study included no controls for other factors that might also have obscured the relationship between police searches and crime. The aggregation of police areas with different police-crime dynamics might have had a similar effect. Finally, the choice of year as the counting unit means the researchers were unable to examine the effect of changes in police activity within a given year.

MacDonald, Fagan and Geller (2016) evaluated a police operation (known as Operation Impact) designed to deploy additional police to high crime areas, known as impact zones, in New York City. In addition to examining the effect of Operation Impact on crime, MacDonald, Fagan and Geller (2016) also examined the effect of what they call 'investigative stops'. These stops are the equivalent of move-on directions and person searches carried out in Australia. They found that Operation Impact had a statistically significant but small impact on total crime in the impact zones, with the largest effects being found for robbery and burglary. It is their finding of the impact of investigative stops, however, which is of greatest relevance to the current study. They found that investigative stops were associated with a reduction in crime but only if they were based on 'probable cause', that is only when they had reason to believe the person they stopped was about to engage in or had engaged in criminal activity. Since only a fraction of all stops were based on 'probable cause' this led them to conclude that:

*....excess stops....had little crime suppression benefits. The scale of deployment and the level of stop activity suggest that [Operation Impact] may have been more productive if it placed more emphasis on probable cause stops more directly related to observable criminal activity. These findings are important for they suggest that more police activity and deployment to high crime areas can reduce criminal activity when constitutionally sound investigative tactics are used. (MacDonald, Fagan & Geller, 2016, p. 1).*

Although the studies just cited have taken us some distance toward understanding the relationship between police activity and crime, they are few and have two notable limitations. The studies by Wilson and Boland (1978) and Sampson and Cohen (1988) were cross-sectional—that is, they examined the correlation between levels of police activity and crime across cities at a point in time. Their results would have been more convincing if they had found (controlling for other factors) that increases in police activity at one point in time were followed by decreases in crime at a later point in time. None of the studies conducted so far have examined the long-run effects of changes in levels of police activity and crime. This is a problem because police activity and crime may be subject to random (and unrelated) fluctuations over the short-run while exhibiting a strong tendency to move together over the long-run.

## THE CURRENT STUDY

The aim of the current study is to examine the long-run effects on crime of changes in move-on directions and person searches. We improve on past research in several ways. A regression model for non-stationary time series generally gives spurious results unless the set of variables are cointegrated. It is also desirable to avoid aggregating over police Local Area Commands (LACs, now known as Police Area Commands) as the relationship between police activity and crime may vary from one LAC to another. We therefore explore the empirical relationship between police activity and crime using a cointegrating panel data approach. This allows us to control the effects of time-constant differences across LACs in factors like age structure, housing type, race, geography, income and urbanisation. Our temporal unit of analysis is a month rather than a year. This allows us to more fully explore equilibrium effects that may not be evident in annual data. The methods we use also allow for the possibility that the dynamics of the relationship between police activity and crime vary across LACs. This is important because decisions about the use of searches and move-on directions are made at LAC level and may differ significantly across LACs.

## METHOD

### INDEPENDENT AND DEPENDENT VARIABLES

The independent variables in our analysis are police move-on directions and person searches (regardless of the manner in which they are effected).<sup>2</sup> The dependent variables are the monthly numbers of police recorded incidents of break and enter, motor vehicle theft<sup>3</sup>, robbery and non-domestic assault. Note that a criminal incident in NSW is defined as an activity detected by or reported to police which involved the same offender(s) and victim(s), occurred at the one location, occurred during one uninterrupted period of time, falls into one offence category and falls into one incident type (for example, 'actual', 'attempted', 'conspiracy'). All variables in this study are de-seasonalised counts in natural logarithm form.

### DATA SOURCE

Data used for statistical analysis were sourced from the NSW Police Force's Computerised Operational Policing System. This database holds a unique record of all criminal incidents reported to, or detected by, police in NSW. The data were extracted as a panel data set and, as noted earlier, the unit of observation was defined as the Local Area Command (LAC). The analysis is limited to metropolitan LACs with at least 5 counts of police activity (move-on or person search) in each month. This results in 17 LACs altogether. Each LAC was observed over 152 time points, from January 2001 to August 2013. The use of a panel greatly increases the number of observations in (and hence the

power of) our analysis. As noted earlier, it also allows for the possibility that the relationship between police activity and crime may vary from one LAC to another.

A sudden drop in the number of police move-on and person search was observed from the time series plots. This is a result of industrial action by police where they refused to record police activities. Most of the fall occurred in November 2011 but the early part of December was also affected. To deal with this problem, the data in these two months have been treated as missing and were imputed using Kalman Smoothing on the state space representation of an Autoregressive Integrated Moving Average (ARIMA) model in each LAC. The best ARIMA model is automatically selected according to the Akaike Information Criterion.

### ECONOMETRIC APPROACH

When examining the relationship between two non-stationary variables, the possible presence of cointegration must be taken into account. Two integrated series may show a significant correlation even though they are not directly related. This is known as spurious correlation. The usual procedure for modelling non-stationary variables is to difference the data and then estimate an Ordinary Least Squares (OLS) regression. However, this procedure ignores possible important long-run relationships between variables when they are cointegrated. We therefore began by testing for a panel unit root using the method proposed by Pesaran (2003)<sup>4</sup> to examine whether the variables are stationary. In the analysis that follows, we use the heterogeneous panel cointegration tests developed by Westerlund (2007) and Pedroni (1999) to examine whether a long-run equilibrium relationship exists between the variables.

The traditional large  $N$ , small  $T$  dynamic panel approach to this problem usually relies on the fixed or random effects and generalised method-of-moments estimator. These methods only allow the intercepts to differ across the groups and force the short-run and long-run parameters to be identical for all cross-sections. If the cointegration coefficients are heterogeneous, these models will produce inconsistent and misleading long-term coefficients. Other techniques have been proposed to estimate nonstationary dynamic panels in which the parameters are heterogeneous across groups, namely the mean group (MG) and pooled mean group (PMG) estimators. The MG estimator allows the intercept, slope coefficients and error variances to differ across groups and does not assume potential homogeneity between groups. It is obtained by first estimating  $N$  regression equations and then averaging the coefficients. The PMG estimator, proposed by Pesaran, Shin and Smith (1999), is an intermediate estimator that allows the intercept and short-run coefficients and error variances to differ across groups but constrains the long-run coefficients to be the same. We employ both the MG and PMG estimators to examine short- and long-run effects.

The MG and PMG estimators involve the estimation of the autoregressive distributed lag (ARDL) models (Pesaran & Shin, 1999). ARDL ( $p, q$ ) dynamic panel models take the general form:

$$Y_{it} = \mu_i + \sum_{j=1}^p \lambda_{ij} Y_{i(t-j)} + \sum_{j=0}^q \delta'_{ij} X_{i(t-j)} + \epsilon_{it}, \quad (1)$$

where the number of groups  $i = 1, \dots, N$ ; the number of periods  $t = 1, \dots, T$ ;  $X_{it}$  is a vector of explanatory variables,  $\delta_{ij}$  are the corresponding coefficients;  $p$  and  $q$  are the lag length of the autoregressive and distributed lags, respectively;  $\mu_i$  is the group-specific effect and  $\epsilon_{it}$  is iid innovation.

The error correction representation of (1) is as follows

$$\Delta Y_{it} = \mu_i + \phi_i (Y_{i(t-1)} - \theta'_i X_{it}) + \sum_{j=1}^{p-1} \lambda^*_{ij} \Delta Y_{i(t-j)} + \sum_{j=0}^{q-1} \delta^*_{ij} \Delta X_{i(t-j)} + \epsilon_{it},$$

where  $\phi_i = -\left(1 - \sum_{j=1}^p \lambda_{ij}\right)$ ,  $\theta_i = \frac{\sum_{j=0}^q \delta_{ij}}{\left(1 - \sum_{k=1}^p \lambda_{ik}\right)}$ ,

$$\lambda^*_{ij} = -\sum_{m=j+1}^p \lambda_{im} \text{ for } j = 1, 2, \dots, p-1$$

and  $\delta^*_{ij} = -\sum_{m=j+1}^q \delta_{im} \text{ for } j = 1, \dots, q-1$

In the above equation,  $\lambda^*_{ij}$  and  $\delta^*_{ij}$  represent the LAC-specific coefficients of the short-term dynamics. The primary interest is  $\theta'_i$ , which contains the long-run relationship between the variables. The error correction coefficient for the  $i$ -th LAC is given by  $\phi_i$ . If  $\phi_i = 0$ , then there is no evidence of error correction and thereby lack of cointegration. This parameter is expected to be significantly negative if the variables return to a long-run equilibrium. The PMG estimator that constrains the long-run elasticities to be the same across all panels yields efficient and consistent estimates when slopes are indeed homogeneous. However, if the slope parameters are heterogeneous, the PMG estimates are inconsistent. Since the MG estimator is always consistent, the test of difference between these two models can be performed using the Hausman test. If the null hypothesis is rejected, the MG estimator is appropriate; failure to reject the null hypothesis suggests the more efficient PMG estimator is preferred. The error correction reparameterisation of the ARDL model is used for parameter estimation.

## RESULTS

Figures 1 and 2 show the time series plots of police move-on directions and person searches aggregated over the 17 LACs. The coloured dots indicate the imputed values in November and December 2011. We observed a clear upward trend in both move-on directions and person searches. Figure 3 shows the time series plots of property crime (break and enter, motor

Figure 1. Time series plot of police move-on directions aggregated over the 17 LACs

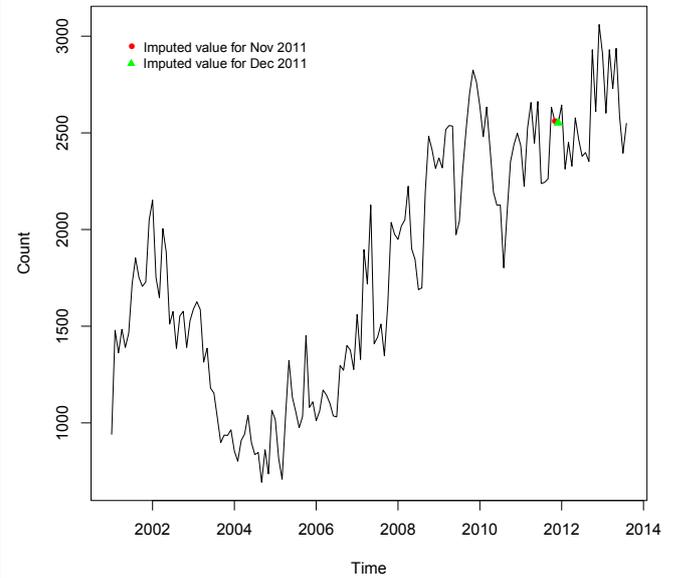
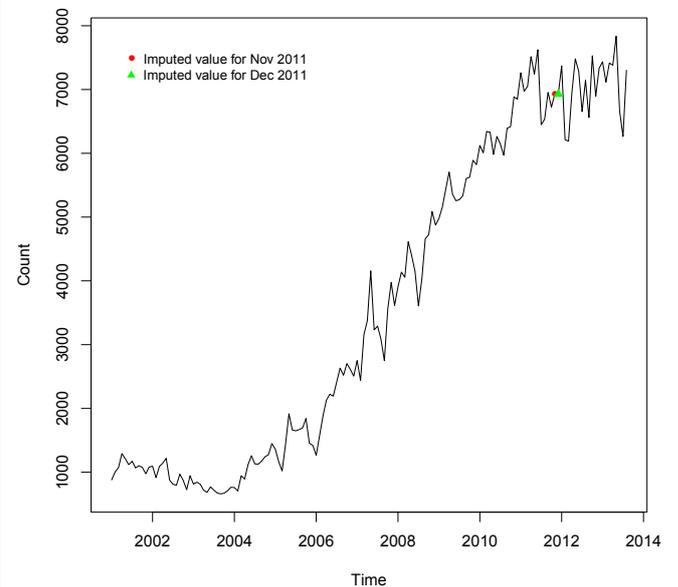
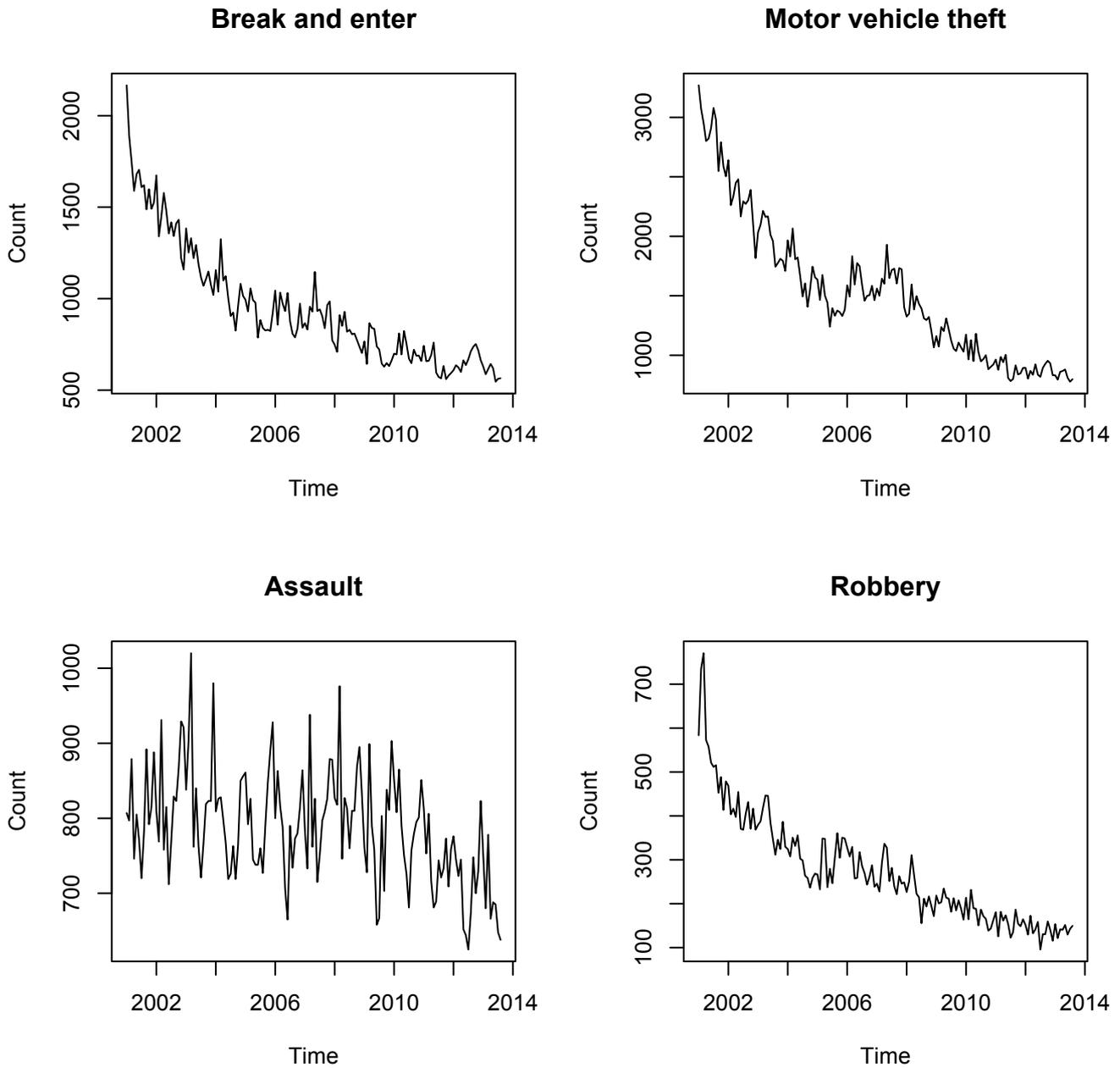


Figure 2. Time series plot of police person search aggregated over the 17 LACs



vehicle theft) and violent crime (assault, robbery) aggregated over the 17 LACs. Apparent downward trends were observed for break and enter, motor vehicle theft and robbery. However, the trend was less obvious in assault, with a downward trend only visible in the second half of the time series.

Figure 3. Time series plots of property (break and enter, motor vehicle theft) and violent (assault, robbery) crimes aggregated over the 17 LACs



**PANEL UNIT ROOT AND COINTEGRATION TEST RESULTS**

Panel unit root test was significant for each independent variable (move-ons and person searches) and dependent variable (violent and property crime)<sup>5</sup>. The results of the Pedroni’s panel cointegration test for each pair of the dependent and independent variables are reported in Appendix Table A1. For both cases, with deterministic trend and without trend, all tests except for some panel  $\nu$ -statistic, rejected the null hypothesis of no cointegration at

the five per cent significance level. Thus, the overall results of the within-group tests and the between-group tests suggest that each pair of police activity and crime were cointegrated. The result of the Westerlund (2007) panel cointegration test is presented in Appendix Table A2. The null hypothesis of no cointegration between police activity and crime was rejected at the one per cent level of significance in all four tests. This is consistent with the Pedroni (1999) cointegration test results, indicating the presence of strong cointegration relationship between police move-on directions, person searches and property and violent crimes.

**Table 1. Panel cointegration estimation results from the PMG estimators: Break and enter and motor vehicle theft**

Dependent variable	Break and enter		Motor vehicle theft	
	Move-on (ARDL(1,1))	Person search (ARDL(1,1))	Move-on (ARDL(2,1))	Person search (ARDL(1,1))
Error correction coefficient	-0.324*** (0.034)	-0.412*** (0.029)	-0.183*** (0.026)	-0.311*** (0.030)
Long-run coefficient	-0.268*** (0.026)	-0.243*** (0.013)	-0.222*** (0.034)	-0.248*** (0.013)
$\Delta Y_{t-1}$	-	-	-0.249*** (0.027)	-
$\Delta X_{t-1}$	0.050*** (0.015)	0.028 (0.016)	0.023 (0.017)	0.040*** (0.014)
Hausman test <i>p</i> -value	0.317	0.596	0.690	0.198

Note. Standard errors are given in parentheses,  $p < 0.001$ \*\*\*,  $p < 0.01$ \*\* ,  $p < 0.05$ \*.

**Table 2. Panel cointegration estimation results from the PMG estimators: Assault and robbery**

Dependent variable	Assault		Robbery	
	Move-on (ARDL(1,1))	Person search (ARDL(1,1))	Move-on (ARDL(2,1))	Person search (ARDL(1,1))
Error correction coefficient	-0.782*** (0.035)	-0.793*** (0.033)	-0.351*** (0.039)	-0.617*** (0.040)
Long-run coefficient	-0.012 (0.007)	-0.029*** (0.004)	-0.334*** (0.038)	-0.337*** (0.013)
$\Delta Y_{t-1}$	-	-	-0.281*** (0.032)	-
$\Delta X_{t-1}$	0.022 (0.012)	0.018 (0.014)	0.126*** (0.027)	0.158*** (0.026)
Hausman test <i>p</i> -value	0.285	0.163	0.353	0.676

Note. Standard errors are given in parentheses,  $p < 0.001$ \*\*\*,  $p < 0.01$ \*\* ,  $p < 0.05$ \*.

**PANEL COINTEGRATION ESTIMATIONS: PMG RESULTS**

Table 1 presents the results of PMG estimation of the long-run and short-run coefficients of break and enter and motor vehicle theft. The Hausman test revealed that the restriction of homogeneity in the long-run coefficients could not be rejected in any of our analyses so we focus our attention on the PMG results. In fact, very similar results were obtained using the MG estimation method although they are not shown here.

In Table 1, the error correction coefficient ( $\phi_i$ ) shows the speed with which the process linking move-on directions or person searches to an offence returns to equilibrium and the long-run coefficient ( $\theta_i$ ) shows the long-run elasticity between changes in police activity and changes in crime. The row labelled  $\Delta X_{t-1}$  shows the short-term coefficients and  $\Delta Y_{t-1}$  shows the autoregressive component, that is, the dependence of successive values of the dependent variable on earlier values. Finally, the Hausman test determines whether to adopt the PMG or the MG estimator.

The first point to note about Table 1 is that the long-run coefficients for both forms of police activity are negative and significant for both break and enter and motor vehicle theft. This indicates the existence of a converging long-run relationship

between police activity and property crime. The model estimates indicate that, in the long-run, a 10 per cent increase in move-on directions results in a 2.68 per cent drop in break and enter offence. A 10 per cent increase in person searches, on the other hand, reduces break and enter over the long-term by 2.43 per cent. The estimates for motor vehicle theft are not dissimilar; with a 10 per cent increase in move-on directions yielding a 2.22 per cent reduction in motor vehicle theft and a 10 per cent increase in person searches yielding a 2.48 per cent reduction in motor vehicle theft.

The estimated long-run adjustment speed in correcting the deviation from the long-run relationship between police move-on and break and enter in the previous month is -0.324. Thus, in the short-run, a cointegrated system of police move-on and break and enter corrects itself at a speed of about 32 per cent in each month. In other words, it would take roughly 3 months for the system to return to equilibrium if it deviates. The estimated error correction coefficient for the relationship between person searches and break and enter is larger in absolute value (-0.412) than the corresponding estimate for move-on directions, indicating a faster speed of adjustment towards equilibrium. A similar pattern is observed for motor vehicle theft, with faster restoration to equilibrium for person searches than move-ons. Comparing the

estimated error correction coefficient between break and enter and motor vehicle theft, we also find higher speed of adjustment to equilibrium for break and enter than motor vehicle theft.

Table 2 provides the same statistical analysis results for assault and robbery. The results for robbery resemble those for break and enter and motor vehicle theft. The long-run coefficients for move-on directions and person searches are both negative and significant. The model estimates suggest that a 10 per cent increase in move-on directions and person searches will, over the long-term, result in a sizeable effect of a 3.34 per cent and 3.37 per cent drop in robbery, respectively. The speed of adjustment to equilibrium for robbery is like that for burglary. The error correction coefficient of 0.351 indicates that the process returns to equilibrium at the rate of about 35 per cent per month. The situation is quite different for assaults. Neither police move-on directions nor person searches have much effect on this offence. The coefficient measuring the effect of move-on directions is negative but insignificant. The coefficient measuring the long-term impact of searches is estimated to be -0.029 and it suggests that a 10 per cent increase in person searches reduces assaults by merely 0.29 per cent. Though this coefficient is statistically significant, its long-term effect on the reduction of assaults is minimal.

For short-run effects, the estimated short-run coefficient for move-on is significant and positive for break and enter and robbery, while the estimated short-run coefficient for person search is significant and positive for motor vehicle theft and robbery. This finding is somewhat puzzling because the coefficient suggests that police activity in these cases generates a short-term increase in crime. One possibility is police activity could be impacting crime through arrests. Short-term increases in crime could be due to police uncovering additional crimes through more contact with individuals on the street. However, the proportion of move-ons and searches that result in an arrest through a direction refusal or an item found is extremely small in NSW (approximately 1.3 per cent for move-ons and 9.0 per cent for searches in 2017 (BOCSAR unpublished data, request no. 17397)). For this reason we are not inclined to put too much emphasis on these effects, which are transient and possibly due to factors outside the model that influence both police activity and crime (Pesaran & Shin, 1999).

## DISCUSSION

The aim of the current study is to examine the long-run relationship between police move-on directions and person searches and four common categories of crime. These four categories were break and enter, motor vehicle theft, assault and robbery. Various techniques were used to estimate the relationships of interest and all indicated that increases in police activity, whether in the form of move-on directions or person

searches, helped suppress break and enter, motor vehicle theft and robbery. It is important to emphasise that these are long-term effects. The present study found no evidence that increases in move-on directions and person searches have an immediate suppression effect on burglary, motor vehicle theft and robbery. Rather, what seems to matter is the overall level of police activity, with sustained high levels of move-on directions and person searches producing lower levels of these offences.

We found no statistical evidence to support that move-on direction had any impact on assault, whether in the long or the short-term. One can only speculate on the reason for this, but deterrence theory would suggest that the threat of apprehension works best when dealing with offenders who make some conscious effort to gauge the risks and benefits of involvement in crime. Break and enter, motor vehicle theft and robbery are all planned and deliberate crimes, whereas assault is often committed by people who are intoxicated and acting on impulse and who may, for these very reasons, be less sensitive to the prevailing level of police activity, if not completely indifferent to it. Exposure to police contact is also an important consideration. It may be that those who commit assault spend far less time on the street (where contact with police is more likely) compared with those who loiter in public places with the intention of engaging in predatory crime such as burglary, motor vehicle theft or robbery.

It is interesting to note that the estimated effects of routine police activities in our analyses are similar in magnitude to those obtained from other studies of the effect of increasing police numbers. For example, Marvell and Moody (1996) estimated a three per cent reduction in total crime with each 10 per cent increase in police numbers and Levitt (1997) also estimated an effect of similar magnitude, both in the US. The similarity in effects raises the question of whether the two processes (police activity and police numbers) are operating through the same channel and, if so, what that channel may be. One possibility is that increases in police activity and police numbers raise the perceived risk of apprehension and act as a general deterrent. Another possibility is that police numbers and police activity achieve their effects by increasing the rate of arrest and incapacitation. Current research does not allow us to resolve this issue; however it would be worth pursuing the approach adopted by MacDonald, Fagan and Geller (2016) and examine whether person searches and move-on directions that result in an arrest have more effect than searches and move-on directions that result in no legal proceeding.

All research is subject to caveats and the research reported here is no exception. Although the methods employed in the current study are the best available for resolving questions of cause and effect in the current setting, they assume there are no other forms of police activity that rise and fall in synchrony with changes in move-on directions and person searches. We are not aware of any forms of police activity that meet this condition, but if some

other form of policing activity is perfectly correlated with move-on directions and police searches, our results may overstate or even misstate the effects of move-on directions and person searches. Furthermore, it is possible that there exists an 'optimal' volume of move-on directions and person searches beyond which police activity becomes less effective in reducing crime. Finding this ideal volume is beyond the scope of this paper.

One final comment is in order. The finding that these forms of police activity have a positive effect on crime should not be read as obviating the need for discussion on whether and in what circumstances it is appropriate to move people on or search them. Many of those asked to move on or who are searched will be found to have committed no crime at all. Move-on directions and person searches are intrusions on civil liberty whose value as crime control tools must be weighed against their costs (Weisburd, Telep & Lawton, 2014).

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## NOTES

1. By marginal effectiveness we mean the additional crime reduction obtained for a given percentage increase in the level of police activity, whatever form that activity may take.
2. Police searches in this bulletin includes both person searches and vehicle searches under the Law Enforcement (Powers and Responsibilities) Act 2002. The majority of these searches are person searches (approximately 82%). Searches conducted in relation to a Firearms Prohibition Order are not included these incident counts.
3. The category 'motor vehicle theft' includes both theft of and theft from motor vehicles.
4. A number of panel unit root tests have been proposed in the literature with two generations of tests developed. The first generation tests include Levin, Lin and Chu test (2002); Im, Pesaran and Shin test (2003) and Fisher-type tests proposed first by Maddala and Wu (1999). The main limitation to the first generation test is the assumption of cross-sectional independence across units. As a result, second generation tests have emerged and address the question of cross-sectional dependence. A well-known second generation test considered in this study is proposed by Pesaran (2003) based on cross-sectional Augmented Dicky-Fuller regression. The null hypothesis assumes that all series are non-stationary.
5. Individual ADF tests showed a small proportion of the cross-section units did not contain unit roots, hence we had a mixed panel. However, since a "weighted sum of an  $I(1)$  process and  $I(0)$  process remains non-stationary" (Ng, 2008), we proceeded by taking the first order difference of all variables.

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APPENDIX

PANEL COINTEGRATION TEST

Pedroni (1999) proposed panel cointegration tests which allow for heterogeneity across individual members of the panel. In the general form, consider the following type of regression:

$$Y_{it} = \alpha_i + \delta_{it} + \beta_i X_{it} + \epsilon_{it}$$

for  $i = 1, \dots, N; t = 1, \dots, T$  where  $N$  refers to the number of panel cross sectional units; and  $T$  refers to the number of periods over which we observe each cross sectional unit. The parameters  $\alpha_i$  and  $\delta_i$  allow for the possibility of LAC specific fixed effects and deterministic trends, respectively. The cointegration tests involve computing residuals from the above equation and then test the presence of a unit root. The residual equation is given by

$$\epsilon_{it} = \rho_i \epsilon_{it-1} + v_t$$

Pedroni (1999) proposed seven different statistics to test panel data cointegration. The first four test statistics are based on the 'within-dimension' approach, which pools the autoregressive coefficients across members of the panel. These four statistics include: 1) panel  $v$ -statistic, 2) panel  $p$ -statistic, 3) panel PP-statistic and 4) panel ADF statistic. In addition, Pedroni (1999) also developed tests based on the 'between-dimension' approach, which averages the individually estimated coefficient for each member. This approach includes three test statistics, namely 1) group  $p$ -statistics, 2) group PP-statistic and 3) group ADF statistic. The distributions of the four 'within-dimension' statistics and the three 'between-dimension' statistics are all asymptotically standard normal. The Schwarz Information Criterion was used to select optimal lag length for the panel unit root test.

Table A1. Pedroni (1999) panel cointegration test results

		Panel $v$	Panel $p$	Panel PP	Panel ADF	Group $p$	Group PP	Group ADF
Move-on & break and enter	Without trend	1.170	-37.450*	-18.408*	-13.714*	-37.063*	-21.177*	-15.140*
	With trend	0.369	-53.949*	-28.834*	-26.670*	-45.283*	-29.575*	-26.847*
Person search & break and enter	Without trend	2.952*	-52.680*	-23.273*	-20.110*	-47.897*	-26.054*	-22.149*
	With trend	0.312	-55.143*	-29.351*	-27.073*	-46.516*	-30.144*	-27.129*
Move-on & motor vehicle theft	Without trend	1.626	-23.783*	-13.401*	-8.887*	-26.283*	-16.299*	-10.237*
	With trend	3.215*	-44.054*	-24.696*	-20.790*	-39.932*	-26.459*	-21.641*
Person search & motor vehicle theft	Without trend	4.191*	-35.532*	-17.526*	-13.468*	-36.403*	-21.200*	-16.536*
	With trend	3.927*	-45.494*	-25.169*	-21.103*	-41.610*	-27.125*	-22.069*
Move-on & assaults	Without trend	6.509*	-103.396*	-36.777*	-27.954*	-98.220*	-43.925*	-31.395*
	With trend	2.778*	-94.131*	-46.447*	-45.330*	-82.304*	-49.279*	-46.710*
Person search & assaults	Without trend	8.250*	-106.164*	-39.060*	-34.383*	-99.247*	-45.713*	-38.100*
	With trend	3.248*	-92.660*	-45.742	-44.222*	-81.267*	-48.583*	-44.472*
Move-on & robbery	Without trend	5.077*	-80.874*	-29.469*	-14.826*	-71.816*	-32.834*	-15.948*
	With trend	5.146*	-85.909*	-44.079*	-43.640*	-72.164*	-44.930*	-44.386*
Person search & robbery	Without trend	4.980*	-91.771*	-33.374*	-25.213*	-81.081*	-37.371*	-27.244*
	With trend	2.677*	-85.473*	-44.008*	-43.175*	-71.820*	-44.846*	-43.242*

Note. \* indicates statistical significance at 5%.

*Table A2. Results of Westerlund (2007) panel cointegration test*

	Gt	Ga	Pt	Pa
Move-on & break and enter	-5.102*	-45.014*	-23.817*	-48.941*
Person search & break and enter	-5.376*	-47.751*	-23.709*	-49.067*
Move-on & motor vehicle theft	-4.953*	-40.548*	-21.126*	-40.227*
Person search & motor vehicle theft	-4.891*	-40.550*	-21.276*	-40.201*
Move-on & assaults	-6.341*	-68.912*	-31.396*	-76.237*
Person search & assaults	-6.238*	-66.912*	-31.027*	-74.752*
Move-on & robbery	-6.479*	-68.360*	-30.930*	-74.664*
Person search & robbery	-6.387*	-69.753*	-24.385*	-69.664*

Note. \* indicates statistical significance at 5%.

