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The Relationship Between Crime and Electronic Gaming Expenditure: Evidence from Victoria, Australia

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Abstract Gambling in Australia is a significant economic activity. Expenditure on its many forms is sizeable and has undergone sustained periods of expansion. At the same time, the structure of the gambling industry has undergone substantial change, with the use of gaming facilities in local hotels and licensed clubs now representing one of the most predominant forms of gambling. Despite this, and the extensive international literature on the relationships between gambling and crime, there have been relatively few studies which examine the local area effects of gaming establishments on crime in Australia. This study uses a unique set of data from the Australian state of Victoria, a region in which local area expansion of gaming networks has been considerable since 1991, to investigate the relationship between gaming machine expenditure and various types of crime in 1996, 2001 and 2006. One particular focus is that of income-generating crime, defined here as theft, fraud, breaking and entering, forgery, false pretences, larceny and robbery. After controlling for a host of statistical issues, our results indicate a consistent positive and significant relationship between gaming and crime rates, especially income-generating crime rates, at the local level.

Keywords Crime · Electronic gaming machines · Income-generating crime

Introduction

Gambling is a significant economic activity in Australia. In 2006–2007, Australians spent a total of $A18.2 billion on all legal forms of gambling, of which 55% was spent in hotels and clubs on gaming machines (Productivity Commission 2009). The average expenditure per adult has increased from roughly $A300 (in 2006–2007 prices) in 1972–1973 to $A1,131 in 2006–2007 (Productivity Commission 1999, 2009). While international comparisons are difficult to make due to differences in the collection and collation of statistics,

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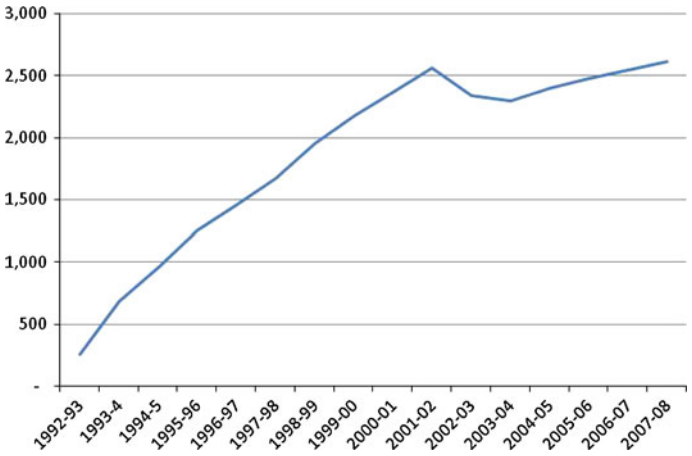

Fig. 1 Net Gaming Expenditure in Victoria ($Am). *Source*: Data provided by Department of Justice in Victoria

it nevertheless appears that, on the basis of the information that is available, Australians are among the biggest gamblers in the Western world. Within Australia, the state of Victoria has one of the largest gambling expenditures (Productivity Commission 2009).[1]

In 1991, legislation in Victoria was passed allowing for the installation of gaming machines in hotels and clubs across the state. The rise in the number of electronic gaming machines (EGMs) in Victoria has been rapid, increasing to 29,779 in 2009 (Productivity Commission 2009).[2] Hence, 94% of EGMs are spread through the community, in hotels, sporting clubs, taverns and bars (ABS 2006) rather than concentrated in casinos. As a share of household disposable income, gambling expenditure in Victoria has increased from 1.26% in early 1982–1983 to 3.58% in 2002–2003, driven largely by EGMs (SACES 2005). Per capita expenditure over the last decade has similarly increased, with a slight tempering of expenditure following the introduction of smoking bans in clubs and hotels in 2002–2003.[3] Figure 1 illustrates the trend in annual net gaming expenditure (total losses minus total winnings) since EGMs were introduced in Victoria.

Relative to other forms of gambling, EGMs are associated with more intensive gambling (that is, more frequent and longer spells of gambling), are often more accessible and provide a greater opportunity for independent participation. In general, the majority of those who gamble can afford to do so and generally obtain satisfaction and enjoyment from the experience (Productivity Commission 1999; SACES 2005). There are a myriad of positive benefits that can arise from gaming activity, in terms of job creation in pubs and clubs, income growth, tax provision, community club support and economic growth.

However, serious concerns have been raised about the negative impacts of gaming activities in Australia (Borrell 2008). One area of debate is the relationship between gaming machine prevalence, expenditure and crime. In particular, the potential local area effects generated by this form of gambling are of concern.

[1] Only NSW and the Northern Territory have higher per capita spending on gambling.

[2] Of these, 27,461 (91%) were located in hotels and clubs in 2009.

[3] Data from the Victorian Department of Justice show that per capita spending on EGMs increased from $615 in 2000 to $649 in 2009. (http://www.vcgr.vic.gov.au/CA256F800017E8D4/Statistics/FD7EA8DF7FD68F8ECA257067001AB256?Open. Last Accessed 26/11/09).

This study investigates whether there is a relationship between expenditure on EGMs and increases in reported crime (particularly income-generating crime which is defined in this study as including theft, fraud, breaking and entering, forgery, false pretences, larceny and robbery) across the state in Victoria. We find that increases in gaming expenditure in local areas in Victoria do drive increases in crime, particularly income-generating crime. These results are of significance, especially given that the relationships may well be underestimated. In particular, many crimes perpetrated by problem gamblers[4] are done so against family or friends (Productivity Commission 1999). Hence, some under-reporting of such crime is likely.

The remainder of the paper is structured as follows. Section 2 discusses the existing literature on gaming and crime. Section 3 presents our analytical methodology. Sections 4 and 5 summarize and discuss our results, followed by concluding remarks including directions for future research.

Literature Review

Gambling and Crime

The increased opportunities to gamble in Australia have resulted in concerns about the advent of 'problem gambling' and its adverse social consequences. Problem gamblers are defined as those who experience severe or moderate problems because of their gambling addiction. Although problem gamblers make up only a very small percentage of gamblers overall in Australia [the latest estimate for Victoria suggests 0.7% of Victorian adults are problem gamblers (Hare 2009)], their expenditures on gambling constitute *at least* one-third and perhaps as high as 40% of all gambling money spent (Productivity Commission 1999; SACES 2005). Problem gamblers are more likely to play EGMs (Hare 2009), with problem gambling highest in jurisdictions with more EGMs. It has been estimated that aggregate problem gambling is greatest in NSW and Victoria and lowest in Western Australia and Tasmania where there are fewer EGMs (Productivity Commission 1999).

There is much evidence and research to suggest that excessive gambling, especially on gaming machines, has led to important social problems. This includes personal financial pressures, emotional distress, domestic violence, employment difficulties, suicide and crime (Blaszczynski and Farrell 1998; Productivity Commission 1999; Committee on the Social and Economic Impact of Pathological Gambling, National Research Council 1999; Blaszczynski and Maccallum 2003; Borrell 2008).

The exact relationship between gambling and criminal activity is potentially complex and there is no firm consensus in the literature. On the one hand, the existence of gambling activities generates economic activity which may have a negative effect on crime. For example, where gambling activities reduce unemployment rates, we may see a drop in crime. However, there is substitution between money spent on gambling and expenditure on other goods and services. Hence, overall employment effects and other potentially

[4] A report for Gambling Research Australia in 2005 set out a national definition of problem gambling as that which "is characterised by difficulties in limiting money and/or time spent on gambling which leads to adverse consequences for the gambler, others, or for the community" (SACES 2005; i). Severe problem gambling can be 'pathological gambling', which is 'a disorder characterized by a continuous or periodic loss of control over gambling, a preoccupation with gambling and with obtaining money with which to gamble, irrational thinking, and a continuation of the behavior despite adverse consequences' (Committee on the Social and Economic Impact of Pathological Gambling, National Research Council 1999; 18).

beneficial effects of gambling activities are unclear. Indeed, it has been argued that local area expenditure shifts, together with the attraction and development of problem gamblers, may increase crime rates (Miller and Schwartz 1998). Moreover, even where a positive statistical relationship is demonstrated, there is a question of causation. It may be that gambling causes crime, but the issue of causation is potentially vexing, and a knowledge of the underlying psychopathology is required to reveal whether individuals who commit crimes have a propensity for gambling, or whether gambling generates criminal activity.

A number of previous studies have attempted to quantify the link between gambling and crime, using a variety of methodologies. Most have focused on self-reported survey data on crime. Sample frames in these studies have included the general population, prisoners, and problem gamblers seeking treatment (Productivity Commission 1999). Others have focused directly on police and court statistics (Smith et al. 2003, Centre for Criminology and Criminal Justice 2000). In general, these studies (e.g. Sakurai and Smith 2003; Doley 2000; Centre for Criminology and Criminal Justice 2000) have been unable to establish robust statistical links between gambling and crime, but they have concluded that there is anecdotal evidence to suggest a positive link between the two.

Many studies focus on individuals' characteristics and their self-reported (or actual) illegal behaviour as a result of gambling activity. These individual characteristics provide clues about people's lifestyles and hence offer insights into the levels of victimisation that may occur (Tseloni et al. 2002). Research on individual influences on crime in general is usually based on data on households or individuals (Trumbull 1989; Entorf and Spengler 2000; Tseloni et al. 2002; Fergusson et al. 2003; Bennett and Holloway 2005; Goudriaan et al. 2006). Studies have involved researchers surveying problem gamblers (Blaszczynski et al. 1989; Blaszczynski and McConaghy 1994; Jackson et al. 1997; Bellringer et al. 2009; Hare 2009); examining criminal prosecution files (Australian Institute of Criminology and PricewaterhouseCoopers 2003); surveying prison inmates or known offenders (Blaszczynski 1994; Yeoman and Griffiths 1996; Abbott et al. 2005; Abbott and McKenna 2005); studying people who use gambling counselling services (Blaszczynski and McConaghy 1994; Jackson et al. 1997; Productivity Commission 1999), or sampling the general population (Productivity Commission 1999). One key finding from all these studies is that a large percentage of problem gamblers admit to having committed a gambling-related illegal offense (most commonly theft, fraud, robbery and assault, and breach of apprehended violence orders). For example, 15.2% of problem gamblers in Victoria in 2008 admitted that their gambling had led them to do something against the law (Hare 2009).

A number of Victorian studies have found evidence of problem gamblers committing illegal acts to fund their gambling habits (i.e. New Focus Research Pty Ltd 2005; Warfield 2008; Hare 2009). Hence, although the causation between gambling and crime may be unknown overall, there is evidence to suggest that excessive problem gambling does lead to increased crime, that is, a one way causality link exists.

Community Area/Ecological Theory Model Studies

This paper examines whether the availability of EGMs in an area has an impact on its crime rate. This is of increasing importance given that gaming machines are becoming more available throughout Australian states. Evidence suggests that the majority of Australian gamblers travel distances of less than five kilometers to gamble on EGMs in hotels and sporting clubs, while most travel distances of less than 2.5 kilometers (KPMG 2000; Marshall and Baker 2001a, b; The Centre for Gambling Research 2004; SACES 2005; Eltridge and Del Fabbro 2006). In Victoria, it is suggested that given the proliferation and

accessibility of EGMs, most players are local (Livingstone 2005; Marshall and Baker 2001a, b).

Increasingly studies are using a community/ecological theory model of crime research, where explanations of crime levels are sought in community attributes such as its socio-economic status, demographics, degree of urbanisation, social settings and other physical aspects of location (Sampson and Groves 1989; Lynch and Cantor 1992; Cornwell and Trumbull 1994; Fajnzylber et al. 1998; Tseloni et al. 2002; Wheeler et al. 2008; SACES 2008). Underpinning this approach is the notion that the determinants of crime lie not only in individual motivation, but in aspects which can broadly change the opportunities for committing criminal acts. Criminological research has found that crime is not randomly distributed but is concentrated in specific locations (Briscoe and Donnelly 2003; Yang 2010), and hence must be influenced by certain physical and social characteristics of that location.[5] From this view, it is important to consider the potential influence of the characteristics of the neighborhood. Differing areas may carry different risk or protective effects.

Community model gaming studies have mainly been conducted in North America and have focused on the influence of large casinos on crime rates (Friedman et al. 1989; Margolis 1997; Albanese 1999; GAO 2000; Gazel et al. 2001; Stitt et al. 2003; Phipps 2004; Grinols and Mustard 2006). Margolis (1997) reviewed four major North American community gambling studies that studied the link between crime and casinos. He concluded that once the additional increase in population from tourists was taken into account, cities with casinos were just as safe as cities without casinos (although there was a slight increase in traffic violations and petty crime). Stitt et al. (2003) compared crime levels in six American casino communities with matched control communities and concluded that crime was not an inevitable or necessary consequence of casinos. In some casino communities, crime decreased (in particular, homicide), while in others it increased (the most common increases in crime categories were prostitution, liquor violations and larceny). Possible reasons for a failure to find a significant relationship between gambling and crime in these studies include a paucity of relevant data and an inability to generate an all-encompassing model. For example, the impact of a casino on crimes may be time and path dependent and hence any analysis of the relationship between crime and gambling may require a sufficiently long time-series in order to uncover any possible links. Even in such circumstances, the number of observations for a study may be limited, leading to a lack of statistical significance or omitted variable bias.[6]

Other studies have concluded that crime rates are positively and significantly linked with the presence of a casino in an area. Grinols et al. (1999) compared United States counties that had casinos with those that did not have them and found that, on average, the former had an 8% higher crime rate. Crime increased after a three to four year lag. Gazel et al. (2001) and Friedman et al. (1989) found that the opening of casinos in the US led to significant increases in crime, and Bridges and Williamson (2004) found positive

[5] This is a complex area of research. For example, Lynch and Cantor (1992) show that the determinants of household larceny and burglary differ. For the former, exposure seems to be important (i.e. it is a crime of opportunity), while for the latter other factors such as guardianship of the property at night may be more important determinants. This study captures some of the elements of this line of enquiry by including differing forms of crime and by considering how gaming machine availability may interact with local crime rates. Notwithstanding, data constraints do exist with regard to many variables that would serve as proxies for the opportunity to commit criminal acts.

[6] Such problems are discussed in Grinols and Mustard (2006). Moreover, these authors draw attention to incidences where funding for the research was derived from vested interests.

associations between a wide range of legalized gambling opportunities and crime rates in Canada. While Phipps (2004) found little evidence to support the argument that the opening of casinos in Canada had an influence on crime rates, he believed that further research was needed before any policy conclusions could be drawn.

One of the most influential studies in this area has been Grinols and Mustard's (2006) analysis of the relationship between casinos and crime in the US from 1977 to 1996. They found that the impact of gambling on crime rates is low shortly after a casino opens, but grows considerably over time due to problem gambling, with around 8% of crime in casino counties in 1996 attributable to casinos. In particular, they studied aggravated assault, rape, robbery, murder, larceny, burglary and auto theft. Overall, they found more influence of casinos on violent crime than property crime, which is not the hypothesis of this paper. However, this influence on violent crime was mainly driven by the individual category of robbery (which was classified as a violent crime but in our database is classified as an income-generating crime). This result is discussed further later in the paper.

In Australia, Wheeler et al. (2008) studied the relationship between EGM expenditures and income- and non-income-generating crime rates in local areas in South Australia in 2002–2003. They found that the higher the expenditure on gaming machines in a particular local area per adult, the higher the income-generating crime rate in that area. No statistically significant links were found between gaming machine expenditure and non-income-generating crime rates. SACES (2008) examined the social and economic impacts of gaming in Tasmania using a cross-sectional panel data analysis for 2001 and 2006. The relationship between gaming expenditure and person, property and fraud offenses (broken down into income-generating and non-income-generating classifications) was examined. The most significant link was detected between income-generating crime and gaming expenditure, but the study also found significantly positive links between gaming expenditure and non-income-generating crime rates.

Other Influences on Crime

There is a vast literature examining the various influences on crime, with a multitude of factors having been identified. Disorder[7] and crime have been linked by researchers, and Yang (2010) found evidence in the US that a lack of disorder problems guarantees places to be violence free, while areas with high levels of disorder predicted violence problems about 30% of the time. Income of an area has been found to be related to crime, with higher and lower family income each associated with higher person and property crime (Ehrlich 1973; Fajnzylber et al. 1998; Masih and Masih 1996; Tseloni et al. 2002; Wheeler et al. 2008). Hence, areas with middle range incomes have been found to have proportionately less crime. Some age profiles of an area are also related to crime, with areas that have higher proportions of teenagers having higher levels of all types of crime (Raphael and Winter-Ebmer 2001; Tseloni et al. 2002). Some studies have found positive links between the proportion of ethnic groups and crime (Smith and Wynne 2000; Parker 2001; Fergusson et al. 2003; Wheeler et al. 2008). Alcohol consumption and the number of licensed premises have been positively linked with criminal behaviour, particularly violent

[7] There are two types of disorder, social and physical. Yang (2010) defined social disorder as including the following: disorderly conduct, noise, alcohol and public drinking, gambling, drug-related offenses (not including large scale drug trafficking), and prostitution. Physical disorder was defined as: illegal dumping, litter, graffiti, weeds, vacant buildings, inoperable cars on the street, junk storage, weeds, zoning violations, exterior abatement, substandard housing and minor property damage.

crime (Raphael and Winter-Ebmer 2001; Briscoe and Donnelly 2003; Carpenter 2007; Wheeler et al. 2008). Similarly, drug consumption has also been positively linked with crime (Fajnzylber et al. 1998; Bennett and Holloway 2005). On the whole, males tend to be more violent than females (Fajnzylber et al. 1998). One of the most-debated influences on crime has been unemployment, with mixed evidence for and against its impact, but its most positive influence has been found to be on property crime (Masih and Masih 1996; Bodman and Maultby 1997; Raphael and Winter-Ebmer 2001; Narayan and Smyth 2004; Lee and Holoviak 2006).

The influence of police in an area is said to have a negative effect on crime (because of deterrence effects), (Ehrlich 1973; Withers 1984; Bodman and Maultby 1997; Fajnzylber et al. 1998; Klick and Tabarrok 2005). Conversely, it can be equally hypothesized that having more police in an area may result in the increased detection of certain types of crime (Wheeler et al. 2008). Endogeneity of this variable (as crime goes up, then more police officers are employed and vice versa) was not found by Narayan and Smyth (2006), though it was found by Marvell and Moody (1996). Very few studies have found any link between the education of a population and criminal activities, although it has been suggested that it can have a 'civilizing' effect by reducing the incidence of criminal activity, but can also raise the opportunities for crime as the population may be wealthier. In terms of where people live (urban or rural), Masih and Masih (1996) found that urbanisation had the second-greatest impact on Australian crime rates (from 1963 to 1990). Finally, the journey-to-crime literature suggests that demographic and urban characteristics influence the choice of where to commit crime (Warren et al. 1998).

Methodology

The hypothesis of this study is that greater levels of expenditure on EGMs in local areas in Victoria lead to an increase in crime in that area. This is based on evidence suggesting that problem gamblers tend to gamble in areas close to their home or workplace and that criminal behaviour as a result of problem gambling is more likely to be opportunistic than planned. As the crimes linked to problem gambling tend to be income-generating (to fund the gambling habit), it is expected that the crimes most influenced by gambling will be those of theft, fraud, breaking and entering, forgery, false pretences, larceny and robbery. These are referred to in this paper as income-generating crimes. All other crimes not associated with income generation are referred to as non-income-generating, and it is hypothesized that the relationship between gambling expenditure and these crimes should be significantly weaker and less significant. However, Warfield (2008) reported that at least five murders had occurred because of gambling debts and in New Zealand Bellringer et al. (2009) found that violence, child neglect and crimes against the person because of problem gambling were becoming more prevalent. Hence, it is still expected that there may be some positive associations found between gaming and non-income-generating offenses. We also seek to test the endogeneity of the relationship between gaming expenditure and crime (i.e. the causation question).

Analytical Methodology

The model employed to test the relationship between gaming expenditure and crime rates is specified as follows:

$$\begin{aligned}\text{Crime}_t =& \beta_0 + \beta_1 \text{socioeconomic and demographic characteristics of area}_t \\ &+ \beta_2 \text{alcohol licenses}_t + \beta_3 \text{regional characteristics}_t \\ &+ \beta_4 \text{gaming expenditure}_t + \beta_5 \text{drug offenses}_t + \varepsilon_t\end{aligned} \quad (1)$$

where t is the time period and a variety of crime rates (such as income- and non-income-generating crime rates, broken down into person, property and other) are employed as the dependent variables (offense data by statistical local area were provided by Victoria Police from 1993–1994 to 2006–2007). Where a vector of explanatory variables was used for a category, each β represents a vector of regression coefficients capturing the marginal effect of each vector on crime (by category of offense type). ε represents the error term.

Socioeconomic characteristics that were tested (all sourced from the Australian Bureau of Statistics (ABS) census data) include total unemployment; youth male unemployment; the percentage of Aboriginal and Torres Strait Islander (ATSI) or indigenous people in the population; the percentage of males in the population; the proportions of the population aged between 15–19, 20–39, 40–54, 55–69 and 70+; the percentage of single parent families; the percentage of students; the percentage of non-English speaking families: the proportion of those who rent their dwelling; and the social disadvantage index. The number of venues with licenses to sell alcohol per adult in the population was provided by the Victorian Department of Justice (this was used as a proxy for alcohol consumption). The third independent variable in Eq. 1 includes dummies for inner, north, south and west regions in Melbourne, and the ABS rural index (taking values from 1 to 3) which provides a measure of the degree of rural settlement in an area. The size of a statistical local area was also included as a regional characteristic.

The fourth independent variable was net gaming revenue per adult (NGR) (provided by the Victorian Commission for Gambling Regulation, 2007). The fifth explanatory variable employed was drug offenses in an area (a proxy for drug use). Table 1 describes the final variables used in our models and how they were measured.

Conventionally, Eq. 1 can be consistently and efficiently estimated by ordinary least squares (OLS). However, there are at least two concerns about using OLS due to the characteristics of our dataset. The first concern is that some of the regressors are potentially endogenous in the equation, such as some of our socioeconomic characteristics, gaming expenditure and drug offenses. This is because crimes, particularly income-generating crimes, as discussed earlier, may have a feedback effect on these variables. Therefore the OLS assumption that the regressors only have a one way effect on crimes may be inappropriate, and two stage least squares (2SLS) estimation may be required.

The other modelling concern is due to the geographical nature of the cross sectional observations, which implies that it is possible for crimes in neighboring areas to have an impact on the number of crimes in the areas in question (social interaction effects). If this is the case, it is called spatial dependence, and if not, it is known as spatial independence. The concept of social interactions arises from the hypothesis that individuals do not make their choices independently, but rather that their decisions arise from their social environment such as their family, friends, neighbors, ethnic and/or religious group, etc. Crime can follow a diffusion process through direct contact between the first criminal and his or her followers (this requires contact between criminals), or a relocation diffusion where criminals move from one point to another, seeking further opportunities for crime (which does not require contact). Glaeser et al. (1996) found that social interactions played a large part in United States crime rates for larceny, theft, car theft; a moderate part for serious crimes (such as robbery, burglary and assault); and a small part for murder and rape.

Table 1 Variable descriptions

	Dependent variables		Independent variables
igcrimep	Income-generating crimes per 1000 adult population	stdgexpp	Standardized net gaming expenditure per capita
perigp	Income-generating person crimes per 1000 adult population	stddrugp	Standardized drug offenses per capita
proigp	Income-generating property crimes per 1000 adult population	stdliqp	Standardized liquor licenses per capita
otherigp	Income-generating other crimes per 1000 adult population	stddisadvant	Standardized ABS disadvantage index
ngcrimep	Non-income-generating crimes per 1000 adult population	stddisandadvant	Standardized ABS disadvantage & advantage index
perngp	Non-income-generating person crimes per 1000 adult population	stdmalep	Standardized number of males per capita
prongp	Non-income-generating property crimes per 1000 adult population	stdteenp	Standardized number of teenagers per capita
otherngp	Non-income-generating other crimes per 1000 adult population	stdage70p	Standardized number of persons aged 70+ per capita
totcrimep	Total crimes per 1000 adult population	inner	Dummy for inner area of Melbourne
		north	Dummy for northern area of Melbourne
		south	Dummy for southern area of Melbourne
		east	Dummy for eastern area of Melbourne
		west	Dummy for western area of Melbourne
		reindex96	Rural index for Victoria from ABS
		stdslasize	Standardized area of SLA in square kilometers

Hence, in this study it is hypothesized that income-generating crime may be more influenced by spatial dependence (or social interactions) than non-income-generating crime, and may need addressing.[8]

If spatial dependence is a factor, then a spatial estimator should be used in place of OLS. This was considered possible in this study given that our data pertains to relatively compact statistical local areas in the community and hence we assessed whether spatial dependence existed, and if so, employed an appropriate estimation procedure (based on Anselin 2006).[9]

[8] If spatial dependence is not accounted for, the regressions can have unstable parameter estimates and yield unreliable significance tests.

[9] According to Anselin (2006) spatial dependence takes two major forms, spatial lag dependence and spatial error dependence. Spatial lag dependence is modelled by including a function of the dependent variable observed at other locations. With a row-standardized spatial weights matrix, this amounts to including the average of the crime rates in particular in neighboring locations (SLAs) as an additional variable in the regression specification. With respect to spatial error dependence, spatial autocorrelation does not enter as an additional variable in the model, but affects the covariance structure of the error term. In order to test whether there is spatial dependence in our dataset and whether a spatial lag or a spatial error model should be considered, diagnostic tests derived from the residuals of an OLS regression were carried out using the robust Lagrange

Data

This study used statistical local areas (SLAs) as its level of area analysis. The ABS collects SLA-level data every five years in its Census, and so, given the availability of crime and gaming data only from the early 1990s onwards, there were three years available to model the relationship between gaming expenditure and crime: 1996; 2001; and 2006. In 2006, there were 210 SLAs in Victoria (ABS 2007), and in 2001 and 1996 there were 200 (ABS 2002). Unfortunately for our analysis, there were significant changes to the boundaries of SLAs in Victoria from the early 1990s, which does not allow for a panel data analysis across years (unless we were prepared to drop a large number of SLAs from the entire analysis, which we were not prepared to do, for the sake of coverage and relevance). Therefore, all years were modelled separately, which also allowed us to compare changes that had occurred every 5 years.[10] Nonetheless, analysis at the SLA level provides us with a highly disaggregated regional data set with which to assess the impact of gaming expenditure and other variables on crime rates. This represents an improvement on some of the previous literature which has been forced to use highly aggregated data.[11]

Victoria Police provided 27 categories of offense data from 1993–1994 to 2006–2007. Appendix 1 details the offense categories, as well as their classification into income- or non-income-generating crime.

Multicollinearity and endogeneity issues were found with several of the explanatory variables. Many of the socio-economic variables were highly correlated with each other (identified through VIFs and correlation analysis) and could not be jointly used in the analysis. Instead, we used the Index of Relative Socio-economic Disadvantage, which includes seventeen measures of disadvantage and which summarizes a wide range of information about the economic and social resources of people and households within an area. A higher index score reflects a relative lack of disadvantage (note a lack of disadvantage does not necessarily show relative advantage). A low score indicates relatively greater disadvantage in general.

Endogeneity problems were found with gaming expenditure and drug offenses in a few models,[12] and accordingly 2SLS had to be used to instrument variables. Available instruments for gaming expenditure were the number of EGMs in an SLA (which is currently not included in our model) or the previous year's gaming expenditure (i.e., using gaming expenditure for 2005 as an instrument for gaming expenditure in 2006) (as suggested in Greene 2009).[13] Possible candidates for drug offenses include other demographic characteristics of an SLA that are not used as separate explanatory variables in the

Footnote 9 continued
multiplier test statistic. The test statistic is reported under both spatial lag and spatial error specifications and the proper alternative is most likely the one with the largest significant value. If neither test statistic is significant, it indicates spatial dependence is not present and spatial modelling is not necessary.

[10] Due to the presence of the Crown Casino, the SLA of Melbourne Southbank Docklands was removed from our databases for 2001 and 2006, and in 1996 Melbourne remainder SLA was excluded. This is because a large proportion of the gamblers in the Crown Casino are either tourists or do not live in the surrounding area, hence their gaming expenditure cannot be related to crime rates in the area.

[11] Lynch and Cantor (1992) note that the use of more disaggregated data to provide analysis at a level something akin to a neighborhood is preferable.

[12] Endogeneity problems were identified with the use of Sargan-Hansen statistics in STATA [under conditional homoskedasticity, this endogeneity test statistic is numerically equal to a Hausman test statistic: see Hayashi (2000; 233–234)].

[13] Weak instruments were identified using the Kleibergen-Paap rk Wald F statistic, with the Stock-Yogo test for critical values.

estimation (and do not cause multicollinearity problems) or the previous year's drug offenses.[14]

It was found that using the previous year's drug offenses was not a weak instrument for current drug offenses, and so we included previous drug offenses in our models. Once the endogeneity of our drug variable was addressed, the endogeneity of gaming expenditure with most forms of crime disappeared. It only remained in a small number of income-generating crime models for 1996. Such a situation is not unusual, as one of the solutions often cited to address endogeneity issues is to include other relevant variables/influences in the model. Where endogeneity of gaming expenditure remained an issue in 1996, we used the previous year's gaming expenditure which was found not to be a weak instrument.

Tests for spatial dependence in our models indicated that it was present in some of them in 2001 and 2006 and thus a spatial lag (or spatial error) was warranted as an additional variable for some crime functions.

Unfortunately, it was not possible to correct for endogeneity issues and spatial dependence issues in the same model simultaneously,[15] and so for some crime models we report the results of both spatial and 2SLS estimators for estimations with both issues (namely three crime models for 2001: income-generating, property income-generating and total crime). The spatial lag versions of these models in 2001 use drug offenses in 2000 as a proxy for current drug offenses to minimize the problem of endogeneity.[16] For all estimations, we standardized (to a mean of 0 and a standard deviation of 1) all independent variables (with the exception of dummy variables). Therefore, the coefficient estimate for one standardized variable can be interpreted as revealing the marginal effect on the dependent variable of a one standard deviation change in the standardized explanatory variable.

Results

Table 2 illustrates the influences on income-generating and non-income-generating crime in Victoria in 2006, 2001 and 1996. Appendix 2 provides the other crime regressions, broken down into person, property and other. The magnitude of the *R* squared coefficients for the models in each year are highly suggestive that the models fit the data well and are likely to offer a sound level of prediction. The most important variable (in terms of adding explanatory power) in all models tends to be drug offenses. Drug offenses are significantly positively related to nearly every type of crime in all years, although the relationship is significantly stronger with income-generating crimes (primarily driven by property

[14] As well as past total drug offenses, we also tested individual past and current offenses such as drug cultivation, manufacturing and trafficking, and drug possession and use, for the best fit for an instrument for total drug offenses. All individual categories of current drug offenses were endogenous with various forms of crime. In some cases, we had to use a lagged version of one individual drug offense (drug cultivation, manufacture, trafficking) as an instrument for current drug offenses.

[15] STATA Version 10 is unable to simultaneously correct for both problems.

[16] Note, the lagged version of drug offenses was used directly as a variable in the regression rather than as an instrument as was the case in the 2SLS models. Although this did solve the endogeneity problem in the spatial models, it introduced a new problem of potential missing variable bias given that the variable representing current drug offenses was not in the regression. In sensitivity testing it was found that when current drug offenses are used instead of lagged drug offenses, the coefficient of current drug offenses is larger than the coefficient of lagged drug offenses in the income-generating crime models (and the coefficient of the gaming variable is smaller—albeit still positive and significant).

Table 2 Income and non-income-generating crimes models in Victoria in 2006, 2001 and 1996 per 1000 adult population

	2006		2001			1996	
	igcrimep 2SLS Coef.	ngcrimep 2SLS Coef.	igcrimep 2SLS Coef.	igcrimep Spatial Lag Coef.	ngcrimep Spatial error Coef.	igcrimep 2SLS Coef.	ngcrimep OLS Coef.
stdgexpp	5.74***	5.49***	11.79*	33.33***	8.34***	40.51***	13.81***
stddrug	59.23***	26.09***	81.04***	–	18.88***	145.11***	37.47***
stddruglagged	–	–	–	44.48***	–	–	–
stdliqp	−0.30**	−0.22**	9.95	26.39***	3.52**	37.79***	4.12
stddisadvant	5.66***	−1.54	3.76*	0.08	−1.67*	4.05**	−0.96
stdmalep	0.32	−2.31**	−7.70	−2.74	−2.41**	−1.44	−4.26***
stdteenp	−3.47**	0.30	−3.01	1.35	0.86	3.53*	1.59*
stdage70p	0.16	−1.82	−4.12	−4.44	−0.401	0.20	−1.44
inner	17.19	−17.81***	69.31***	67.00***	5.72	40.0***	0.93
north	4.15	−3.44	4.20	12.75**	0.35	13.50**	−0.54
south	2.93	1.42	9.23	12.64**	−0.94	16.44***	−1.93
east	6.28	−1.36	10.22	20.12***	−1.48	21.89***	−2.46
west	8.62*	−8.35***	5.56	2.88	−6.42*	9.86	−2.48
reindex96	0.28	5.40**	−6.05	3.742	6.12**	−6.91*	3.83*
stdslasize	−2.26*	−2.07***	−3.72	−7.44***	−2.16**	−4.90**	0.55
Constant	35.54***	19.97***	63.43***	30.54***	16.65***	70.17***	21.09***
Obs	201	201	194	194	194	194	194
F statistic	181	1180	817	471[1]	665[1]	1192	19697
Prob of *F* stat	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R^2	0.94	0.91	0.96	0.96	0.93	0.99	0.97

* Signifies significant at least at the 0.1 level. ** Signifies significant at least at the 0.05 level. *** Signifies significant at least at the 0.01 level

[a] This is the Log likelihood statistic for the spatial regression

income-generating crime) than non-income generating crime. For our models in 2006, if drug offenses were zero (note: a hypothetical situation), income-generating crime would have dropped by 55%, signifying the importance of this variable's influence on crime.

Gaming expenditure per capita is significantly positively associated with nearly every type of crime in all years of the analysis. The strongest relationships (in terms of the size of significant coefficients) were found with total crimes, followed by income-generating crimes (mainly property income-generating crimes), and then non-income-generating crimes (mainly property and other non-income-generating crimes). The standardized coefficient on the gaming expenditure variable in the models for income-generating crime ranges from 40.51 in 1996, to between 11.79 and 33.33 in 2001 (two models were estimated for income-generating crime in this year) and 5.74 in 2006. Thus a one standard deviation increase in per capita EGM expenditure in Victoria in 2006 increased the income-generating offense rate by 5.74 per thousand adult population.

Another way of explaining the influence of EGM expenditure on income-generating crime is to explore the unstandardized coefficients. The unstandardized coefficients on all the gaming variables ranged from 0.02 to 0.08 across the 3 years. For example, for each additional $10,000 net dollars per adult spent on EGMs in Victoria in 2006 (the year with the smallest influence), this increased the income-generating offense rate per 1,000 adult population by 150. Or alternatively, if gaming expenditure were zero in our regression, total income-generating crime would decrease by 21,547. This represents about 10% of total income-generating crime across Victoria.[17] It is important to note that the social and other costs of crime are not quantified here. Hence, while the result may at first appear small, it does translate to a significant number of crimes and potentially a large social cost. Moreover, our results are likely to be under-estimates given the under-reporting issue associated with theft from family and friends which characterizes gambling related crime.

Liquor licenses per capita are significantly positively related to most types of crimes in 1996 and 2001 but the relationship was negative for 2006. The ABS disadvantage index (in which an area becomes less disadvantaged as the index increases) generally was significantly positively associated with income generating crimes, but was negatively associated with non-income generating crimes. Contrary to expectations, the percentage of the population that was male was significantly negatively related to non-income-generating crimes in two of the years. The proportion of teenagers in the population was found to be negatively and significantly related to income-generating crimes in 2006, and positively associated with income and non-income-generating crimes in 1996. The dummy for inner Melbourne is significant and positive for income-generating crimes in 2001 and 1996, but a negative influence on non-income generating crimes in 2006. The dummies for northern, southern and eastern Melbourne have a positive significant influence on some income-generating crimes in 2001 and 1996 (note, the base case is the remainder of Victoria), with less of an impact in 2006.

The dummy for western Melbourne is negatively and significantly associated with a number of non-income-generating crimes in 2001 and 2006.The ABS index of remoteness (the higher the index, the more remote) is positive and generally significant for a range of non-income-generating crimes in all three years, but remoteness appears to have had little impact on income-generating crimes, with the exception of 1996 where it had a negative and significant impact. SLA size is significantly negatively related to income-generating crimes in all three years, and is also significantly negatively related to non-income-generating crime in 2001 and 2006.

Discussion

The results support the findings from previous research about the positive influence of gaming expenditure on crime. Our study has attempted to overcome some of the criticisms

[17] This was calculated for 2006 by taking the unstandardized coefficient of gaming in the income-generating crime regression multiplied by both the gaming mean ($383.86) and then by total adult Victorian population.

surrounding methodology (such as multicollinearity, endogeneity and spatial concerns) and inadequate data (lack of time-series data and observations) which have been levelled at previous research. By studying the relationship in the three years from 1996 to 2006 (beginning 5 years after EGMs were legalized in Victoria in 1991), this study encompasses a sufficiently long time frame and generates a large number of observations. Our results are robust and provide strong evidence of a significant and positive relationship between gaming expenditure and crime. This study used actual expenditure on electronic gaming machines to model directly its influence on crime in local areas, which is an improvement on other studies that have only looked at participation issues. We also used a highly detailed breakdown of crime offenses, 27 categories in all, that allowed us to finely categorize all types of crimes into income-generating and non-income generating subsets, as well as income and non-income-generating crimes by person, property and other. For example, the most comprehensive study so far on the link between casino gaming and crime (Grinols and Mustard 2006) only had access to seven types of crime offenses (aggravated assault, rape, robbery, murder, larceny, burglary, and auto theft). Our results have shown that the influence of explanatory variables differs according to the type of crime in question.

In Australia previously, Wheeler et al. (2008) and SACES (2008) found positive relationships between crime and gaming in South Australia in 2001, and in Tasmania in a panel dataset for 2001 and 2006. However, these studies had various methodological shortcomings and used smaller datasets. The present Victorian study was designed to address some of these, and especially to address endogeneity and spatial issues. It is also more data-intensive than the other two Australian studies, with more areas and years of analysis.

As noted previously, gaming expenditure per capita is significantly and positively associated with all types of crimes in all years. Our results confirm the hypothesis that the strongest relationship (measured in terms of the size of the standardized significant coefficient of the gaming variable) should exist between income-generating crime and gaming expenditure rather than between non-income- generating crime and gaming expenditure (albeit the largest relationship was found with total crimes). This was the case for all years in Victoria, although we have found that the influence of gaming on crime seems to have fallen since 1996.

Net gaming expenditure in Victoria did decrease after 2001 (see Fig. 1) and only climbed gradually back to a slightly higher level in 2006. Our results may be reflecting this decrease in expenditure. Legislation in Victoria was introduced in 2002 that sought to reduce the social costs from EGM gambling via a variety of responsible gambling and harm minimisation strategies. Such a policy change included a smoking ban implemented on 1 September 2002. The smoking ban had a sizeable influence on the amount of gaming dollars spent (Productivity Commission 2009). Diamond (2009) estimated an immediate 18% reduction in expenditure and a decrease in annual expenditure trends over time (the time period studied was monthly expenditure from 1999–2000 to 2006–2007). It is possible that this ban did break the cycle for some problem gamblers. Diamond also found some evidence to suggest that there appeared to be a reduction in the number of problem gamblers who sought counselling following the smoking ban. However, it is unclear whether the ban was solely responsible for the decrease in problem gambler numbers during this timeframe, given that the decrease started before the ban was introduced, and the relatively short time series data used. Our results may indicate that there was a lessening in problem gambling in Victoria from 1996 to 2006, but it seems that this trend began at least from the early 2000s.

In 2001 the average net gaming expenditure per adult in Victoria was $662, while it was $630 in 2006. Later year data will confirm whether income-generating crime has increased or decreased in association with changes in gaming expenditure.

The variables that showed the greatest relative influence on crime in Victoria across all years were drug offenses, which were consistently significantly and positively related to all types of crimes. As would be expected, they were more associated with income-generating crime than non-income generating crime. Wheeler et al. (2008) and SACES (2008) have previously found drug offenses to be a positive significant influence on both South Australian and Tasmanian crime levels. Drug offenses in our models were often found to be endogenous, indicating that the type of person who consumes, traffics, manufactures or grows drugs is also highly likely to be the type of person who commits other non-drug categories of crimes. Such a result is important for criminology studies, especially where drug offenses are often considered with other measures of 'disorder'. For example, Yang (2010) includes drug offenses as part of a social disorder measure. Our results incorporate a wide variety of influences on a wide variety of different crimes and emphasize the need to individually examine the impacts of drug use on crime, separating it out from other nuisance crimes.

The variables with the next largest influence were gaming expenditure, liquor licenses and dummies for some Melbourne regions. Comparing these results with the gaming and crime relationships that have been estimated for Tasmania and South Australia (these comparisons should be treated with some care given the different methodologies and variables used), it does seem that the positive relationship between crime and gaming expenditure in Victoria is stronger. The reason for this is unclear, although the structure of the Victorian gaming market may be one reason (Livingston 2006; Livingstone et al. 2008). In his review of a selection of Australian court files, Warfield (2008) found that Victoria had both the highest number of gambling motivated frauds, as well as the most lost to fraud overall—over $100 million. However, Warfield's study cannot be considered to be representative of problem gaming issues given the methodology used and the focus on gambling overall. For our supposition about the relative differences between states to be confirmed or rejected, additional analysis needs to be undertaken using the same methodology and the same variables in each state, or by running one analysis across all states combined for a national analysis.

Interestingly, with our fully specified models, endogeneity of gaming expenditure only occurred with a small number of income-generating crimes in Victoria in 1996. For these two models, gaming expenditure had to be instrumented (using the previous year's gaming expenditure as an instrument). Therefore, in our models gaming expenditure caused changes in crime rates, and not the reverse. This indicates that the causal relationship runs generally from gaming to crime, though this does not hold for every type of crime across the years. Drug offenses were found to be endogenous in most income-generating crime models across all three years, indicating those who are involved with drug crimes are more likely to be the type of person to commit income-generating crimes anyway. Only a few studies (i.e. Mast et al. 2000) that we know of have allowed or tested for the endogeneity of drug offenses.

Spatial dependence was present in a number of the income-generating and non-income generating crime models. Although it was expected from our literature review (given the results reported in Glaeser et al. 1996) that income-generating crimes may be more influenced by spatial dependence than non-income-generating crimes, it seems that social interactions play a role in both types of crimes in our models. In addition, the impact of social interactions is picked up via our dummies for regions (Inner, North,

South, East and West) in Melbourne. As mentioned previously, the concept of social interactions arises from the hypothesis that individuals do not make their choices independently, but rather that their decisions arise from their social environment such as their family, friends, neighbors, ethnic and/or religious group, etc. Crime can follow a diffusion process through direct contact between the first criminal and his or her followers (this requires contact between criminals), or a relocation diffusion where criminals move from one point to another, seeking further opportunities for crime (which does not require contact).

Unfortunately, because of data issues we could not individually include a range of variables in their own right (such as income, unemployment, education etc.) that have been found to play a large part in influencing crime rates in other studies. As a compromise, we used the ABS index of disadvantage for all three years (that includes income, unemployment, education and other social variables). One problem with including this index is that it is a composite of a wide range of variables (seventeen), and so the influence of some key variables on crime rates may be hidden. This may explain why the index was not significant in all of the crime models. However, our results indicated a positive relationship between lesser disadvantage and income-generating crime, while they often found a negative relationship between lesser disadvantage and non-income-generating crime. These results are interesting, as past studies have generally found a positive relationship between poorer areas and crime. Although we do agree that areas of disadvantage have higher levels of non-income-generating crime, our research suggests that the less disadvantaged an area is, the more certain types of crime (namely property income-generating crime) it has, which may be considered to be somewhat controversial. On the other hand, it could be argued that criminals are venturing to areas where there may be greater opportunities for theft. Upon closer inspection of these results, when one eliminates drug offenses and gaming expenditure variables from the regressions, the relationship between all types of crime and the disadvantage index is highly negative and significant (that is, more disadvantaged areas have more overall crime, which is the common expectation). These results are indicating the importance of drug offenses and gaming expenditure in local areas, and without these key variables the disadvantage index becomes a proxy for some of their influences on income-generating crime in particular.

Leading on from this discussion, regional characteristics played an important part in influencing all types of crime rates. Our dummies for areas in Melbourne (as compared to the remainder of Victoria) revealed a significant and positive influence on a range of crime types, a finding consistent with the previous literature (i.e., Masih and Masih 1996). The dummy for inner Melbourne exhibited the largest and most significant coefficient across all three years. On the other hand, another measure of urbanisation, the ABS remote index, which accounts for the differing degrees of remoteness in rural Victoria, was positively and significantly related to non-income-generating crime. That is, non-income generating crime seemed to be occurring more in remote areas.

On the whole, the number of liquor licenses per capita in an SLA was significantly and positively related to most crime types, supporting the hypothesis that alcohol availability is linked with crime (as confirmed by Carpenter 2007). Whether the existence of liquor licenses facilitates the co-existence of gambling and alcohol consumption is a question that warrants further consideration.

Conclusion

The amount spent on gaming machines in Australia is substantial. The prevalence of these machines has increased in a relatively short time and their availability has become progressively decentralized such that the majority are now located in local hotels and clubs. It is natural to postulate that if gambling is associated with crime, then such decentralisation could have local area effects. This study has attempted to uncover the link between gaming expenditure and crime at a local area level using data from the Australian state of Victoria. The results suggest that the relationship between gaming expenditure and crime in Victoria, in particular income-generating crime, was consistently significant and positive from 1996 to 2006. Our findings support previous results that gaming expenditure plays a part in influencing crime, and in particular, income-generating crime. The evidence suggests that it is excessive gaming that is leading people to commit crimes, as there was only limited evidence that gaming expenditure in Victoria is endogenous with crime, and where it existed it was most evident for income-generating crimes. On the other hand, this is not the case for our drug offense variable, as it seems that people who commit drug offenses are the type that will also commit other non-drug categories of crimes (and most likely income-generating crimes). There is evidence of social interactions occurring for some types of crimes across the three years, where surrounding areas' crime rates had an influence on a given area's crime rates.

The extent of the relationship between gaming expenditure and crime generally is not as large as other influences. Key social influences (such as drug offenses, regional impacts, alcohol licenses and urbanisation) played important and significant roles in impacting on crime. Hence, the interactions between these variables and the availability of gaming machines at the local level warrants further research. Overall the models performed well, had high explanatory power, and provided results generally consistent with theoretical expectations. Whilst the magnitudes associated with marginal increases in gaming revenue were found to be relatively small, this does not render them trivial. It was estimated from our models that if gaming expenditure were zero in 2006, income-generating crime would fall by about 10%. In addition, this study has not made any attempt to measure the social costs associated with crime. Moreover, given that some under-reporting is likely, especially with regard to income-generating crime associated with problem gambling, the effects may indeed be larger for this sub-group.

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Appendix 1

See Table 3.

Table 3 Classification of 27 Victorian offenses into income- or non-income-generating

	Income (IG) or non-income (NG) generating
Person	
Homicide	NG
Rape	NG
Sex (non rape)	NG
Robbery	IG
Assault	NG
Abduction/kidnap	NG
Property	
Arson	NG
Property damage	NG
Burglary (aggravated)	IG
Burglary (residential)	IG
Burglary (other)	IG
Deception	IG
Handle stolen goods	IG
Theft from motor vehicle	IG
Theft (shopstealing)	IG
Theft of motor vehicle	IG
Theft of bicycle	IG
Theft (other)	IG
Drug	
Drug (cultivation, manufacture, trafficking)	IG
Drug (possess, use)	NG
Other	
Going equipped to steal	IG
Justice procedures	NG
Regulated public order	NG
Weapons/explosives	NG
Harassment	NG
Behaviour in public	NG
Other	NG

Appendix 2

See Tables 4, 5, and 6.

Table 4 Income- and non-income-generating crime models by category in Victoria in 2006 per 1,000 adult population

	perigp 2SLS Coef.	proigp 2SLS Coef.	perngp 2SLS Coef.	prongp Spatial error Coef.	totcrimep 2SLS Coef.
stdgexpp	−0.004	5.71***	0.95***	3.50***	11.40***
stddrug	1.32***	58.05***	7.60***	1.47**	85.30***
stdliqp	−0.01**	−0.57***	−0.24***	0.04	−1.23***
stddisadvant	0.11***	5.60***	−0.83***	−1.48***	3.77*
stdmalep	0.02	0.03	−0.69**	−1.34***	−2.22
stdteenp	−0.11**	−3.35**	0.11	−0.06	−2.33
stdage70p	−0.01	−0.14	−0.69**	−1.27**	−2.11
inner	−0.05	16.47	−4.11*	4.02*	−0.04
north	0.14	4.58	−0.95	−0.78	0.98
south	0.26***	1.23	0.73	0.89	1.460
east	0.28**	5.01	−0.005	−0.03	2.64
west	0.17	7.32	−1.47*	−2.41*	−1.48
reindex96	−0.06	0.12	1.55**	1.97	5.05
stdslasize	−0.04	−2.11*	−0.39**	−0.71	−3.82**
Constant	0.44***	35.68***	5.72***	7.43***	56.48***
Obs	201	201	201	188	201
F statistic	214***	173***	811***	781[a,***]	408***
R^2	0.91	0.94	0.9	0.67	0.95

* Signifies significant at least at the 0.1 level. ** Signifies significant at least at the 0.05 level. *** Signifies significant at least at the 0.01 level

[a] This is the Log likelihood statistic for the spatial regression

Table 5 Income- and non-income-generating crime models by category in Victoria in 2001 per 1,000 adult population

	perigp	proigp		perngp	prongp	totcrimep	
	2SLS Coef.	2SLS Coef.	Spatial lag Coef.	Spatial error Coef.	2SLS Coef.	2SLS Coef.	Spatial lag Coef.
stdgexpp	0.01	11.74*	32.70***	2.288***	4.42***	19.99***	47.42***
stddrug	1.83***	78.95***	–	4.63***	0.31	100.99***	–
stddruglag	–	–	43.31***	–	–	–	56.12***
stdliqp	−0.006	10.01*	26.03***	1.34**	0.70	12.47	32.93***
stddisadvant	0.11***	3.65*	0.056	−0.72**	−0.62*	2.37	−1.67
stdmalep	−0.08	−7.59	−2.76	−0.50*	−0.76*	−9.68*	−3.90
stdteenp	−0.11*	−2.87	1.39	0.18	0.30	−1.52	2.64
stdage70p	−0.06	−4.045	−4.34	−0.17	−0.22	−3.95	−4.73
inner	1.55***	67.39***	64.89***	1.56	3.79**	77.60***	86.77***
north	0.18	3.99	12.40**	0.50	−0.73	4.60	15.63*
south	0.33***	8.90	12.32**	−0.64	−1.84*	8.36	13.42*
east	0.48***	9.70	19.49***	−0.40	−2.22*	8.58	21.67**
west	0.26**	5.31	2.70	−1.99	−2.68**	0.68	0.01
reindex96	−0.11	−5.96	3.65	1.73*	1.56**	0.34	10.66*
stdslasize	−0.07	−3.64	−7.27***	−0.92***	−0.33	−5.64*	−10.35***
Constant	0.61***	62.72***	30.23***	4.92**	7.71***	79.08***	44.11***
Obs	194	194	194	194	194	194	194
F statistic	864***	803***	475[a,***]	874[a,***]	113***	788***	418[a,***]
R^2	0.94	0.96	0.96	0.88	0.72	0.96	0.96

* Signifies significant at least at the 0.1 level. ** Signifies significant at least at the 0.05 level. *** Signifies significant at least at the 0.01 level

[a] This is the Log likelihood statistic for the spatial regression

Table 6 Income- and non-income-generating crime models by category in Victoria in 1996 per 1,000 adult population

	perigp 2SLS Coef.	proigp 2SLS Coef.	perngp OLS Coef.	prongp OLS Coef.	totcrimep OLS Coef.
stdgexpp	2.544***	39.810***	3.82***	4.76**	50.12***
stddrug	0.241	142.56***	12.08***	7.23**	186.13***
stdliqp	0.130	37.53***	0.75	1.4	42.68***
stddisadvant	0.10***	3.97**	−0.52*	−0.32	2.77
stdmalep	0.106**	−1.616	−1.11	−2.46***	−6.30*
stdteenp	0.070**	3.471*	0.36	0.35	5.12*
stdage70p	0.095*	0.058	−0.05	−1.31**	−1.36
inner	0.55*	39.38***	1.01	1.44	38.96***
north	0.15	13.32**	0.22	−0.84	13.07*
south	0.23***	16.26***	0.5	−1.84	15.10**
east	0.37***	21.48***	0.4	−2.19	19.94**
west	0.10	9.92	−0.93	1.1	8.12
reindex96	−0.16***	−6.71*	2.06**	0.26	−3.71
stdslasize	−0.057	−4.84**	0.83	−0.29	−4.50**
Constant	0.66***	69.22***	4.25**	10.29***	92.26***
Obs	194	194	194	194	194
F statistic	2798***	1190***	6510***	1271***	1661***
R^2	0.99	0.99	0.94	0.92	0.99

* Signifies significant at least at the 0.1 level. ** Signifies significant at least at the 0.05 level. *** Signifies significant at least at the 0.01 level

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