This study was funded through the Community Support Fund as part of the pilot round - Submission Based Grants System for Gambling Research - a commitment under *Taking Action on Problem Gambling: A strategy for combating problem gambling in Victoria*, under Action Area 7: Fostering Gambling Research.

This study investigates the relationship between gaming expenditure and crime in Victoria (especially income-generating crime - theft, fraud, break and enter, forgery, false pretences, larceny and robbery). This research involved an extensive literature review and developed complex databases to model the relationship between crime and its various influences across three years in Victoria: 1996, 2001 and 2006.

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THE RELATIONSHIP BETWEEN CRIME AND GAMING EXPENDITURE IN VICTORIA

FINAL REPORT

JUNE 2010

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Centre for Regulation and Market Analysis, School of Commerce, University of South Australia

Victoria The Place To Be

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Background

Gambling expenditure in Australia, and in particular gaming expenditure from electronic gaming machines (EGMs), has substantially increased in the last few decades, with takings from Victoria representing a considerably greater amount than would be expected from its proportion of the estimated Australian resident adult population.

EGMs have been present in hotels and clubs in Victoria since 1992 and in the Crown Casino since it was established in 1994. In 2007, there were over 27,000 poker machines in Victoria in 522 venues. The increased opportunities to gamble have resulted in concerns about the advent of 'problem gambling' and its adverse social consequences. One of these adverse social consequences is crime.

Relationship between Gambling Expenditure and Crime

To date, the literature has found no firm consensus over the extent of the relationship between gambling and criminal activity. Gambling and criminal behaviour can be linked either negatively (an increase in gambling expenditure may positively influence the economy by creating jobs, increasing income and adding entertainment options and have a positive, indirect influence on the economy (and hence decrease the need to resort to crime)), or positively (increased gambling expenditure may hinder economic development and decrease job opportunities, increase dissatisfaction and increase the potential for crime, or new gambling opportunities may attract tourists to the area who otherwise would not have come and they may commit crimes

(or become victims of crimes), or lead to the advent of problem gamblers who commit crimes (primarily income-generating crime) in order to fund their gambling habit).

The relationship between crime and gambling is a complex one, and while there is mixed evidence, past literature is at least suggestive of a causal link (ie Productivity Commission 1999). However, gambling is just one of many factors that have been identified as influencing crime rates. Other influences include: income levels, age, ethnicity, alcohol and other drug consumption, the percentage of males in the population, unemployment rates, regional factors, single parent families, non-English speaking population, probability of arrest (or police presence) and education. This study has attempted to control for these other variables in order to determine whether EGM expenditure can be an independent predictor of crime rates.

The underlying hypothesis examined in this study is that higher expenditure on gaming machines in a local area leads to an increase in crime in that area. This is based on the belief 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 based on opportunity rather than being planned, and is thus more likely to occur in the same local area as the gambling took place. As the crimes linked to problem gambling tend to be income-generating crimes (to fund the gambling habit), it is expected that the crimes most influenced by gambling will be those of theft, fraud, break and enter, forgery, false pretences, larceny and robbery. These crimes 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 crimes, and it is hypothesised that gaming expenditure should be less strongly related to such crimes.

Methodology

This study uses statistical local areas (SLAs) as its level of area analysis. There were 210 SLAs in Victoria in 2006, with 79 of these in Melbourne. We obtained gaming data by venue from 1992 to 2007, and offence data from the Victoria Police from 1993-94 to 2006-07 (data was provided for 27 major categories of crime, which were classified into income- and non-income-generating crime). When combined with ABS census data, there were three separate years which were available to model the relationship between gaming and crime: 1996, 2001 and 2006.

Findings

Our models of influences on various crime rates had to be corrected for a variety of statistical issues, namely multicollinearity, endogeniety and spatial dependence. Our final models predicted extremely well, conformed to expectations, and were robust. In summary, the results reveal that:

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 respectively 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);

Drug offences 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 income-generating crime) than non-income generating crime;

Liquor licences per capita are **significantly positively related** to most types of crimes in 1996 and 2001; however the relationship changes in 2006 to a negatively significant one negative weak one for most types of crimes;

The ABS disadvantage index (where 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 is male was **significantly negatively related** to non-income-generating property crimes in all years. There was generally no significant relationship detected with income-generating crimes;

The proportion of teenagers in the population was found to be **negatively and significantly related** to income-generating crimes (mainly person and property income-generating crimes) in 2006, person and other income-generating crimes in 2001, and income-generating crimes in 1996. It was found to be positively associated with other non-income-generating crime in 2001 and non-income-generating crime in 1996;

The percentage of the population aged 70 and over is **negatively and significantly associated** with person and property non-income crimes in 2006, and property non-income crimes in 1996. It is weakly positively related to person and other income-generating crimes in 1996;

The dummy for inner Melbourne is **significant and positive** for income-generating crimes in 2001 and 1996 (with property non-income generating crimes also significant in 1996), with only other income-generating crimes and property non-income generating crimes significant in 2006. The dummy for inner Melbourne is significant and negatively associated with non-income generating crimes in 2006. The

dummies for northern, southern and eastern Melbourne have a positive significant influence on some income-generating crimes and total crime 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; and

SLA size is **significantly negatively related** to a range of income-generating crimes in all three years, and is also significantly negatively related to non-income-generating and total crime in 2001 and 2006

Discussion and Conclusion

This is the third study undertaken by members of this research team to have found a ***positive, significant relationship*** between gaming expenditure and crime in Australia. The current Victorian study is more sophisticated and thorough in its methodology and is larger than the previous two studies, in the sense that it has more units of observation and its analysis spans three separate years.

As predicted, the relationship between gaming and income-generating crime was stronger than the relationship between gaming and non-income-generating crime. This was the case for all three years in Victoria. It seems that the relationship between crime and gaming expenditure has lessened somewhat from 1996 to 2006. Reasons for this are unclear, though the smoking ban and other policy initiatives may have played a part. Comparing Victorian results with the gaming and crime relationships

found in Tasmania and South Australia (these comparisons should however 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 overall. This may be because of Victoria's network of gaming machines and venues (Livingston 2006 and Livingston *et al.* 2008). For this supposition to be confirmed, additional analysis needs to be undertaken by using the same methodology and same variables in each state, or by running one analysis across all states combined for a national analysis. Other key influences on crime generally included drug offences, the number of alcohol licences in an area, the level of urbanisation and regional dummies.

The most important influence on crime (and in particular, income-generating crime) was drug offences. We had to instrument this variable due to its endogeneity status in many models (in terms of those who live in areas with high crimes being more likely to commit drug offences). Interestingly, without drug offences in the models, gaming expenditure was much more likely to be endogenous. With drug offences, it was only endogenous a couple of times in some income-generating crime models. Spatial dependence (spatial dependence is present when crimes in neighbouring areas impact on crimes in the unit areas in question because of social interaction effects) occurred in some of our estimated crime models. This indicates that in some models across some years, criminals were not making their decisions independently, but their decisions were influenced by their environment, family, neighbours and friends.

Generally, our results were consistent with theoretical expectations, and confirmed the positive link between income-generating crime (in particular, property-related income-generating crime) and gaming expenditure.

1. INTRODUCTION

1.1 Background

Gambling expenditure in Australia has substantially increased in the last few decades. The Productivity Commission (1999) reported that in 1997-98 over $11 billion was spent on legal gambling, representing approximately 3 per cent of household disposable income, as compared to 1972-73 when Australians spent the equivalent of 1.6 per cent of disposable income (or $2.7 billion in today's prices) on gambling activities. The average expenditure per adult (over 18 years) 'has increased from $300 (in today's prices) in 1972-73 to over $800 in 1997-98' (Productivity Commission, 1999, p. 38). Net takings from gambling for businesses operating in New South Wales ($6,195m) and Victoria ($4,383.2m) represented 68.4% of the total Australian net takings from gambling. The New South Wales and Victorian contributions to total net takings from gambling were 40.1% and 28.4% respectively, which was higher than their respective proportions of the estimated Australian resident adult population of 33.4% and 24.9% (Productivity Commission, 1999).

Table 1 illustrates the average weekly expenditure on gambling products for some states in Australia in 2003-04. It should be noted that this data is based on the ABS Household Expenditure Survey (HES), which has a range of problems associated with it (SACES 2006).[1] Nevertheless, it indicates that Victorians are perhaps below the Australian average per household when it comes to expenditure on gaming machines, albeit being above the average expenditure on gambling products in total.

[1] The main problem associated with the HES is that it underestimates average gambling expenditure (either because of sampling errors; respondent recall or deliberate attempt to hide gambling spending).

International comparisons are difficult to make due to differences in the collection and collation of statistics. Nevertheless, on the basis of the information that is available, it appears that Australians are among the biggest gamblers in the Western world (Productivity Commission 1999).

Table 1 Household Expenditure Survey: Average Weekly Expenditure on Gambling ($) Selected States and Australia – 2003-04

Type of Gambling	South Australia	New South Wales	Victoria	Western Australia	Australia
Lottery tickets	0.65	0.60	0.10[b]	-	0.32
Lotto type games & instant lottery	3.32	2.65	3.73	5.30	3.52
TAB, on-course betting & related	-1.10[b]	0.12[b]	0.76[a]	0.32[b]	0.09[b]
Poker machines & ticket machines	1.46	1.07[a]	0.64[a]	0.04[b]	0.76
Blackjack, roulette & other casino games	0.07[b]	-0.02[b]	-0.24[b]	-0.74[b]	-0.14[b]
TAB - betting (excluding animal racing)	-0.23[b]	0.06[a]	0.08[b]	0.09[b]	0.03[b]
Club & casino broadcast gaming	0.10[b]	0.15[a]	0.01[b]	-	0.07[b]
Gambling nec	0.45	0.85	0.48	0.51	0.59
Gambling not further described	0.50[a]	0.24[b]	-	0.20[a]	0.25[a]
Total gambling	5.24	5.71	5.56	5.71	5.48
Est. total annual gambling expenditure ($m)	171	749	551	229	2,204

Note: [a] This estimate has a high relative standard error (of 25 to 50%) and should be used with caution.
[b] This estimate has a very high relative standard error (of greater than 50 per cent) and is considered too unreliable for general use.
Source: SACES (2006) p. 61.

In 1991, legislation in Victoria was passed allowing for the installation of gaming machines in hotels and clubs in 1992, and then the establishment of Crown casino in 1994. Following legalisation, the rise in the number of gaming machines in Victoria has been rapid, rising to 27,279 in 522 venues in 2007 (Victorian Commission for Gambling Regulation 2007). Gambling expenditure in Victoria has increased considerably since the early 1990s, and SACES (2006) estimated that average household total expenditure on gambling products in 2003-04 in Victoria was $551 million. The Victorian Commission for Gambling Regulation (2007) estimated that over $2,543million was spent on gaming machines in Victoria in 2006-07, representing an annual amount of around $640 per adult.

As a share of household disposable income, gambling expenditure in Victoria has increased from 1.26 % in early 1982-83 to 3.58 % in 2002-03, driven entirely by casino gambling and electronic gaming machine expenditure (SACES 2005). In terms of participation, around 80% of Victorians gamble each year (the percentage has ranged from 75% in 1992 when EGMs were introduced, to a high of 87% in 1996).

Relative to other forms of gambling, gaming machines are associated with more intensive gambling (that is, more frequent and longer gambling), are often more accessible and provide a greater level of independent participation. The majority of those who gamble can afford to do so and generally obtain satisfaction and enjoyment from the experience. The largest sources of funds for gambling expenditure for Victorians were described by Roy Morgan Research (2000) respectively as: pocket money (43 per cent), specific budget for entertainment or recreation (19 per cent); money for basic living expenses (19 per cent); savings (6 per cent); and 3 per cent fund their gambling from a 'specific gambling budget'. Gamblers were profiled into five categories: disinterested gamblers; occasional gamblers; social gamblers; acknowledged heavy gamblers; and committed heavy gamblers. The study suggested that the increase in gambling in Victoria had been financed largely out of net cash savings, therefore impacting on asset formation.

In the US, casinos have often argued that they spur local and regional economic growth through taxes and the provision of high paying jobs. Walker (2007) agrees that there is a short-term positive impact of casino gambling on economic growth, but that the effect disappears in the longer term. He suggests that the influence may only be short term because of competition for the gambling dollar from other legal gambling, or, that in the long run expenditures in casinos are simply

redirected from other local industries, which eventually contract or disappear. He found that some gambling forms in the US complement each other (such as casinos and horse racing, lotteries and dog racing, and horse racing and lotteries). Others seem to be substitutes, such as lotteries and casinos, and dog and horse racing. The increases in casino spending in the US were associated with decreased lottery expenditure, but with increased horse racing expenditure.

1.2 Problem Gambling

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 (described further below) because of their gambling addiction. A report for Gambling Research Australia in 2005 set out a national definition of problem gambling as "problem gambling 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 2005a; p. i). Although problem gamblers make up only a very small percentage of gamblers overall in Australia (estimates range from 1.5 to 3.7 per cent), their expenditures on gambling constitute at least one third and perhaps as high as 40 per cent of all money spent on gambling (Productivity Commission, 1999). Others suggest that heavy gamblers contribute to over 80% of all money spent on gambling (Borderlands Cooperative 2003). A higher percentage (nearly 5 per cent) of electronic gaming machine (EGM) players in Australia are problem gamblers, with problem gambling being highest in jurisdictions where there are increased opportunities to spend on EGMs (Productivity Commission, 1999). By way of example, the Productivity Commission estimated that aggregate problem gambling was greatest in NSW and Victoria (where 2.55 and 2.14 per cent respectively of all

gamblers were identified as problem gamblers), and lowest in Western Australia and Tasmania (0.7 and 0.44 per cent respectively) where there were fewer EGMs.

Surveys of the Victorian public have often found that people associate gambling (and in particular gambling on EGMs) with negative impacts in general on the community (Hames Sharley 1997, 1997a, KPMG 2000, Borderlands Cooperative 2003, The Centre for Gambling Research 2004). One often cited example is crime, explored in detail later.

1.2.1 Profile of a Problem Gambler

There have been a number of profiles on problem gamblers. A survey conducted by Roy Morgan Research (2000) of the Victorian public found that those who were more likely to report problems with problem gambling in the family had the following characteristics: they were acknowledged heavy gamblers; single parents with dependent children; had an income between $20,000-$40,000; were aged between 30-39 years; and were born in Australia. In particular, males, those of a younger age, those who work as plant/machine operators/drivers, and those working full-time were more likely to be at risk of experiencing problems with gambling. It has been found that only 3% of all problem gamblers actually seek help for their addiction (Borderlands Cooperative 2003).

Although many studies have portrayed problem gamblers as being almost exclusively male (such as the Borderlands Cooperative study described above), an analysis by Crisp *et al*. (2004) of 1520 persons who sought assistance due to concerns about their gambling from the publicly-funded BreakEven counselling services in Victoria found that females comprised 46% of this group. They found that females were: more likely to use EGMs (91.1% vs. 61.4%); older (39.6 years vs. 36.1 years);

more likely to be born in Australia (79.4% vs. 74.7%); more likely to be married (42.8% vs. 30.2%); living with family (78.9% vs. 61.5%); and were more likely to have dependent children (48.4% vs. 35.7%), than did the males who attended counselling services. However, female gamblers reported average gambling debts of less than half of that owed by males ($7,342 vs. $19,091).

The existence of co-morbidities (such as alcohol and drug abuse) along with the dependency on gambling has also been studied and conflicting views have been found. Although the link between alcohol abuse and problem gambling is not absolutely clear (Kidman, 2002), there does seem to be some evidence linking the two. Grant *et al* (2002) found that pathological gambling and alcohol abuse go hand in hand, and suggest that a defect in brain function may be responsible, with the causal link between the two poorly understood. Blaszczynski and Maccallum (1999) also found support for an apparent link between crime and financial problems (suicidal gamblers had a median debt level of $2,500 compared with $200 for non-gamblers), and suicide risk.

Meyer and Stadler (1999) argue that problem gambling and anti-social criminal behaviour go hand in hand, with many gamblers who commit offences having prior convictions. But much evidence has also supported the psychopathology theory that it is gambling addiction that leads people into crime (Sakurai and Smith 2003).

Studies find that the majority of Australian gamblers travel distances of less than 5 km to gamble on EGMs in hotels/pubs and sporting clubs, while most travel distances of less than 2.5 km (SACES, 2005; The Centre for Gambling Research, 2004, KPMG 2000). A more recent study by Eltridge and Del Fabbro (2006) found that more than 90 per cent of frequent gamblers in South Australia travelled less than

4km from home to their preferred gambling venue. In Victoria, studies suggest that given the proliferation and accessibility of EGMs, most players are local (Livingstone 2005, Marshall and Baker 2001). Marshall and Baker (2001a) found that very few residents of the inner LGAs of Melbourne lived further than 5 km from a venue.

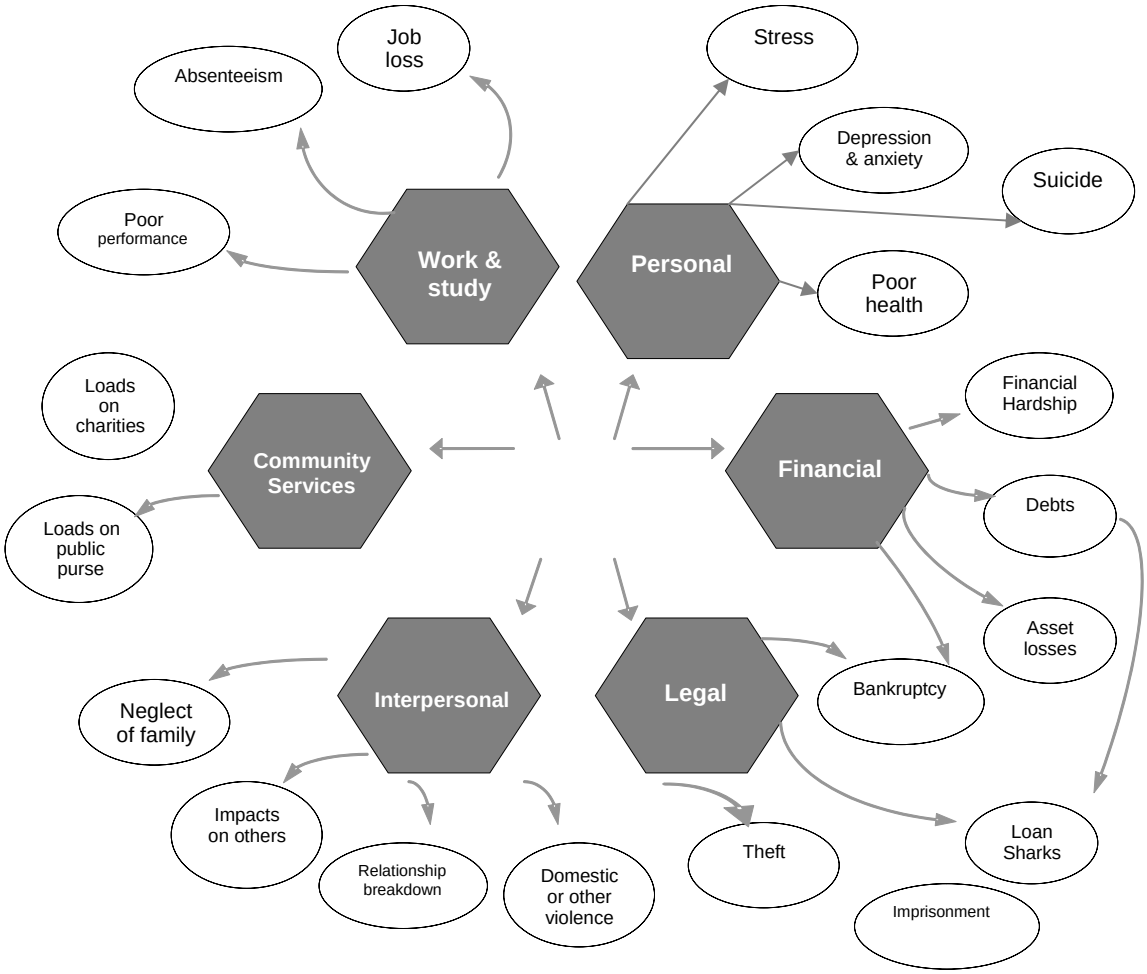
1.2.2 Consequences of Problem Gambling

There is much evidence and research in Australia to suggest that excessive gambling, especially on gaming machines, has led to considerable social problems. The Productivity Commission (1999) identifies several examples, such as personal financial pressures, emotional distress, domestic violence, employment difficulties and suicide. Blaszczynski and Farrell (1998) documented 44 examples of gambling-related suicides in Victoria occurring between 1990 and 1997, in which the State Coroner identified the presence of a putative gambling problem. Most were male, with an average median age of 40 years, unemployed, and from a lower socioeconomic background. Blaszczynski and Maccallum (2003) identified suicide ideation[2] (36%) and suicide attempts (8%) among a population of problem gamblers seeking treatment in Australia, while other studies in America have found that up to 20% of problem gamblers have attempted suicide (Zangeneh 2005).

Figure 1 illustrates the consequences that may result from problem gambling. It is important to note that the arrows do not necessarily signify causal relationships; the relationships may operate in the reverse direction.

[2] Suicide ideation is the idea of suicide.

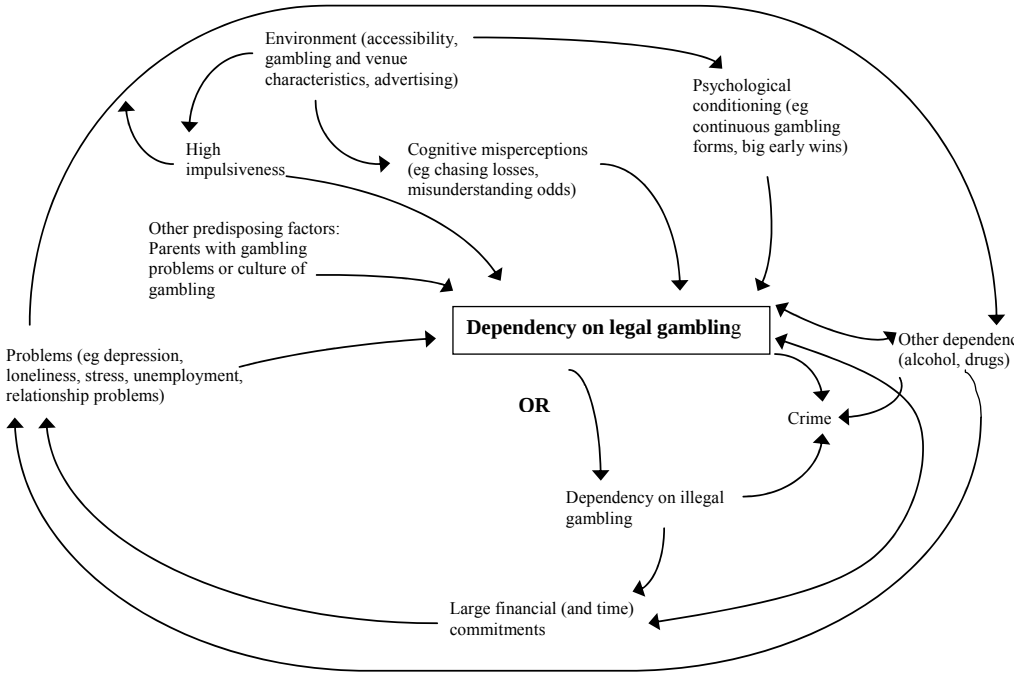
Figure 1: Potential Impacts of Problem Gambling



Source: Productivity Commission (1999) p. 7.3.

Figure 2 shows the different potential relationships associated with problem gambling, its outcomes and determinants. Again, arrows do not signify causality.

Figure 2: Problem Gambling's Potential Relationships



Source: Productivity Commission (1999) p. 74.

New Focus Research Pty Ltd (2003a) interviewed a wide range of people in Victoria who suffered as a result of problem gambling. Some comments included (p. 50):

'I was working as a fundraiser for an organisation, and I used to skim 'expenses' from them. When they found out, they laid criminal charges. It was then that I realised it was a huge problem. I had a breakdown — I couldn't remember anything that happened for two weeks … '

'I've borrowed money for work, for living money, rather than for the gambling. I took a "director's" loan — I guess you'd call it embezzlement. Yes, I gamble to the point where I'm skating on the thin edge of legality … '

Issues with problem gambling only emerge over time. Evidence suggests that problem gamblers can gamble for up to ten years before they seek treatment, which

has been described as an 'incubation period' (Smith and Wynee 2000; Blaszczynski, 2002).

Sakurai and Smith (2003) suggest that as problem gamblers deplete their own resources, they often turn to family and friends to borrow money, with little prospect of repayment. Some may pawn assets, while others take out high interest loans. Once debts have accumulated beyond their means, then other illegal activities to gain money may be undertaken.

1.2.3 The Theoretical Relationship between Gambling and Criminal Activity

There is no firm consensus over the nature and extent of the relationship between gambling and criminal activity (Grinols & Mustard, 2006; Phipps, 2004; Sakurai & Smith, 2003; South Australian Independent Gambling Authority, 2003; Gazel et al, 2001; GAO, 2000; Doley, 2000; Centre for Criminology & Criminal Justice, 2000; Albanese, 1999; Hames Sharley, 1997; Nelson et al 1996; Margolis, 1997; Florida Department of Law Enforcement, 1994; Friedman et al, 1989). Indeed, the National Gambling Impact Study Commission in the United States was charged with investigating the benefits and costs of problem gambling but it lamented that the lack of research in the area meant that it was not possible to determine how gambling affects national rates of crime (Smith and Wynne 2000).

Miller and Schwarz (1998) called for an investigation into theory-based studies on the causal relationship between gambling and crime. Theoretically, the relationship between gambling and crime could be positive or negative. The four relationships that have been identified include:

a. NEGATIVE: Crime rates could be negatively related to gambling expenditure as an increase in gambling expenditure may positively

influence the economy by creating jobs, increasing income and adding entertainment options and have a positive, indirect influence on the economy (and hence decrease the need to resort to crime);

b. POSITIVE: Similarly, crime rates could be positively related to gambling expenditure because increased gambling expenditure may hinder economic development (income might be diverted from socially-worthwhile goods and services that create income, or gambling expenditures might be captured by those outside the community and this leads to a net loss of income/output within the community's economy), hence decreasing job opportunities and increasing dissatisfaction and potential crime;

c. POSITIVE: New gambling opportunities may attract tourists to the area who otherwise would not have come and they may commit crimes (or become victims of crimes). Such a situation is generally only likely when large gambling opportunities exist such as casinos;

d. POSITIVE: The creation of gambling opportunities may lead to the development of problem gamblers who commit crimes (primarily income- generating crime) in order to fund their gambling habit (Smith and Wynne 1999).

While the magnitude of, and inter-relationships between, these effects is not certain, it is plausible to suggest the existence of a positive relationship between gambling expenditure and crime – that is, as gambling expenditure increases, so does crime. Chapter Two discusses the links between crime and gambling behaviour in more detail.

2. CRIME AND GAMBLING BEHAVOUR

2.1 Various Types of Crimes Associated with Gambling

There are a variety of crime links associated with gambling in general, such as organised criminal activity (systematic money laundering through EGMs); opportunistic criminal activity such as hold-ups of gambling clubs; offences within gambling clubs; and offences associated with problem gambling (SACES 2005).

2.1.1 Organised Crime Links

The relationship between the gambling industry as a whole and organised crime has been established in past literature (Pinto and Wilson, 1990). Different forms of illegal activity have been linked to the various legal and illegal gambling modes. For example, casinos have been shown to be susceptible to a myriad of criminal activities including tax evasion, money laundering and loan sharking. Despite the fact that Australian regulations for casinos are recognised as some of the most stringent controls in the world, the rapid growth of the casino industry may have increased the opportunity for internal corruption within the industry (Pinto and Wilson 1990, SACES 2005). Doley (2000) states that illegal casinos also exist, along with their links to organised crime.

Proceeds from illicit drug trade and various other illegal activities can be 'laundered' through certain forms of gambling, such as unregistered (SP) bookmakers. According to one account “illegal bookmaking is biggest in NSW with the industry worth $1,000 million a year, followed by Victoria at $300 million a year” (Ewing, cited in Healey, 1997, p. 3). The illegal bookmaking industry is recognised as being highly profitable, not simply because of its links to organised crime, but also because

SP bookmakers do not pay the taxes or fees usually associated with legal bookmaking. The magnitude of the monetary flow through this industry means it is well placed to finance other forms of illegal activity. For example, SP bookmaking has also been connected to major drug crime including heroin trafficking and domestic drug distribution (Pinto and Wilson 1990).

2.1.2 Other Crime Links

Other links between crime and gambling are associated with venues with a large number of EGMs; internet betting; and juvenile crime and amusement centres.

Criminal activity associated with EGMs mainly occurs through loan organisations which charge exorbitant interest rates to gamblers as well as "tax evasion, player cheating, theft by management or staff and possible kickbacks or illegal commissions paid by poker machine manufacturers for placement of their machines" (Pinto and Wilson 1990, p. 3).

A variety of illegal offences have been associated with internet betting, such as the legality of the gambling site; vulnerability of credit card or account details; accessibility to children; privacy invasions; and the addictive nature of online betting activity (Doley 2000).

Gambling has also been associated with drug dependency and hence, by implication, it indirectly supports the illegal drug trade by exacerbating addiction (Allcock and Grace 1990).

2.2 Crimes Associated with Problem Gambling

Within Australia, there has been much conjecture about the extent to which crime is initiated or driven by excessive gambling on EGMs. As already touched upon

previously, the literature suggests that one needs to be careful making assumptions about whether problem gamblers turn to crime, or whether it is offenders who tend to gamble. More discussion is provided on this later in this report.

Based on anecdotal evidence, the community seems to believe that problem gamblers turn to crime to fund their habits. For example, studies such as the Impact of Electronic Gaming Machines on Small Rural Communities by Hames Sharley in Victoria in 1997 found that a slight majority of telephone survey respondents considered that there had been an increase in the incidence of crime since the introduction of EGMs. In 2003, many Victorians (more than 65%) surveyed by The Centre for Gambling Research believed that gaming machines do more harm than good.

The Productivity Commission (1999) found that up to 70 per cent of problem gamblers may commit offences.

2.2.1 Self-Reporting and Legal Studies of the Link between Problem Gambling and Crime

A number of previous studies have attempted to quantify directly the link between illegal gambling and crime, using a variety of methodologies. Most have tended to focus on self-reporting of crime, through surveying various samples of the community. Targets of these samples have included the general population, prisoners, and problem gamblers seeking treatment (Productivity Commission 1999). Other studies have focussed directly on police and court statistics (Centre for Criminology and Criminal Justice 2000, Office of Crime Statistics and Research 2003). In general these studies have been unable to establish robust statistical links between gambling and crime. This is most likely because the extent of illegal gambling is difficult to

determine given the problems associated with the detection and monitoring of these activities (Sakurai and Smith 2003; Doley 2000; Centre for Criminology and Criminal Justice 2000). However, they have concluded that there is anecdotal evidence to suggest a positive link between crime and gambling.

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 are usually based on data on households or individuals (e.g., Tseloni 2006, Goudriaan *et al*. 2006, Bennett & Holloway 2005, Fergusson *et al.* 2003, Tseloni et al. 2002, Entorf & Spengler 2000, Trumbull 1989). Studies have involved researchers surveying problem gamblers (Jackson *et al*. 1997, Blaszczynski & McConaghy 1994, Blaszczynski *et al*. 1989); examining criminal prosecution files (Australian Institute of Criminology and PricewaterhouseCoopers 2003; Crofts 2002); surveying prison inmates or known offenders (Abbott *et al.* 2005; Abbott and McKenna 2005; Yeoman and Griffiths 1996, Blaszczynski 1994); studying people who use gambling counselling services (Productivity Commission 1999; Jackson *et al.* 1997; Blaszczynski and McConaghy 1994), 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 offence (most commonly theft, fraud, robbery and assault, and breach of apprehended violence orders).

A study by Jackson *et al*. (2005) uses data relating to criminal activity among 12,500 clients who registered with problem gambling counselling agencies in Victoria in the period 1 July 1995 to 30 June 2005. One issue is whether such people have

committed illegal acts (e.g. forgery, fraud, theft or embezzlement) in order to finance their gambling. Over this period, the study found 17 per cent of clients admitted to having committed illegal acts to finance their gambling habit. In some years, the percentage was as high as 30% (Jackson *et al*. 1997).

New Focus Research Pty Ltd (2005) interviewed a number of Victorian problem gamblers as to the consequences of their addiction. In 2005, they found that 43% of respondents indicated that their gambling had resulted in a significant loss of money and 33% reported complete financial ruin (this was a reduction from the previous survey where 61% of problem gamblers reported such financial ruin). Male problem gamblers were still far more likely to report complete financial ruin compared to female problem gamblers, but females were more likely than males to report that they felt they had lost control of their lives.

Crofts (2002, 2003) confronted the causal link between gambling and crime by examining court files that identified a direct link between the two. She found that 15-20% of offence files were gambling-related. The amounts stolen ranged from $950 to $425,000, with the average amount stolen being $95,935. The offences ranged from one-offs to thefts occurring over ten years.

Table 2 illustrates some of the studies that have sought to determine the link between gambling and crime in Australia.

The Office of Crime Statistics and Research (2003) concluded that problem gambling and crime had some connection, but it was impossible to reach a conclusion as to the proportion or extent.

Table 2: Studies into the Relationship between Gambling and Crime in Australia

Study	*Methodology*	*Results*
Warfield (2008)	Police court statistics	Law files from 1998 to 2007 were searched, found 528 gambling related offences., with 202 of these gaming related
Centre for Criminology and Criminal Justice (2000)	Police court statistics	Official files could not be used to detect a link between gambling expenditure and crime, though it seemed that substantial anecdotal evidence existed.
Office of Crime Statistics and Research (2003)	Police court statistics	0.7 to 4% of a variety of police and court criminal offence files randomly selected were gambling related
Crofts (2002)	Property criminal files	4% of the files examined were identified as gambling related
Australian Institute of Criminology & PricewaterhouseCoopers (2003)	Serious fraud prosecutions	23% were motivated by gambling reasons
Productivity Commission (1999)	Problem gamblers seeking treatment Problem Gamblers	Around two-thirds of problem gamblers had committed a crime 10% had committed a crime because of gambling
Jackson *et al* (2005)	Problem gamblers seeking treatment between June 1995 and June 2000	16.8% admitted committing an illegal act due to a problem with EGMs. Offences are mainly non-violent property crime. Around 40% are caught and convicted.
Blaszczynski, McConaghy and Frankova (1989)	Pathological gambling patients	54.1% admitted to a criminal offence because of gambling problem, with 21.1% charged.
Blasczyznski and Steel (1996)	Control group	58.3% admitted to gambling-related offence and 22.6% had been convicted
Blaszczynski and McConaghy (1994)	Problem gamblers	Nearly 25% admitted to a conviction in court hearing, with most common offences being theft, embezzlement and misappropriation. The higher the debt, the more offences reported.
Blasczyznski (1994)	Prison inmates	22% were problem gamblers, with 50% citing gambling as the reason for their behaviour
Queensland DFYCC (1996)	Counselling services Prison inmates	13% stole to gamble and 40% appeared in court on a gambling related offence. 5.4% admitted to stealing money to play EGMs
Lahn (2005)	Participants in correctional centres	34.3% of those surveyed were problem gamblers. 45.7% of those problem gamblers said they had committed crimes to pay for their gambling debts
KPMG (2006)	Surveyed large organisations in Australia and New Zealand	47% of all organisations had experienced at least one case of fraud. Gambling was named as the second largest motivator (22%) of those frauds. Gambling had the largest $ fraud associated with it (average value per incident almost $300,000). Within gambling motivations, EGMs had the largest value, followed by casino gambling.

In Australia, studies on the impacts of casinos have found little evidence for an increase in the rate of crime in the community (McMillen 2000, Lynch 1999), although Lynch (1999) did find there was an increase in the incidence of some crimes associated with the Sydney casino, namely assault, theft and offensive behaviour. In general, most of the literature seems to agree that the major increase in crime due to problem gambling is primarily directed at property, although some increases have

been found for violent crime, personal crime and drink-driving offences (Stitt *et al*. 2003).

As interviews with Victorian problem gamblers have suggested, there is negative impact on the family as a result of problem gambling, which may lead to child maltreatment or domestic violence. For example, some comments profiled in New Focus Research Pty Ltd (2003) included (p. 52):

> '*Children are neglected because no money is spent on them, no holidays are taken … '*
>
> *'Arguments (and sometimes violence) are common, especially over money issues… '*
>
> *'Some gamblers are very angry or moody when they lose money or can't gamble and put their anger on their children and partners … '*

Warfield (2008) reported that at least 5 murders had occurred because of gambling debts.

2.2.1.1 Profile of a Gambling Offender

A study by the Australian Institute of Criminology and PricewaterhouseCoopers (2003) found that gambling offenders were mainly male, with an average age of 37 (the female offenders had an average age of 46). They had gambled on average for 17 years (with 9 of these at a problem level). 43% of gambling offenders obtained money by obtaining finance or credit by deception or fraudulent cheque (43%); misappropriated funds (19%); or obtained goods and services by deception (19%). There was also a close dependency between gambling and alcohol consumption (Borderlands Cooperative 2003). Lahn (2005) reports that gambling offenders were mostly young, male, white, relatively less educated, single and often unemployed. On

the other hand, Warfield (2008) found that 64% of the gaming related offenders were female in his Australian study.

2.2.2 International Community Model Studies of the Link between Problem Gambling and Crime

Only a few studies have used a community model of crime research, where crime levels are sought to be explained by attributes of that community such as its socio-economic status, demographics and urbanisation (Wheeler *et al*. 2008; SACES 2008; Tseloni *et al*. 2002; Fajnzylber et al. 1998; Cornwell & Trumbull 1994; Sampson & Groves 1989). Criminological research has found that crime is not randomly distributed but is concentrated in various locations (Briscoe and Donnelly 2003) and hence must be influenced by certain characteristics of that location.

Area level studies tend to be mainly North American and focus mainly on the influence of large casinos on crime rates (e.g., Grinols & Mustard 2006; Phipps 2004; Stitt *et al*. 2003. Gazel *et al*. 2001; GAO 2000; Albanese 1999; Nelson *et al*. 1996; Margolis 1997; Florida Department of Law Enforcement 1994; Friedman *et al*. 1989). Evidence from these studies has often been contradictory, with some, for example, finding no impact on crime, while others have concluded that crime does increase as a result of the introduction of casinos. Some authors are suspicious that such findings simply mirror the objectives of those who funded the study (Walker 2007; Grinols & Mustard 2006; Banks 2002).

Margolis (1997) reviewed four major community North American 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 (though there was a slight increase

in traffic violations and petty crime). Stitt *et al*. (2003) compared crime levels in six American casino communities with their matched control communities and concluded that crime did not seem to be 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).

Nevertheless, many 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 with 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 3-4 year time 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 associations between a wide range of legalised gambling opportunities and crime rates in Canada. Although 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. Grinols and Mustard (2006) suggested that the impact of gambling on crime rates is low shortly after a casino opens, but grows considerably over time due to problem gambling. Walker (2008) has criticised this highly influential study, arguing that the effect of casinos on crime is probably overstated because (a) it used a crime rate that excludes the visiting population at risk; (b) the crime data used are potentially inaccurate; (c) there may be a self-selecting bias into the "casino county" category; (d) the casino dummy variables do not isolate the crime effect caused by casinos; and (e) the conclusions are overstated.

2.2.3 Australian Community Model Studies of the Link between Problem Gambling and Crime

Pickernell *et al.* (2009) studied the correlations between a variety of socio-economic factors and EGM numbers and expenditure by local government areas (62 in total) in Victoria for 2006. They found that EGM spend per adult was negatively influenced by the amount of volunteering, and positively by the number of EGMs per population and the number of EGMs per venue. They found that cash related crime was positively influenced by drug possession, median income, unemployment and overseas visitors. However, it is highly likely that their regression analysis would have suffered from problems of multicollinearity and endogeneity and hence their results are questionable.

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 2002/03. They found that the higher the expenditures 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 offences (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. The relationship was described as a very slight one with other factors having a much larger influence on

crime. A number of difficulties were experienced in this Tasmanian study as key variables were missing, not all non-income-generating offences were available, and the number of observations available was comparatively small.

2.2.4 Other Studies of the Link between Problem Gambling and Crime

Piscitelli and Albanese (2000) found that the rate of criminally inadmissible persons attempting to enter Canada from the United States increased after the opening of Casino Niagara. Another study in Canada by Stowkowski in 1996 found that crime (and in particular larceny and theft, motor vehicle theft and drink driving) increased significantly two years later in two mountain towns after casino gambling was introduced in 1991. Other Canadian studies that matched similar towns with and without casino gambling found no significant differences in per-capita crime rates (reported in Smith and Wynne 1999).

Smith and Wynne (1999) surveyed key participants in Canada's legal enforcement community to try and establish what their perception of the link between gambling and crime was. Although many believed that the problem was rampant, they could only speculate as to the true links between the two. Many informants also believed that problem gamblers who stole were as much victims in themselves as offenders.

Blaszczynski and Farrell (1998) found that eight of their 44 gambling-related suicides records indicated that the person was in severe debt due to their gambling habits. However they concluded that there was insufficient information in the records to fully identify the link between gambling and crime.

2.2.5 Under-reporting Issues with Problem Gambling and Crime

MacDonald (2002) refers to the 'dark figure' of crime, in terms of the hidden crimes which are committed but are not included in official recorded statistics. The countries considered included the United Kingdom, Europe and the United States. This 'dark figure' is influenced by the public's willingness to report crimes and a change in police reporting practices, referred to as 'under-reporting' and 'under-recording'. From surveys it has been found that the greatest problems in under-reporting occur for crimes such as vandalism, assault, robbery, domestic violence and mugging (around only 30% of these crimes were reported to British police in 1999). 60% of burglary thefts were reported to police in this same time period, making it the highest reporting crime category (followed by motor vehicle thefts at 50%). MacDonald found that under-reporting varied over time, and was influenced by time-variant factors such as unemployment and economic status.

Many problem gamblers often steal from friends or family, hence increasing the probability of the under-reporting of crime related to legal gambling (Productivity Commission 1999). SACES (2005) also identified the possibility that many defendants who go to court are deliberately advised not to mention their gambling problem as it may leave them open to further liability (such as an additional jail term). Crofts (2003) suggested that nearly 40% of employee-related crime is not reported to police by companies.

The under-reporting or non-admission of criminal behaviour by problem gamblers is consistent with the under-reporting of gambling expenditure in the ABS Household Expenditure Survey. In this survey, people consistently underestimate how much they actually spend on gambling. Therefore, the incentive to not admit to a gambling problem that may result in further fines or imprisonment is even greater.

2.2.6 Summary

The relationship between crime and gambling is a complex one, and while there is mixed evidence, the literature is at least suggestive of a positive relationship between the two. It remains to be seen as to how gaming and crime interact with each other.

3. OTHER FACTORS INFLUENCING CRIME

There is a vast literature examining the various influences on crime and a multitude of factors have been identified. In a study of the impact of gambling on crime, it is important to identify as many of these other factors as possible, because the omission of them from the analysis may create correlation between the gaming expenditure variable and the regression's error term, yielding biased estimates. In some situations, estimation using instrumental variables may be required. Such variables are correlated with gaming expenditure, but not with the residual of the crime equation. The main influences that have been identified are discussed below.

3.1 Income

Ehrlich (1973) found that both higher and lower family incomes were associated with higher rates of personal and property crime. Fajnzylber *et al.* (1998) found that income inequality was associated with crime. Tseloni *et al*. (2002) found that areas with low levels of affluence in Britain were more likely to have high levels of property crime. Masih and Masih (1996) found that the greatest impact on Australian crime rates from 1963-1990 was provided by the number of dwelling commencements (a proxy for wealth in the economy). Personal and household income is linked to the business cycle. Fajnzylber *et al.* (1998) found that economic downturns raised a country's national crime rates.

It has generally been found that the higher the income, the more likely it is that households gamble, although low income households are overrepresented in the top gambling expenditure quintiles (Smith and Wynne 2000, MacDonald *et al.* 2004). As Smith (1998) argues, if low-income households and problem gamblers coincide in the

same local area, this could have devastating social and economic impacts for that area. Worthington (2001) suggested that the source of income (such as a government-derived benefit) was much more important than the level of income in determining gambling expenditure in New South Wales.

3.2 Age

Raphael and Winter-Ebmer (2001) found that the proportion of the population aged between 15 and 17 had a positive and significant effect on all types of crime in the US, although the proportion between 18 and 24 was not significant. Tseloni et al. (2002) found that areas with high proportions of teenagers were more likely to have high levels of property crime.

Over-representation of young people was found by Jackson *et al.* (2000) in their study of those who admitted to committing criminal acts due to their gambling behaviour. Middle-aged groups were more likely to have higher rates of gamblers than other groups, but it has been found that the youngest and oldest age groups have a higher likelihood of being in a higher spending gambling group (Borderlands Cooperative 2003; MacDonald *et al.* 2004).

3.3 Ethnicity

Tseloni (2006) found little empirical evidence to suggest any influence of ethnicity on area crimes, although Asian households have been linked with property crime in individual studies. Tseloni suggests that once neighbourhood characteristics are accounted for, race effects tend to disappear. In New Zealand, Fergusson et al. (2003)

found that even when controlling for all other individual characteristics, Maori people still had conviction rates substantially higher than non-Maori people.

The North American literature suggests that African-Americans and Hispanics gamble more than the general population and that aboriginal people are more likely to become problem gamblers than the general population (Smith and Wynne 2000). A Victorian study suggested that 30-40% of people seeking counselling help for problem gambling were of a non-English speaking background (Borderlands Cooperative 2003). Worthington (2001) found that one of the major factors determining gambling was ethnicity. In metropolitan Victoria, Hames Sharley (1997a) found that Asians did not frequent local EGM clubs, but rather tended to gamble exclusively at the casino. Cultural Partners Australia Consortium (2000) explored the impact of gambling in four ethnic groups in Victoria: Arabic-speaking people, Chinese-speaking people, Greek-speaking people, and Vietnamese-speaking people. They found that the rates of participation in gambling amongst respondents from these four cultural groups were lower than those in the general community, but larger gambling amounts were outlaid by them on average. In addition, some respondents were found to encounter difficulties as a result of their gambling activities and this was occurring at higher rates within the four cultural groups than within the general community.

3.4 Alcohol

Alcohol consumption has been linked with criminal behaviour (Raphael and Winter-Ebmer 2001). Licensed premises are strongly associated with substantial levels of alcohol-related harm, in particular violent crime (Briscoe and Donnelly 2003).

3.5 Drugs

Fajnzylber et al. (1998) found that a rise in drug trafficking increased a country's national crime rate. Bennett and Holloway (2005) suggested that there may be some link between misuse of drugs and offences such as shoplifting, but in general there was no discernible link between crime and drug use.

3.6 Gender

On the whole, it is suggested by the literature that young males tend to commit more violent crimes than females (Fajnzylber et al. 1998). Jackson et al. (2000) found that men were more likely to commit crimes due to their gambling habit than females.

Women are less likely to gamble than men, and those that become problem gamblers become so because of different reasons than men (Smith and Wynne 2000). In addition, women are more likely to seek help more quickly than men for problem gambling (on average within 5 years), regardless of age. Men took longer to ask for help the older they were (Borderlands Cooperative 2003).

3.7 Unemployment

One of the most debated influences on crime has been unemployment, with mixed evidence for and against. The major question in the literature has been whether crime influences unemployment, or unemployment influences crime. There has been some simultaneity bias found between unemployment and crime (with criminal activity reducing the employability of offenders, hence making it more likely they will offend again).

Raphael and Winter-Ebmer (2001) found that unemployment in the US had a large and significant effect on various crime rates. Unemployment was a much more significant predictor of property crime (burglary, larceny-theft, motor vehicle theft) than violent crime (murder, forcible rape, robbery and aggravated assault). They also suggested that there may be cyclical influences of unemployment on crime, for example, during periods of recession there are fewer consumer durables purchased, lessening the targets for lucrative crime. Unemployment is of course associated with the business cycle, which is also associated with the consumption of normal goods (such as alcohol), and is an indicator of the income opportunities available in the labour market. Masih and Masih (1996) were the first to examine the relationship between unemployment and crime in Australia (from 1963-1990) and found evidence of long-term (albeit weak) cointegration.[3] In Australia from 1964 to 2001, Narayan and Smyth (2004) found that fraud, motor vehicle theft and homicide are cointegrated with male youth unemployment and real male average weekly earnings, but no cointegration was found with break and enter, robbery, serious assault, or stealing (therefore these variables could be used reliably to predict their influences on those crime rates). Lee and Holoviak (2006) examined three countries (Australia, Japan and South Korea) from 1972 to 2001 and found cointegration between unemployment and total and property crime. In particular, the 15-19 years male age group was cointegrated with total, property and violent crime. For Australia, Lee and Holoviak (2006) found evidence of a cointegrating relationship between unemployment and robbery and motor vehicle theft. Bodman and Maultby (1997) looked at Australian crime from 1982 to 1991 and found a significant deterrence relationship between the

[3] Cointegration implies that the two series follow a similar path through time, hence both can be influenced by similar factors.

aggregate unemployment rate and the labour force participation rate and certain categories of property crime.

3.8 Child Maltreatment

The literature has suggested that there are a number of events which condition offending that occur well before children become adults, or even before they attend secondary school. Poverty and child maltreatment are interlinked, with a well-established link between poor parenting and juvenile crime. The situation is made worse by single parent families, large numbers of children, depression, drug use and living in a disadvantaged area (Weatherburn and Lind 1999).

3.9 Marital/Family Status

Overrepresentation of single people living in a shared household who admitted to committing criminal acts due to their gambling behaviour was found by Jackson *et al.* (2000). Masih and Masih (1996) found that divorce rates had a significant impact on Australian crime rates from 1963-1990. MacDonald *et al.* (2004) found that households that rely on government transfers or are single parent or one-person families are less likely to be in the top gambling quintile.

3.10 Enforcement Mechanisms

A common theme in the literature relating to criminal activity, dating back to Becker (1968), is that those who seek to commit a crime will consider the risk of being caught and the associated punishment. Intuitively, greater detection and higher punishments

imply a higher expected cost for criminal activities and hence should be associated with lower crime rates.

There are many ways through which better enforcement of laws can deter crime. Possible measures to improve enforcement may include increasing expenditure on police to facilitate greater detection of criminal activity, improving the efficiency of the judicial system, or imposing appropriate penalties commensurate with the nature of the crime. Several studies have attempted to examine this relationship between crime and enforcement.

Ehrlich (1973) found that police presence had a negative effect on crime. Fajnzylber *et al.* (1998) found that increased expenditure on police resources in a variety of countries was associated with a decrease in crime. For Australia, Withers (1984) found that court committals and imprisonments played a very important role as major deterrent factors. Narayan and Smyth (2006) tested for the endogenity of police presence influencing crime in South Australia from 1921 to 2000 and concluded that with the exception of homicide in the long run, an increase in most crime rates did not result in an increase in police numbers. In the US however, Marvell and Moody (1996) found strong evidence of bivariate Granger causality[4] between police levels and crime rates. Bodman and Maultby (1997) looked at Australian crime from 1982 to 1991 and found a negative deterrent effect of both clearance rates (as a proxy for the probability of punishment) and expected sentence length (as a proxy for the severity of punishment) on the number of property crimes committed.

[4] Bivariate Granger causality is a test associated with time series analysis, looking at whether the past values of one variable can predict the future value of another variable (once their past values have been modelled).

3.11 Education

Average levels of education in a population can determine both the net returns from legal and illegal activities, as well as potentially having a 'civilizing' effect by reducing the incidence of criminal activity. The first effect occurs because greater education is generally associated with higher material well being. Hence, the returns from illegal activity are diluted by potential foregone income from incarceration or fines. The second effect links education and crime more directly by influencing social values.

Little evidence of a link between education and gambling behaviour has been found, except that university-educated households seem to be less likely to gamble or if they do gamble, are less likely to gamble heavily, and the lowest educated households are more likely to gamble heavily (MacDonald et al. 2004). On the other hand, Borderlands Cooperative (2003) reported a link between students and problem gambling on EGMs in Australia, and these students tended to be from overseas countries rather than being born in Australia.

3.12 Area

People living in urban areas are more likely to gamble and also are more likely to spend more (MacDonald *et al*. 2004). Smith and Wynne (2000) also report disparities in regional spending on gambling in Canada. Masih and Masih (1996) found that urbanisation had the second greatest impact on Australian crime rates (from 1963-1990).

3.13 Previous and Surrounding Crime Rates

There is research suggesting that previous crime rates play a large role in determining current crime rates. This is based on the idea that crimes committed in the past fuel future crimes, partly because individuals believe that they may face a lower probability of apprehension (because police are busy chasing other crime or past crime) and hence their belief in being caught decreases over time. The social values of neighbours (and the crime rates in surrounding areas) may play a role in influencing an individual's decision to take part in crime (Glaeser et al. 1996). The implication of social interactions is discussed further in the next chapter.

3.14 Summary

This chapter had detailed some of the main influences on crime. They include: income levels, age, ethnicity, alcohol and other drug consumption, the percentage of males in the population, unemployment rates, regional factors, single parent families, non-English speaking population, probability of arrest (or police presence) and education. The next chapter details how this study has attempted to control for these other variables in order to determine whether EGM expenditure can be an independent predictor of crime rates.

4. METHODOLOGY

This study was designed to investigate whether there is a causal connection between expenditure on EGMs and increased crime rates in Victoria.

As discussed earlier, most previous studies have focused on individual self-reporting through individual/household/prisoner/gambling counselling records or by examining criminal prosecution files, with only a few studies (mainly North American) using a community model of crime research. This study attempts to model the influences on crime in Victoria using cross-sectional analysis of local area data against a variety of community attributes.

The underlying hypothesis is that excessive expenditure on gaming machines in a local area leads to an increase in crime in that area. This is based on the belief that problem gamblers tend to gamble in areas close to their home or workplace (as discussed in section 1.2.1), and that criminal behaviour as a result of problem gambling tends to be more based on opportunity rather than being planned, and is thus more likely to occur in the same local area as the gambling took place. As the crimes linked to problem gambling tend to be income-generating crimes (to fund the gambling habit), it is expected that the crimes most influenced by gambling will be those of theft, fraud, break and enter, forgery, false pretences, larceny and robbery. These crimes 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 crimes, and it is hypothesised that gambling expenditure should not be significantly related to such crimes, or at the very least, any significant positive relationship would be very weak.

There is an argument that some violent criminal offences are committed by frustrated problem gamblers (Productivity Commission, 1999) but this issue is not the focus of this research.

4.1 Analytical Methodology

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

$$\text{Crime}_t = \beta_0 + \beta_1\text{Socioeconomic and Demographic Characteristics of Area}_t + \beta_2\text{Alcohol Licences}_t + \beta_3\text{Regional Characteristics}_t + \beta_4\text{Gaming Expenditure}_t + \beta_5\text{Drug Offences}_t \quad (1)$$

where t is the time period (namely models for 1996; 2001 and 2006), and a variety of crime rates (such as income- and non-income-generating crime rates, broken down into person, property and other) are the dependent variables. 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. All in all, we have 27 models, looking at the influence on nine different types of crime across three Census years in Victoria.

Socioeconomic characteristics that were tested (all sourced from ABS census data)[5] 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

[5] ABS provided specialised data requests via SuperTable.

proportion of those who rent their dwelling; and the social disadvantage index. The number of venues with licences to sell alcohol per adult of the population was provided by the Victorian Department of Justice (this was used as a proxy for alcohol consumption). The third independent variable in equation (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 an 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). The fifth explanatory variable employed was drug offences in an area (a proxy for drug use).

A number of variables that have been made available by other police organisations in other states such as drink driving statistics and charges levied by police in local areas were not available for Victoria.

4.1.1 Endogeneity Issues

Conventionally, equation (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 offences. This is because crimes, particularly income-generating crimes, 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. One of the remedies commonly used to eliminate the endogeneity problem is to use the two stage least squares (2SLS) estimation process. The need for this is discussed later.

4.1.2 Spatial Dependence

The other modelling concern is due to the geographical nature of the cross sectional observations, which implies that it is possible for crimes in neighbouring areas to impact on 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. OLS is inappropriate in the presence of spatial dependence and a spatial estimator will need to be used to address this issue if spatial dependence is present.

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, neighbours, 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. Hence, income-generating crime may be more influenced by spatial dependence (or social interactions) than non-income-generating crime.

According to Anselin (2006) spatial dependence takes two major forms, spatial lag dependence and spatial error dependence. The spatial lag dependence is modelled by including a function of the dependent variable observed at other locations on the right hand side:

$y_i = g(y_{Ji,}\, \theta) + x_i\beta + \varepsilon_i$

where J_i includes all the neighbouring locations j of i, with $j \neq i$.

The function g typically is simplified by using a spatial weights matrix[6]. The spatial autoregressive model then takes the form:

$$y=\rho Wy + X\beta + \varepsilon$$

where ρ is the spatial autoregressive coefficient. With a row-standardised spatial weights matrix, this amounts to including the average of the neighbours of an area as an additional variable into the regression specification. This is referred to as a spatially lagged dependent variable, or a spatial lag. In this report, this variable is measured as the average of the crime rates in the neighbouring locations. Neighbouring locations were those SLAs whose boundaries touched the SLA in question.[7]

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. The spatial covariance structure can be obtained in a number of ways. The first approach is by a spatial autoregressive process:

$$\varepsilon_i = \lambda \sum_j w_{ij}\varepsilon_j + u_i$$

[6] We used the ABS Census of Population and Housing, Selected Characteristics for UrbanCentres and Localities, Victoria (2001) to generate the statistical local area (SLA) spatial matrix as this publication includes maps for SLAs in Victoria in 2001. Due to the slight difference of SLAs between 1996 and 2006, we used the spatial matrix in 2001 for 1996 and 2006, and hence we had to delete certain SLAs for 1996 and 2006. For 1996, the deleted SLAs were Melbourne (C)-Inner (this had to be dropped as it has no border with other SLAs given Melbourne (C)-Remainder was dropped), Wyndham (C)-NorthWest, Wyndham (C)-Werribee and Wyndham (C)-Bal. For 2006, the deleted SLAs were Delatite (S)-Benalla, Delatite (S)-North, Delatite (S)-South, Knox (C)-North, Whittlesea (C)-South and Yarra Ranges (S)-SouthWest. Note: (C) = cities and (S) = shire.

[7] In both the spatial lag and spatial error models, the spatial weights matrix could be alternatively specified as one weighted by the distance between two locations. This specification assigns a higher weight to other locations that are closer to the location in question and a lower weight to other locations that are further to the location in question. The weight is usually calculated by the inverse of the distance between two locations. However this specification is not adopted in the current report due to technical difficulties in measuring the distances between two SLAs. Further advanced work could consider using GIS (geographical information systems) to model the average of distances from one SLA to another.

where λ is the autoregressive parameter and u_i is a random error term (typically assumed to be *i.i.d*) (Anselin 2006).

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 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 (Anselin 2006). If neither test statistic is significant, it indicates spatial dependence is not present and spatial modelling is not necessary. This issue is further discussed later.

4.2 Data Issues and Sources

The community level analysis used in this study requires information on socio-demographic and area level characteristics. The ABS provides consistent socio-demographic estimates at various geographical hierarchies (spatial units) over time (via the Census). Apart from Australia in total and totals for states and territories, the Australian geographical hierarchy is as follows:

Collection District (CD): An area that one collector can cover and deliver censuses to in around ten days. In 2001 there were 37,209 CDs;

Statistical Local Area (SLA): A SLA contains one or more CDs and is based on the boundaries of incorporated bodies of local government areas (LGAs) where these exist. These bodies are the Local Government Councils. An LGA often contains two or more SLAs. In 2001 there were 1,353 SLAs and 624 LGAs;

Statistical Subdivisions (SSD): A general purpose spatial unit of intermediate size that contains one or more SLAs. In 2001 there were 207 SSDs;

Statistical Divisions (SD): A general purpose spatial unit that is the largest and most stable unit within each state. It contains one or more SSDs, and in the 2001 Census there were 66 SDs.

Postcodes are not part of the official hierarchy, and can fall anywhere between a CD and a SLA.

This study used SLAs as its level of area analysis. The Victorian Commission for Gambling Regulation provided net gaming expenditure data by venue from 1992 to 2007, and offence data were provided by Victoria Police from 1993-94 to 2006-07. Hence, when combined with ABS census data, there were three years which were available to model the relationship between gaming expenditure and crime, namely 1996, 2001 and 2006. There were 210 SLAs in Victoria in 2006, with 79 of these in Melbourne (ABS 2006). In 2001, there were 200 SLAs, with 75 in Melbourne (ABS 2001), the same as in 1996.

As discussed previously in section 1.2.1, SLAs are thought to be the most relevant unit of area analysis upon which to model the links between gaming expenditure and crime. Unfortunately for this analysis, there were significant changes to the boundaries of SLAs in Victoria from the 1990s onwards, which does not allow for a panel data analysis of SLAs (i.e. adding census years together to create a much larger dataset upon which to model). Therefore the years 1996, 2001 and 2006 had to be modelled separately.[8]

[8] All the original data relating to liquor licences, offences, ATO taxable income and gaming expenditure were grouped by postcodes. We concorded data from postcodes to SLAs using concording files provided by ABS for 1996, 2001 and 2006. There are some postcodes that had gaming, liquor or offence data that are not in the ABS concording files. For these postcodes, we used suburbs to help classify them into relevant SLAs, according to the Australia Post webpage

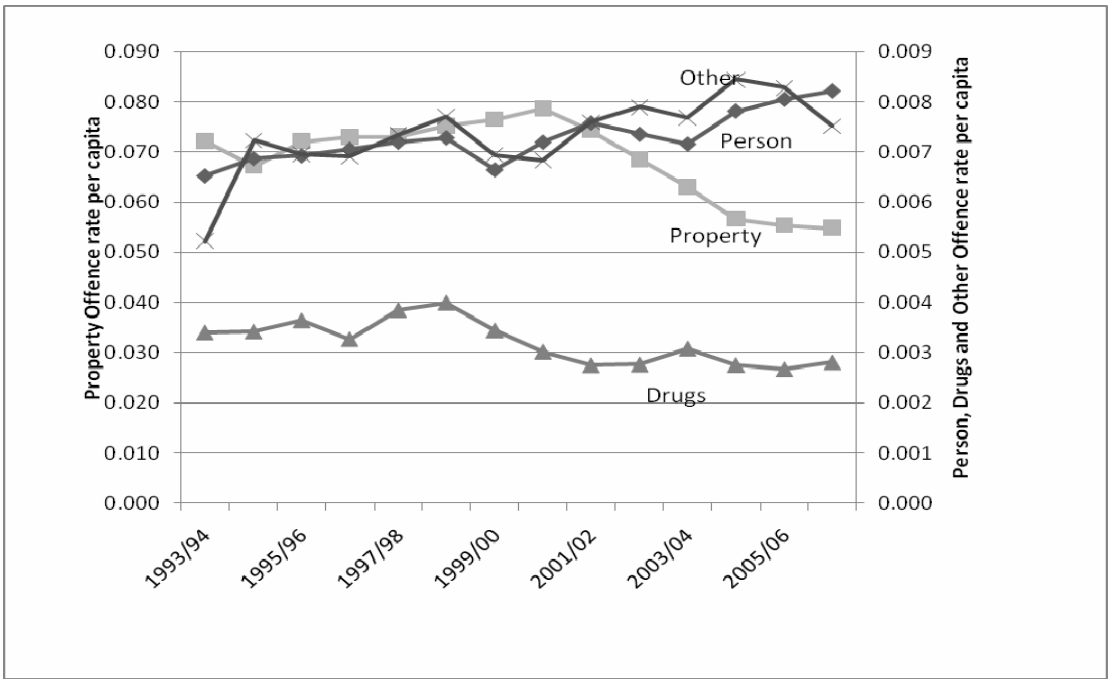
Due to the presence of the Crown Casino, the SLA of Melbourne Southbank Docklands was removed from our databases for 2001 and 2006, and in 1996 Melbourne remainder was excluded. This is because a large proportion of the gamblers in the Crown Casino are either tourists or do not live in the surrounding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

4.2.1 Offence data

Data were requested on all recorded offences, drug offences, drink driving charges, and total charges made, from the Victorian Police. Information was only available for offence data from the Law Enforcement Assistance Program (LEAP) database from 1993-94 to 2006-07.

(http://www1.auspost.com.au/postcodes/). This was necessary for only a very small percentage of postcodes overall.

Figure 3 Property, Person, Drugs and Other Offence Rates per Capita in Victoria



Source: Victoria Police

Recorded crime consists of those offences recorded on LEAP during the reporting period, regardless of when the offence occurred or when it was reported to police. The offence data included totals for: Crime against the person; crime against property; drug offences; and other crime. Figure 3 illustrates the changes in offence rates (taking population into account) over this time period. Property crime dominated the offences until 2001/2, and although it is still the main offence, it has decreased in absolute numbers since then. Person-related crime rates and other crime rates have generally increased over the time period, while drug offence rates per capita have fallen a small amount.

Data were also provided for the 27 major categories of crime classified by Victoria Police. Table 3 illustrates the categories, as well as our classification of whether they are income- or non-income-generating crime.

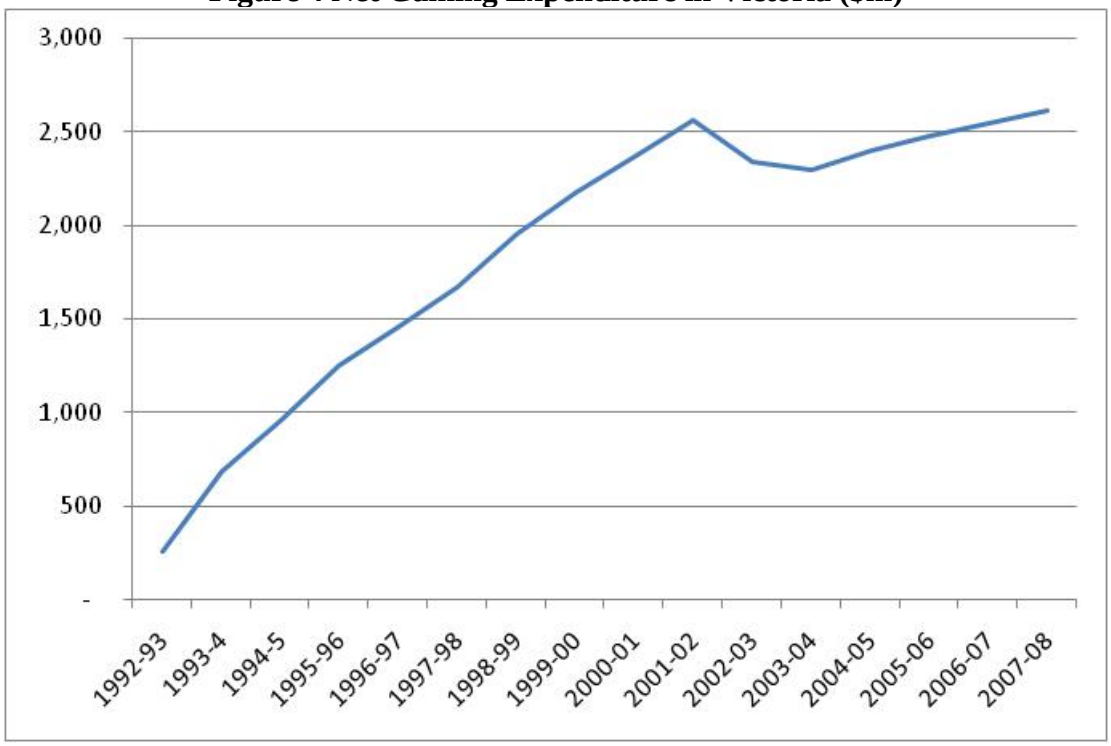
Table 3 Classification of Victorian Offences into Income- or Non-Income-Generating

	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

4.2.2 Gaming data

Data were collected on the net gaming expenditure by postcode in Victoria from 1992-93 to 2006-07. Figure 4 illustrates the trend in annual net gaming expenditure. As noted previously, we then concorded the data to the SLA level for 1996, 2001 and 2006.

Figure 4 Net Gaming Expenditure in Victoria ($m)



Source: Department of Justice

Table 4 illustrates that net EGM expenditure in Victoria fell in the early 2000s (most likely due to the smoking ban introduced in 2002-03), but increased from 2004 through to 2006. Average expenditure per adult fell marginally from $662 in 2001 to $647 in 2008.

Table 4 Victorian Gaming Profile from 2000 to 2008

Date	No. of Venues	No. of EGMs	Net EGM expenditure	Average no. EGMs per 1,000 adults	Average no. adults per venue	Average net EGM expenditure per adult
30/06/2000	536	27,408	$2,170,581,995	7.76	6,589	$615
30/06/2001	537	27,444	$2,366,016,584	7.68	6,653	$662
30/06/2002	534	27,400	$2,562,820,950	7.45	6,891	$696
30/06/2003	532	27,260	$2,334,294,514	7.33	6,994	$627
30/06/2004	530	27,132	$2,290,929,976	7.11	7,202	$600
30/06/2005	523	27,124	$2,393,030,966	7.01	7,401	$618
30/06/2006	521	27,147	$2,472,451,853	6.92	7,533	$630
30/06/2007	522	27,279	$2,543,175,356	6.86	7,623	$639
30/06/2008	520	26,797	$2,611,507,885	6.64	7,759	$647

Source:http://www.vcgr.vic.gov.au/CA256F800017E8D4/Statistics/FD7EA8DF7FD68F8ECA257067001AB256?Open Last Accessed 2/7/09

4.3 Empirical Results

The table below describes the final variables used in our models and how they were measured.

Table 5 Variable Descriptions for the Final Models

	Dependent Variables		***Independent Variables***
igcrimep	Income-generating crimes per capita	stdgexpp	Standardised net gaming expenditure per capita
perigp	Income-generating person crimes per capita	stddrugp	Standardised drug offences per capita
proigp	Income-generating property crimes per capita	stdliqp	Standardised liquor licences per capita
otherigp	Income-generating other crimes per capita	stddisadvant	Standardised ABS disadvantage index.
ngcrimep	Non-income-generating crimes per capita	stddisandadvant	Standardised ABS disadvantage & advantage index
perngp	Non-income-generating person crimes per capita	stdmalep	Standardised number of males per capita
prongp	Non-income-generating property crimes per capita	stdteenp	Standardised number of teenagers per capita
otherngp	Non-income-generating other crimes per capita	stdage70p	Standardised number of persons aged 70+ per capita
totcrimep	Total crimes per capita	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	Standardised area of SLA in square kms

4.3.1 Modelling Issues

Several modelling issues were encountered with our models of influences on various crime rates. First, multicollinearity problems were found with several of the explanatory variables. Many of the socio-economic variables were highly correlated with each other and hence some were dropped from the analysis (for example, income of an SLA and unemployment within the SLA). Using the ABS index of disadvantage and eliminating a range of demographic variables helped address these correlation

issues. The socio-economic disadvantage index includes the following 17 measures (in percent):

- occupied private dwellings with no internet connection
- employed people classified as labourers
- people aged 15 years and over with no post-school qualifications
- people with stated annual household equivalised income between $13,000 and $20,799
- households renting from government or community organisations
- people (in the labour force) unemployed
- one parent families with dependent offspring only
- households paying rent less than $120 per week
- people aged under 70 who have a long-term health condition or disability and need assistance with core activities
- occupied private dwellings with no car
- people who identified themselves as being of Aboriginal and/or Torres Strait Islander origin
- occupied private dwellings requiring one or more extra bedrooms
- people aged 15 years and over who are separated or divorced
- employed people classified as machinery operators or drivers
- people aged 15 years and over who did not go to school
- employed people classified as low skill community and personal service workers
- people who do not speak English well.

This index is a general socio-economic index that summarises a wide range of information about the economic and social resources of people and households within an area. It only includes measures of relative disadvantage, and a higher 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.

This index was the only one available for the census year of 1996 and was used in our models for this year.

For 2001 and 2006, the Index of Relative Socio-economic Advantage and Disadvantage was available (not available in 1996). It measures a continuum of advantage (high value) to disadvantage (low value), and is comprised of 21 variables. In pretesting of the models we used this index in 2001 and 2006, and results changed only very marginally (and were not significantly different). Therefore, for consistency purposes we used the narrower Index of Relative Socio-economic Disadvantage in all three years.

As discussed previously, tests for endogeniety of gaming expenditure were carried out.[9] A failure to reject in the test indicates that gaming expenditure is exogenous and 2SLS estimation is not required. Our tests revealed that endogeneity was likely for some variables (gaming expenditure, drug offences and some of the previously-used socio-economic characteristics), and hence 2SLS was needed to estimate some of the models.

The endogeneity of socio-economic characteristics in our models was solved by replacing them with the ABS Disadvantage Index (which upon testing was found not to be endogenous). This left endogeneity problems with some gaming expenditure variables and drug offences in a few models.

In order to use 2SLS, we needed to find appropriate instruments for gaming expenditure and drug offences (the ABS Disadvantage Index replaced the endogenous socio-economic variables and this index was found not to be endogenous). Greene (2008 p.316) states that instrument variables must have two properties: a)

[9] See Hayashi (2000, pp. 233-34) for an explanation of these tests.

Exogeneity: They must be uncorrelated with the disturbance; and b) Relevance: they must be correlated with the independent variables.

Available instruments for gaming expenditure are the number of EGMs in an SLA (which is currently not included in our model) or the previous year's gaming expenditure (ie; using gaming expenditure for 2005 as an instrument for gaming expenditure in 2006). Greene (2008 pp324-325) used lagged real disposable personal income as an instrument for current real disposable personal income to help solve an endogeneity problem.

For the instrument for drug offences, possible candidates include other demographic characteristics of an SLA that are not used as separate explanatory variables in the estimation (and do not cause multicollinearity problems)[10] or the previous year's drug offences.[11]

It was found that using the previous year's drug offences was not a weak instrument for current drug offences, and so we could include drug offences in our models. One interesting outcome of this is that once this additional drug variable was included (with its endogeneity 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 endoegenity of gaming expenditure remained an issue in 1996, we had two instruments for gaming expenditure to choose

[10] The closest demographic characteristic found was the percentage of the population that is enrolled as tertiary students. However a test for weak instruments after 2SLS was carried out and it indicated that tertiary student percentage is a weak instrument for drug offences.

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

from, and the test for weak instruments indicated that EGM licence numbers and past gaming expenditure were not weak instruments (and that past gaming expenditure was a better instrument than licence numbers, and so this variable was used as an instrument in the model/s).

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 needed as an additional variable for some crime functions. Table 6 summarises the occurrence of spatial dependence and endogeniety in our models across the three years, and shows what type of model was used in the final regression form for all crime types.

Table 6 Summary for spatial dependence and endogeneity tests and the final model used

Dependent variable	*Spatial dependence*			*Gexpp Endogenous*			*Drugp Endogenous*			*Final Model (robust)*		
	1996	*2001*	*2006*	*1996*	*2001*	*2006*	*1996*	*2001*	*2006*	*1996*	*2001*	*2006*
igcrimep	N	Y	N	Y	N	N	N	Y	Y	2SLS	2SLS & spatial lag	2SLS
perigp	N	N	N	N	N	N	Y	Y	Y	2SLS	2SLS	2SLS
proigp	N	Y	N	Y	N	N	N	Y	Y	2SLS	2SLS & spatial lag	2SLS
otherigp	N	N	Y	N	N	N	N	N	N	OLS	OLS	spatial lag
ngcrimep	N	Y	N	N	N	N	N	N	Y	OLS	spatial error	2SLS
perngp	N	Y	N	N	N	N	N	N	Y	OLS	spatial error	2SLS
prongp	N	N	Y	N	N	N	N	Y	N	OLS	2SLS	spatial error
otherngp	N	N	N	N	N	N	N	N	Y	OLS	OLS	2SLS
totcrimep	N	Y	N	N	N	N	N	Y	Y	OLS	2SLS & spatial lag	2SLS

Unfortunately, it was not possible to correct for endogeneity issues and spatial dependence issues in the same model simultaneously,[12] and so for some crime models

[12] STATA Version 10 (a common econometrics program) was used to undertake the econometrics and it was unable to correct for both problems. There is only a small number of econometric packages (none that we have available to us), that apparently can correct for these two issues simultaneously.

we need to report the results of both spatial and 2SLS estimators for estimations with both spatial dependence and endogeneity problems. Spatial dependence and endogeneity issues were only simultaneously found in three cases in 2001 (as shown in Table 6). Hence, for 2001, the 2SLS models of income-generating crime, property income-generating crime and total crime suffer from spatial dependence. The spatial lag versions of these models in 2001 use drug offences in 2000 as a proxy for current drug offences to minimise the problem of endogeneity.[13] 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 offences was not in the regression. In the interest of total transparency, Appendix One therefore presents the results for 2001 spatial models where current drug offences are used instead of lagged drug offences. It can be seen that the coefficient of current drug offences in the models in Appendix One is larger than the coefficient of lagged drug offences in the income-generating crime models in Table 8 (and the coefficient of the gaming variable is correspondingly lower). We have presented the results of all the models for 2001.

For all the estimations, we standardised (to a mean of 0 and a standard deviation of 1) all independent variables (with the exception of course of the 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 standardised explanatory variable.

[13] Note, the lagged version of drug offences was used directly as a variable in the regression rather than as an instrument as was the case in the 2SLS models.

4.3.1 Summary of Key Results

Tables 7 to 9 illustrate the influences on various types of crime in Victoria in 2006, 2001 and 1996. 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. Note, the most important variable (in terms of adding explanatory power) in all models tends to be drug offences. When drug offences are not included in the models the R squared generally drops by approximately 0.2.

The coefficient on the gaming expenditure variable in the models for income-generating crime ranges from 0.04 in 1996, to between 0.012 and 0.033 in 2001 (two models were estimated for income-generating crime in this year) and 0.006 in 2006. Thus a one standard deviation increase in per capita EGM expenditure in Victoria in 2006 increased the income-generating offence rate per capita by 0.006.

Another way of explaining the influence of EGM expenditure on income-generating crime is to explore the unstandardised coefficients.[14] The coefficients on all the gaming variables ranged from 0.00001 to 0.0001 across the three years. For example, one additional net dollar per adult spent on EGMs in Victoria in 2006 increased the income-generating offence rate per capita by only 0.00002.

In summary, the results reveal that:

- 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 respectively 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);

[14] Due to the large number of models already in this report, unstandardised results (apart from the coefficients reported in this paragraph) are not shown, but are available upon request.

Table 7 Various Influences on Income and Non-income-generating Crimes in Victoria in 2006

2006	*igcrimep*		*perigp*		*proigp*		*otherigp*		*ngcrimep*		*perngp*		*prongp*		*otherngp*		*totcrimep*	
	2SLS		*2SLS*		*2SLS*		*Spatial lag*		*2SLS*		*2SLS*		*Spatial Error*		*2SLS*		*2SLS*	
	Coef.	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*
stdgexpp	0.006	0.01	-0.000	0.94	0.006	0.00	0.000	0.39	0.005	0.00	0.001	0.01	0.004	0.00	0.002	0.07	0.011	0.00
stddrug	0.059	0.00	0.001	0.00	0.058	0.00	0.000	0.00	0.026	0.00	0.008	0.00	0.001	0.03	0.016	0.00	0.085	0.00
stdliqp	-0.000	0.04	-0.000	0.02	-0.001	0.00	-0.000	0.02	-0.000	0.02	-0.000	0.00	0.000	0.65	-0.000	0.00	-0.001	0.00
stddisadvant	0.006	0.00	0.000	0.00	0.006	0.00	-0.000	0.12	-0.002	0.17	-0.001	0.01	-0.001	0.01	-0.001	0.33	0.004	0.07
stdmalep	0.000	0.87	0.000	0.69	0.000	0.99	-0.000	0.39	-0.002	0.04	-0.001	0.02	-0.001	0.00	0.001	0.45	-0.002	0.40
stdteenp	-0.003	0.05	-0.000	0.03	-0.003	0.04	-0.000	0.59	0.000	0.70	0.000	0.65	-0.000	0.89	0.000	0.40	-0.002	0.29
stdage70p	0.000	0.91	-0.000	0.84	-0.000	0.93	-0.000	0.64	-0.002	0.11	-0.001	0.03	-0.001	0.02	0.001	0.41	-0.002	0.33
inner	0.017	0.21	-0.000	0.92	0.016	0.23	0.000	0.04	-0.018	0.01	-0.004	0.08	0.004	0.07	-0.015	0.00	-0.000	1.00
north	0.004	0.37	0.000	0.16	0.005	0.30	0.000	0.44	-0.003	0.24	-0.001	0.17	-0.001	0.61	-0.002	0.28	0.001	0.87
south	0.003	0.57	0.000	0.00	0.001	0.80	0.000	0.32	0.001	0.58	0.001	0.29	0.001	0.52	-0.001	0.70	0.001	0.83
east	0.006	0.19	0.000	0.02	0.005	0.26	0.000	0.10	-0.001	0.69	-0.000	1.00	-0.000	0.99	-0.001	0.42	0.003	0.71
west	0.009	0.09	0.000	0.19	0.007	0.13	0.000	0.24	-0.008	0.01	-0.001	0.07	-0.002	0.10	-0.004	0.03	-0.001	0.84
reindex96	0.000	0.94	-0.000	0.49	0.000	0.97	-0.000	0.75	0.005	0.02	0.002	0.02	0.002	0.14	0.001	0.47	0.005	0.34
stdslasize	-0.002	0.06	-0.000	0.18	-0.002	0.08	-0.000	0.20	-0.002	0.01	-0.000	0.04	-0.001	0.20	-0.000	0.31	-0.004	0.04
Constant	0.036	0.00	0.000	0.01	0.036	0.00	0.000	0.11	0.020	0.00	0.006	0.00	0.007	0.00	0.008	0.00	0.056	0.00
Obs	201		201		201		188		201		201		188		201		201	
F statistic	181		214		173		1529*		1180		811		781*		804		408	
Prob	0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
R-Squared	0.94		0.91		0.94		0.71		0.91		0.90		0.67		0.89		0.95	

* This is the Log likelihood statistics for the spatial lag regression.

** Note, in a number of the models above, the variables seem to have no influence on crime (i.e., those with coefficients of 0.000). However, this is not a true reflection of their impact, if there were greater decimal points all would have non-zero coefficients, but the table space above does not allow for an increase in decimal spaces.

Table 8 Various Influences on Income and Non-income-generating Crimes in Victoria in 2001

	igcrimep				*perigp*		*proigp*				*otherigp*	
2001	*2SLS*		*Spatial lag*		*2SLS*		*2SLS*		*Spatial lag*		*OLS*	
	Coef.	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*
stdgexpp	0.012	0.07	0.033	0.00	0.000	0.94	0.012	0.06	0.033	0.00	0.000	0.00
stddrug	0.081	0.00	-	-	0.002	0.00	0.079	0.00	-	-	0.000	0.00
stddruglagged	-	-	0.044	0.00	-	-	-	-	0.043	0.00	-	-
stdliqp	0.010	0.11	0.026	0.00	-0.000	0.96	0.010	0.10	0.026	0.00	-0.000	0.92
stddisadvant	0.004	0.09	0.000	0.97	0.000	0.00	0.004	0.09	0.000	0.98	-0.000	0.57
stdmalep	-0.008	0.13	-0.003	0.25	-0.000	0.54	-0.008	0.12	-0.003	0.24	-0.000	0.11
stdteenp	-0.003	0.30	0.001	0.59	-0.000	0.06	-0.003	0.31	0.001	0.57	-0.000	0.06
stdage70p	-0.004	0.19	-0.004	0.11	-0.000	0.40	-0.004	0.18	-0.004	0.11	-0.000	0.36
inner	0.069	0.00	0.067	0.00	0.002	0.00	0.067	0.00	0.065	0.00	0.000	0.02
north	0.004	0.56	0.013	0.05	0.000	0.15	0.004	0.58	0.012	0.05	0.000	0.26
south	0.009	0.13	0.013	0.03	0.000	0.01	0.009	0.13	0.012	0.04	0.000	0.72
east	0.010	0.13	0.020	0.01	0.000	0.00	0.010	0.15	0.019	0.01	0.000	0.12
west	0.006	0.42	0.003	0.68	0.000	0.05	0.005	0.43	0.003	0.70	-0.000	0.94
reindex96	-0.006	0.22	0.004	0.36	-0.000	0.24	-0.006	0.21	0.004	0.36	0.000	0.49
stdslasize	-0.004	0.17	-0.007	0.00	-0.000	0.28	-0.004	0.17	-0.007	0.00	-0.000	0.38
Constant	0.063	0.00	0.031	0.00	0.001	0.00	0.063	0.00	0.030	0.00	0.000	0.08
Obs	194		194		194		194		194		194	
F statistic	817		471*		864		803		475*		364	
Prob	0.00		0.00		0.00		0.00		0.00		0.00	
R-Squared	0.96		0.96		0.94		0.96		0.96		0.83	

* This is the Log likelihood statistics for the spatial lag regression.
** Note, in a number of the models above, the variables seem to have no influence on crime (i.e., those with coefficients of 0.000). However, this is not a true reflection of their impact, if there were greater decimal points all would have non-zero coefficients, but the table space above does not allow for an increase in decimal space.

Table 8 (continued) Various Influences on Income and Non-income Generating Crimes in Victoria in 2001

	ngcrimep		*perngp*		*prongp*		*otherngp*		*totcrimep*			
2001	*Spatial error*		*Spatial error*		*2SLS*		*OLS*		*2SLS*		*Spatial lag*	
	Coef.	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*
stdgexpp	0.008	0.00	0.002	0.00	0.004	0.00	0.002	0.00	0.020	0.01	0.047	0.00
stddrug	0.019	0.00	0.005	0.00	0.000	0.75	0.013	0.00	0.101	0.00		
stddruglagged											0.056	0.00
stdliqp	0.004	0.03	0.001	0.03	0.001	0.35	0.002	0.09	0.012	0.12	0.033	0.00
stddisadvant	-0.002	0.09	-0.001	0.03	-0.001	0.08	-0.000	0.53	0.002	0.39	-0.002	0.52
stdmalep	-0.002	0.02	-0.001	0.10	-0.001	0.09	-0.001	0.27	-0.010	0.08	-0.004	0.26
stdteenp	0.001	0.39	0.000	0.56	0.000	0.50	0.001	0.03	-0.002	0.66	0.003	0.42
stdage70p	-0.000	0.70	-0.000	0.66	-0.000	0.58	0.000	0.63	-0.004	0.27	-0.005	0.20
inner	0.006	0.30	0.002	0.41	0.004	0.04	0.003	0.28	0.078	0.00	0.087	0.00
north	0.000	0.91	0.000	0.69	-0.001	0.53	0.001	0.30	0.005	0.60	0.016	0.06
south	-0.001	0.72	-0.001	0.52	-0.002	0.06	0.002	0.09	0.008	0.26	0.013	0.09
east	-0.001	0.63	-0.000	0.72	-0.002	0.06	0.002	0.16	0.009	0.31	0.022	0.04
west	-0.006	0.10	-0.002	0.12	-0.003	0.03	-0.000	0.74	0.001	0.94	0.000	1.00
reindex96	0.006	0.02	0.002	0.09	0.002	0.05	0.003	0.00	0.000	0.96	0.011	0.06
stdslasize	-0.002	0.02	-0.001	0.01	-0.000	0.48	-0.001	0.01	-0.006	0.07	-0.010	0.00
Constant	0.017	0.00	0.005	0.02	0.008	0.00	0.004	0.04	0.079	0.00	0.044	0.00
Obs	194		194		194		194		194		194	
F statistic	665*		874*		113		134		788		418*	
Prob	0.00		0.00		0.00		0.00		0.00		0.00	
R-Squared	0.93		0.88		0.72		0.95		0.96		0.96	

* This is the Log likelihood statistics for the spatial lag regression.

** Note, in a number of the models above, the variables seem to have no influence on crime (ie, those with coefficients of 0.000. This is not the case, if there were greater decimal points all would have non-zero coefficients, having the table space above does not allow an increase in decimal space.

Table 9 Various Influences on Income and Non-income-generating Crimes in Victoria in 1996

	igcrimep		*perigp*		*proigp*		*otherigp*		*ngcrimep*		*perngp*		*prongp*		*otherngp*		*totcrimep*	
1996	*2SLS*		*2SLS*		*2SLS*		*OLS*		*OLS*		*OLS*		*OLS*		*OLS*		*OLS*	
	Coef.	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*	*Coef.*	*prob.*
stdgexpp	0.041	0.00	0.003	0.00	0.040	0.00	0.000	0.01	0.014	0.00	0.004	0.00	0.005	0.04	0.005	0.00	0.050	0.00
stddrug	0.145	0.00	0.000	0.14	0.143	0.00	0.001	0.00	0.037	0.00	0.012	0.00	0.007	0.03	0.018	0.00	0.186	0.00
stdliqp	0.038	0.00	0.000	0.33	0.038	0.00	-0.000	0.40	0.004	0.22	0.001	0.55	0.001	0.34	0.002	0.18	0.043	0.00
stddisadvant	0.004	0.02	0.000	0.00	0.004	0.02	-0.000	0.87	-0.001	0.27	-0.001	0.10	-0.000	0.41	-0.000	0.73	0.003	0.21
stdmalep	-0.001	0.61	0.000	0.04	-0.002	0.56	0.000	0.16	-0.004	0.00	-0.001	0.11	-0.002	0.00	-0.001	0.23	-0.006	0.06
stdteenp	0.004	0.09	0.000	0.05	0.003	0.09	-0.000	0.62	0.002	0.10	0.000	0.34	0.000	0.48	0.001	0.01	0.005	0.05
stdage70p	0.000	0.94	0.000	0.07	0.000	0.98	0.000	0.10	-0.001	0.17	-0.000	0.91	-0.001	0.02	-0.000	0.87	-0.001	0.65
inner	0.040	0.00	0.001	0.07	0.039	0.00	-0.000	0.50	0.001	0.85	0.001	0.57	0.001	0.59	-0.002	0.57	0.039	0.01
north	0.013	0.05	0.000	0.21	0.013	0.04	-0.000	0.56	-0.001	0.84	0.000	0.85	-0.001	0.52	0.000	0.95	0.013	0.10
south	0.016	0.01	0.000	0.01	0.016	0.00	-0.000	0.50	-0.002	0.44	0.001	0.64	-0.002	0.12	-0.001	0.56	0.015	0.04
east	0.022	0.00	0.000	0.00	0.021	0.00	-0.000	0.93	-0.002	0.41	0.000	0.73	-0.002	0.13	-0.001	0.58	0.020	0.02
west	0.010	0.18	0.000	0.73	0.010	0.17	-0.000	0.25	-0.002	0.51	-0.001	0.51	0.001	0.61	-0.003	0.07	0.008	0.42
reindex96	-0.007	0.07	-0.000	0.01	-0.007	0.08	-0.000	0.23	0.004	0.06	0.002	0.05	0.000	0.74	0.002	0.05	-0.004	0.48
stdslasize	-0.005	0.03	-0.000	0.14	-0.005	0.03	-0.000	0.90	0.001	0.70	0.001	0.44	-0.000	0.38	0.000	0.99	-0.005	0.02
Constant	0.070	0.00	0.001	0.00	0.069	0.00	0.000	0.00	0.021	0.00	0.004	0.03	0.010	0.00	0.007	0.00	0.092	0.00
Obs	194		194		194		194		194		194		194		194		194	
F statistic	1192		2798		1190		933		19697		6510		1271		5452		1661	
Prob	0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
R-Squared	0.99		0.99		0.99		0.66		0.97		0.94		0.92		0.97		0.99	

** Note, in a number of the models above, the variables seem to have no influence on crime (i.e., those with coefficients of 0.000). However, this is not a true reflection of their impact, if there were greater decimal points allowed all would have non-zero coefficients, but the table space above does not allow for an increase in decimal spaces.

- Drug offences 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 income-generating crime) than non-income generating crime;
- Liquor licences per capita are significantly positively related to most types of crimes in 1996 and 2001; however the relationship changes in 2006 to a negatively significant one negative weak one for most types of crimes;
- The ABS disadvantage index (where an area became 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 is male was significantly negatively related to non-income-generating property crimes in all years. There was no significant relationship detected with income-generating crimes (with the exception of person income-generating crime in 1996);
- The proportion of teenagers in the population was found to be negatively and significantly related to income-generating crimes (mainly person and property income-generating crimes) in 2006, person and other income-generating crimes in 2001, and income-generating crimes in 1996. It was found to be positively associated with other non-income-generating crime in 2001 and non-income-generating crime in 1996;
- The percentage of the population aged 70 and over is negatively and significantly associated with person and property non-income crimes in 2006,

and property non-income crimes in 1996. It is weakly positively related to person and other income-generating crimes in 1996;

- The dummy for inner Melbourne is significant and positive for income-generating crimes in 2001 and 1996 (with property non-income generating crimes also significant in 1996), with only other income-generating crimes and property non-income generating crimes significant in 2006. The dummy for inner Melbourne is significant and negatively associated with non-income generating crimes in 2006. The dummies for northern, southern and eastern Melbourne have a positive significant influence on some income-generating crimes and total crime 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; and
- SLA size is significantly negatively related to a range of income-generating crimes in all three years, and is also significantly negatively related to non-income-generating and total crime in 2001 and 2006.

5. DISCUSSION

5.1 Gaming Expenditure and Drug Offences - Discussion

This is the third study undertaken by members of this research team to have found a positive and significant influence between gaming expenditure and crime in Australia. 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. The current Victorian study is more sophisticated and thorough in its methodology and is larger than the previous two studies in the sense that it has more units of analysis (over 200 SLAs) and spans three years of observations (1996, 2001 and 2006). On the other hand, the previous studies had access to variables that were not available to us (such as police charges in an area and drink driving charges), which may have changed the Victorian results if they had been available. However, it is unlikely that our findings for the impact of gaming expenditure on crime would have changed, given their strong significance and consistent impact across years and model specifications.

As noted previously, gaming expenditure per capita is significantly and positively associated with all types of crimes in all years. Although it was predicted that if the relationship between gaming expenditure and crime was positive, then the strongest relationships (measured in terms of the size of the standardised coefficient of the gaming variable) should exist between income-generating crime and gaming expenditure, this was not convincingly found. The largest relationship was found with total crimes, followed by income-generating crimes (mainly property income-generating crimes) and then non-income-generating crimes. This was the case for all years in Victoria.

Our other hypothesis that the relationship between gaming expenditure and crime should grow over time (given that problem gambling takes a number of years to develop and get out of control) was not supported. If anything, the impact between gaming expenditure and income-generating crime seems to have lessened from 1996 to 2006 (although the relative difference between 2001 and 2006 is not significant). The same is the case for the relationship between gaming expenditure and non-income generating crimes.

Net gaming expenditure in Victoria did decrease after 2001 (see Figure 4) and only climbed gradually back to a slightly higher level in 2006. Our results may be reflecting this fall off 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, and this was implemented on 1 September 2002. The smoking ban had a sizeable influence on the amount of gaming dollars spent. 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 1999-00 to 2006-07). 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.

Table 4 shows that 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.

In terms of which variables had the greatest relative influence on crime in Victoria from our standardised variables across all years, it seems that drug offences played the largest role. Drug offences were consistently significantly and positively related to all types of crimes, across all years. 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 offences to be a positive significant influence on both South Australian and Tasmanian crime levels. Drug offences 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 crimes (that is, there is no causality between crime and drug offences). Fortunately we were able to instrument the drug offence variable in our models with the previous year's drug offences.

The variables with the next largest influence were gaming expenditure, liquor licences 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 (we used the previous year's gaming expenditure as an instrument). Therefore, in our models it was gaming expenditure causing changes in crime rates, and not the other way around. This indicates that the causal relationship runs from gaming to crime, though this does not hold for every type of crime across the years. However, this relationship only occurred once we had a fully specified model with drug offences instrumented within it. Without drug offences as a variable, gaming expenditure tested positive for endogenity (hence the gaming variable was taking on some of the relationship of the omitted drug variable). Drug offences were found to be endogenous in mostly 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.

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, neighbours, 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).

5.2 Discussion of Other Variables

Unfortunately, because of modelling problems we could not include a range of variables (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. One problem with including these indexes is that they are a composite of a wide range of variables (17), 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 quite 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 flawed. On the other hand, it can 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 offences 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 theory). These results are indicating the importance of drug offences and gaming expenditure in local areas, 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 above 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 (see, for example, 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 took into account 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 licences per capita in an SLA was significantly and positively related to most crime types, supporting the hypothesis that alcohol availability is linked with crime. This is an issue of whether the existence of liquor licences facilitates the co-existence of gambling and alcohol consumption is a question that warrants further consideration.

In terms of our age variables, we generally found that the percentage of teenagers in an area was associated with an increase in non-income-generating crime (mainly other non-income-generating crime such as harassment and behaviour in public). Interestingly, the percentage of teenagers in the population was negatively associated with some forms of income-generating crime for some years. Other studies have not distinguished between income- and non-income-generating crime, and this may be one reason for the differences that we have found and is of interest in its own right. Increases in the percentage of older people in the population in a SLA were negatively associated with non-income-generating crime rates, conforming to our expectations from the literature (Raphael and Winter-Ebmer 2001).

6. CONCLUSION

The relationship between gaming expenditure and crime in Victoria, in particular income-generating crime, was consistently significant and positive from 1996 to 2006. Comparisons between our research and existing findings for South Australia and Tasmania are difficult to make because of the different methodologies and variables used in each study, although each suggests that gaming expenditure plays a part in influencing crime. There was only limited evidence that gaming expenditure in Victoria is endogenous (in terms of those who live in areas with high crimes being more likely to gamble), and where it existed it was most evident for income-generating crimes. Our drug offence variable was much more likely to be endogenous than the gaming variables in the models. 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.

A positive and significant relationship was found between gaming expenditure and other crime rates as well, although the results did not confirm all the hypotheses suggested in the review of the likely impact of our many variables of interest. The extent of the relationship between gaming expenditure and crime generally is not as large as other influences. Key social influences (such as drug offences, regional impacts, alcohol licences and urbanisation) played important and significant roles in impacting on crime. Overall we believe that the models have performed well, had extremely high explanatory power, and provided results generally consistent with theoretical expectations. All in all, this report has provided strong and robust evidence of a positive and significant link between gaming expenditure and crime (in

particular, income-generating crime) in Victoria across the three years (1996, 2001, and 2006) under review in this investigation.

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APPENDIX 1:
Spatial model with Current Drug Offences (2001)

	igcrimep		proigp	
	Spatial lag		Spatial lag	
2001	Coef.	prob.	Coef.	prob.
stdgexpp	0.019	0.00	0.019	0.00
stddrugp	0.059	0.00	0.057	0.00
stdliqp	0.022	0.00	0.022	0.00
stddisadvant	0.001	0.60	0.001	0.61
stdmalep	-0.005	0.16	-0.005	0.16
stdteenp	0.001	0.65	0.001	0.62
stdage70p	-0.004	0.12	-0.004	0.12
inner	0.044	0.00	0.042	0.00
north	0.009	0.13	0.009	0.14
south	0.012	0.02	0.011	0.02
east	0.017	0.00	0.016	0.00
west	0.001	0.82	0.001	0.83
reindex96	-0.001	0.78	-0.001	0.79
stdslasize	-0.004	0.04	-0.004	0.04
constant	0.037	0.00	0.036	0.00
Obs	194		194	
Log Likelihood	491		494	
R-Squared	0.97		0.97	

Note: For total crime, when current drug is used, there's no spatial dependence detected. Therefore it is not reported in this table.
The results of this table must be considered with care as drug offences do test positive for endogeneity.