社會科學論叢 2021 年 06 月
第十五卷第一期 85-130 頁
DOI:10.30401/RSS.202106_15(1).0003

The Panel Estimates of Socioeconomic Factors on Different Types of Crime in Brisbane, Australia

澳洲布里斯本不同類別犯罪之社會經濟因素：縱橫面分析

Ti-Ching Peng
Associate Professor, Department of Real Estate and Built Environment
National Taipei University, Taiwan
彭蒂菁[1]*
國立臺北大學 不動產與城鄉環境學系 副教授

Jun-Kai Huang
Master, Department of Economics
National Dong-Hwa University, Taiwan
黃俊凱[2]
國立東華大學 經濟學系 碩士

1 電子郵件信箱：tcpeng@mail.ntpu.edu.tw（通訊作者）
2 電子郵件信箱：610442007@gms.ndhu.edu.tw
* 作者們由衷感謝匿名評審們對此篇文章的指正與寶貴建議。

收件日期：2020 年 12 月 18 日
接受日期：2021 年 04 月 21 日

The Panel Estimates of Socioeconomic Factors on Different Types of Crime in Brisbane, Australia

Ti-Ching Peng
Associate Professor, Department of Real Estate and Built Environment
National Taipei University, Taiwan
Jun-Kai Huang
Master, Department of Economics
National Dong-Hwa University, Taiwan

Abstract

This study uses a panel data of Statistical Area Level 2 (SA2; generally known as suburbs) in Brisbane regions of Australia from 2002 to 2010, to examine the effects of various factors on four categories of crime (including total crime rate, property crime, violent crime and drug crime). The results show that the conventional socioeconomic and demographic factors, such as "unemployment rate", "income" and "population density", have the expected influence on criminal behaviours. Moreover, the demographic factor "male25-29" had positive effect on drug crime possibly because of the highest percentage of illicit drug use in Australians' late 20s. The demographic variable "male30-49", as an indicator of male population with a higher opportunity costs of committing crime, had the expected discouraging effect on violent crime but not on drug crime. Drug crime may be less age-specific probably due to addiction developing that continues through life.

Furthermore, under Australia's Youth Allowance policy, "youth allowance" variable, as an indicator of proportion of youth receiving allowance

from government, showed its inhibiting influence on different types of crime, especially on drug crime. This finding implies that adolescents, who may be compelled to resolve to drug-related crime for money, could be restrained when they are financially supported and periodically supervised by the social welfare program of the government.

Keywords: Youth allowance; socio-economic factors; different types of crime; drug; Brisbane; Australia

NATIONAL CENTRAL LIBRARY ROC

I. Introduction

The costs of crime to the entire society is far beyond our imagination. In the case of the United States, the estimated annual costs of crime varied from $1.57 trillion (Anderson, 1999) to 3.41 trillion (Anderson, 2012). Although crime rates in south-hemisphere Australia are relatively low [3], the serious and organised crime still costed Australia up to $36 billion in 2013-14, which accounted for 24% of Australia's social security and welfare budget [4] (equivalent to $1,561 taken from every individual including child). Given the tangible costs and intangible pressure upon the society, a better understanding on the causes of crime could help prioritise law enforcement, educational or social programs that deter criminal activities.

Besides the commonly-known violent crime or property crime, drug crime is an emerging offence in recent years; according to a report published by the United Nations Office on Drugs and Crime in 2017 [5], the number of people with drug use disorder totalled 255 million in 2015, accounting for 5.3% of the world's population aged 15- 64. Moreover, the estimated drug market sales were $109 billion (U.S. dollars) in the United States in 2010 and $24.3 billion (euros) in Europe in 2013 [6]. In the case of Australia, the economic costs associated with drug use was up to $56.1 billion (AUD) in 2004-05, estimated by Collins and Lapsley (2008).

Ever since Becker (1968) published his influential work on the economics of crime, numerous empirical papers have established the relationship between dif-

---

3 According to the OECD Safety Index (measured by homicide rate, and the percentage of people feeling safe walking alone at night), Australia's homicide rate of 1.1 is lower than the OECD average of 3.7; 63% of people in Australia said that they feel safe walking alone at night, whereas the OECD average is 68%.

4 Australian Crime Commission, "The Costs of Serious and Organised Crime in Australia 2013-14". Please refer to: https://www.acic.gov.au/sites/default/files/2020-08/the_costs_of_serious_and_organised_crime_in_australia_2013-14.pdf.

5 United Nations Office on Drugs and Crime (UNODC), "World Drug Report 2017". Please refer to: https://www.unodc.org/wdr2017/field/WDR_2017_presentation_lauch_version.pdf

6 UNODC, "Global Overview of Drug Demand and Supply". Please refer to: https://www.unodc.org/wdr2017/field/Booklet_2_HEALTH.pdf

ferent types of crime and socio-economic issues. However, as time goes by, the factors that alter crime rate, such as demographics, become more complex. Take Australia for example, on an average day in 2011–12, almost 7,000 young people aged 10 and older, 83% as male and 79% as aged 14–17, were under youth justice supervision due to their involvement in crime [7]. Although juvenile delinquency is associated with many reasons, one of the most crucial factors is money; in Prichard and Payne's (2005) survey on 371 juveniles in detention centres in all Australian jurisdictions, one of the main reasons for committing the current offence is 'needing or wanting money'. Therefore, in this paper, besides the socio-economic and demographic factors as the determinants of different crimes, the focus of this study is the proportion of young people in 'cash crisis', measured by the portion of the youths under Youth Allowance policy in Australia. Higher ratio of youths receiving government's financial aid (i.e. youth allowance) implies that adolescents would be able to manage their expenses in times of need and are less likely to commit crime for money.

It should be further noted that the categories of crime varied across regions through time. Take the yearly crime data from 2009-10 to 2013-14 [8] in Australia for example, the offender rates were relatively unchanged in states of New South Wales, Victoria and Queensland, while Northern Territory reported a consistently increase. Each state's highest rate of offence differed as well: in 2013-14, South Australia had the highest illicit drug offences rate, while New South Wales with the highest theft offence rate. Therefore, as pointed out by Cornwell and Trumbull (1994), previous studies based on cross-sectional techniques of aggregate crime data, to some extent,

---

7 Australian Institute of Health and Welfare, "Youth justice in Australia 2011–12: an overview". Please refer to: https://www.aihw.gov.au/getmedia/aefb7cdb-027f-41b0-815d-9d9a-9d58e9a1/15446.pdf.aspx?inline=true. This figure remained high in 2018 and further caused debate on the push to raise the age of criminal responsibility.

8 Australian Bureau of Statistics, "4519.0 - Recorded Crime - Offenders, 2013-14". Please refer to: https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/4519.0~2013-14~Main%20Features~Key%20Findings~1

inevitably fail to control for unobserved heterogeneity; that is, crime analyses, when conducted in a wide geographic area (e.g. country- or state-level), tends to average out crime rate variations among smaller regions. Hence, several studies conducted crime analyses in county-level, such as Cornwell and Trumbull (1994) on 90 counties of North Carolina, or Howsen and Jarrell (1987) on 120 counties in Kentucky, Gazel *et al*. (2001) on Wisconsin counties, James and Smith (2017) on shale-rich US counties, or Andresen (2012) on suburb-level in City of Vancouver, Canada, just to name a few.

With the purpose of measuring the changes of crimes across different areas through time, we exploit a nine-year panel (from 2002 to 2010) of 149 neighbourhood-level SA2 (Statistical Area Level 2) of Brisbane (in State of Queensland, Australia) to estimate three panel models that investigate the effects of various socio-economic factors on four categories of crimes, including total crime, property crime, violent crime and drug crime.

The remainder of this paper is set out as follows. A brief review on various causes of crime are presented in the next section, followed by descriptive statistics of the collected data in Section III. Section IV presents empirical panel models and the relevant tests, and Section V discusses empirical results and findings. The conclusion and recommendations are provided in the final section.

II. Literature Review

The theory of crime has long been discussed and composed in many domains, such as sociology, psychology, laws, and criminology. In general, criminological literature consists of three branches, including biological factors that contribute to crime, individuals' failure to reach goals through licit means, and the social interaction in which crime behaviours are cultivated or transmitted. The emphases in criminology and in economics, which seem to be different, are to some extent relevant and consistent.

The economics of crime has its origin back in late 1960s in Becker (1968) with

the assumption of rational behaviour "…that a person commits an offense if the expected utility to him exceeds the utility he could get by using his time and other resources at other activities" (ibid., p. 176); his theory of deterrence explains how the possibility and severity of punishment alter individuals' rational judgement between expected benefit and cost of crime, and therefore the supply of crime.

Ehrlich (1973) further extended Becker's theory by constructing a time allocation model, which measures the time allocation trade-off between legal and illegal activities given the fixed leisure time; in other words, if legitimate income opportunities are not likely, then crime becomes likely due to trade-off of allocated time. Since legal income opportunities can be measured or captured by work abilities, income, human capital and other social demographic aspects (such as age, race or gender), the Ehrlich model can be tested by empirical analyses. Since then, the Becker-Ehrlich model has been used by numerous studies to empirically examine crime behaviours from economic aspect, such as Levitt (1998), Glaeser et al. (1996), Glaeser and Sacerdote (1999), Machin and Meghir (2004) and others. For instance, in line with the works of Becker and Ehrlich, Machin and Meghir (2004) set up a choice theoretic model and further empirically established a negative correlation between earnings levels and criminal activities.

Given the rise of recent social and economic problems (such as juvenile delinquency) in recent years, the attention of modern studies has shifted from the test of deterrence hypothesis to the empirical examination of socioeconomic and demographic factors of crime behaviours. It is found in modern literature that criminal behaviour is shaped by family, financial and socioeconomic factors, such as Allen (1996), Lofstrom and Raphael (2016) or Bernasco et al. (2017); Levitt (2017) also presents a thorough review on the economics of crime. The following is a review on the types of crime and its causes in previous studies.

A. Types of crime

Previous works have mostly investigated the causes of crime from the perspective of

total crime (Avio 1988; Craig 1987), which assigns equal weight to various types of crime under the total figure without measuring the different severity of each crime category such as homicide, aggravated assault, sexual assault, robbery, burglary, vandalism and auto theft (for example, the severity of homicide is far greater than vandalism or burglary); therefore, using a general measurement such as total crime is prone to weighing errors. For this reason, some researchers chose to analyse the determinants of several types of crime such as homicide, aggravated assault, sexual assault, robbery, burglary, vandalism, or theft (Entorf and Spengler 2000; Gould *et al.*, 2002; Ihlanfeldt and Mayock, 2010; Kelly, 2000; Neumayer, 2005).

Among all crime categories, drug crimes have been prevalent in recent years. Previous studies have found that the more severe the drug abuse in a region, the higher the occurrence of violent crimes and property crimes (Bennett *et al*., 2008; Taniguchi and Salvatore, 2012). While some studies found that drug abuse among adolescents has a profound effect on youth crime (Brook *et al*., 1996; Dawkins, 1997; Moss *et al*., 2014), it should be noted that drug crime is not limited to a specific age since the addiction is likely to be carried into adulthood. The causes of drug use are complex, including behavioural factors, psychological factors (e.g. low emotional control), and especially interpersonal relationship (e.g. contact with family members or friends with drug use), which are applicable to all ages. During the period of 2001 to 2010 in United States, while the drug abuse violators aged under 18 decreased by 13.4%, the drug offenders aged 18 and over increased by 8.3% [9]. Take New Zealand for another example, in the category of 'possess and/or use illicit drugs' in 2012, there was a relatively even spread of offenders across the age groups of 0–20 (approximately 2,600 apprehensions), 21–30 (about 2,700), and 31–50 (about 2,500)[10]. In the case of Australia, the situation is similar: in a statistics of il-

[9] According to the publication "Crime in the United States" of FBI: https://ucr.fbi.gov/crime-in-the-u.s/2010/crime-in-the-u.s.-2010/tables/10tbl32.xls

[10] Please refer to Statistics New Zealand, "Drug Crime in 2012": http://www.stats.govt.nz/browse_for_stats/snapshots-ofnz/yearbook/society/crime/drug-crime.aspx

licit drug use in 2010 [11], while the teens (aged 14-19) accounted for 18.2%, the age groups of 20-29, 30-49 were 27.5% and 31.6%, respectively.

This study has classified crimes with reference to Entorf and Spengler (2000), Gould et al. (2002), and Ihlanfeldt and Mayock (2010). Besides total crime, violent crime and property crime, drug crime is also taken into account in this paper. Although different crimes are driven by various factors, these causes still have similarities, as discussed in Section 2.2.

B. The causes of crime

(B) 1. Economic, social factors and police deterrence

Crime is closely associated with economic conditions. In line with the models of Becker (1968) and Ehrlich (1973), the returns to legitimate earning activities can be approximated by employment status or availability of financial resources. Being unemployed implies the decrease in an individual's marginal returns from legal-earning activities (if lower than the illegal income) and, in time allocation sense, the opportunities (derived from the extra available time) to engage in illegal behaviours to get financial relief.

Previous studies have revealed that areas with higher unemployment rates tend to be associated with more prevalence of crimes (Carmichael and Ward, 2001; Entorf and Spengler, 2000; Gould *et al*., 2002; Nordin and Almén, 2017; Raphael and Winter-Ebmer, 2001). Some studies suggested the inverse relationship in individual level, such as Borland and Hunter's (2000) sample of 18,960 respondents [12], because a person with criminal records (i.e. being arrested or convicted) may discourage employers from offering a vacant position; even an individual tried to conceal his sentence records, his absenteeism from labour market still cause doubt to poten-

---

[11] Please refer to Australian Institute of Health and Welfare, "2010 National Drug Strategy Household Survey Report": https://www.aihw.gov.au/

[12] This study examined the determinants of employment status of indigenous Australians; the sample consisted of 15,726 indigenous respondents, 3076 non-indigenous persons living in the same household as an indigenous person, and 158 prisoners.

tial employers. It may be plausible in individual cases, but it seems less likely in the neighbourhood-level or county-level scenario because the unemployment difference among individuals could be averaged or even aggregated in empirical analyses; for example, in the case of Australia, Kapuscinski *et al.* (1998) noted that crime is posited as a function of unemployment, and Bodman and Maultby (1997) presented a similar finding. Therefore, this study, which assumes the positive relationship between unemployment and crime in regions of Australia, measures the lagged value of unemployment so as to evaluate the effect of the unemployment in previous period on the crime in current period.

By the same token, the level of disposable income or wage also represents the economic incentives of illegal behaviours. A decrease in income level (proxied by GDP per capita, household income or wage), indicating a lower opportunity cost for committing crime, has the potential to raise the chances of crime, as empirically illustrated in Gould *et al*. (2002) or Machin and Meghir (2004). Crime is also closely associated with general economic performance. The world has endured several financial crises in recent decades. During such crisis, people face difficulties in making ends meet and sometimes have to resort to illegal means to stay above water. Peri (2004) studied the relation between economic cycle and crime in Italy and found a significant increase in crime through contraction period and a decrease in crime during the expansion phase. Habibullah and Law (2008) discovered a significant rise in property crime during recessions. For example, Tomasic (2011) and Krambia-Kapardis (2017) discovered that financial crises led to an increase in property crime, fraud and corruption.

Among others, level of education also determines one's opportunity costs to engage in illicit conducts. As pointed out by Lochner and Moretti (2004), schooling attainment should lower the likelihood of crime commitment because it increases the financial returns in legal labour market (as well as the opportunity costs of illegal behaviours), directly affects the financial or psychological rewards from crime (through raising individuals' concepts of law-abiding or morality), and alters indi-

viduals' biased preference towards crime (from risk-taking to risk-averting); similar findings include Samavati (2006) or Machin *et al*. (2011).

Criminal activities, in Becker's economic theory of crime, result from individuals' judgement between perceived benefits (i.e. return retrieved from crime) and costly consequences if being arrested, punished and imprisoned. Hence, many empirical studies (Kelly, 2000; Lin, 2009) considered police expenditure per capita as a measure of the deterrent effect of the criminal justice system to discourage crime commitment. That is, higher police expenditure allows more officers' prompt response to crime behaviours, and the visibility of polices also shapes residents' sense of safety; as proved in Cheng and Long (2018), the increase of police presence, as an indicator of police institution's determination in fighting crime, is effective in crime deterrence in the case of France.

The empirical works on criminal behaviours in sociology have investigated various indicators of social disintegration, one of which is divorce (Blau and Blau, 1982). Divorce has consistently demonstrated a negative effect on numerous measures of living conditions and well-being (Amato 2001). The dissolution of a marriage, as a force of social instability and lack of effective social control, may deprive living resource, intensify interpersonal conflict, and thus lead to relevant criminal activities (Williams and Flewelling, 1988). It is found that divorce caused an increase in violent conflict or domestic violence (Cáceres-Delpiano and Giolito, 2012; Stolzenberg and D'Alessio, 2007), or led to inter-generational transmission of youth offending such as theft (Van de Weijer *et al*., 2015; Tham and Von Hofer, 2009).

B (2). Demographic factors

Apart from economic factors, demographic factors are also crucial in crime commitment. The demographic factors that are commonly considered in previous studies include population density, gender or age. Neighbourhoods with high population density, which are likely to have a complex and heterogeneous composition of residents and alienation among neighbours, tend to have a higher crime rate (Brush,

2007; Cullen and Levitt, 1999). A higher percentage of male population is often related to higher crime rates (Edlund *et al*., 2007), probably because of not only men's physical advantage but also the higher social expectations imposed on men, which create mental stress and thus drive them to commit crime in the moments of low self-control.

Age structure also affects the level of crime. Hirschi and Gottfredson (1983) once argued that age, as a primal variable with "inherent pathogenic qualities", is typically and universally related to crime. Based on numerous types of data from England, France and the United States for over 150 years, Hirschi and Gottfredson (1983) found that a rapid rise in criminal acts in teen years, followed by a peak at around age 20, and later a decline through adulthood till the very low level at age 65 and older. In contemporary times, the Crime Index of the FBI's *Uniform Crime Report* (UCR) arrest data (1935–1997) also archived the consistency of the age effect on crime, especially a long-term trend toward *younger* age-crime distributions; nowadays, the peak age-crime involvement is younger than 25 for all crimes reported in the FBI's UCR program, and rates start to decline in late teenagehood and early adulthood (Ulmer and Steffensmeier, 2014).

B (3). Social benefit for teenagers

1. Finding in literature

The worldwide surge in youth crime in recent years has become a social concern. As the economy grows, adolescents' purchasing power is also increasing (Bailey, 1992; O'Neill, 1992). For adolescents in school unlikely to work full time, their basic spending needs would drive them to resort to misconduct (particularly relatively minor crime such as theft) if parents do not provide them with adequate allowance. Lu and Tung (2010) found that the greater the allowances received by junior high school students, the lesser are their misbehaviour, and males exhibited more deviant behaviours than females. Parents should provide children with adequate amounts of allowance and educate them to have a healthy attitude towards money (Danes,

1994).

In the other social aspect, for the youths in transition from school to work in labour market due to deprived living conditions, the situation is more complex. Adolescents' deviant behaviours are largely associated with their demand for money. Adolescents with criminal misconducts tend to lack saving habits and value money above all else (Belk *et al*., 1985). Getting a properly-paid job for unemployed teenage school leavers is depressingly difficult, and thus part-time employment, accompanied with potential exploitation at work environment, tend to become a norm. The lack of opportunity to work in full-time positions for adequate income leads young people down to the path of alienation and criminal activities as an alternative source of income for survival. Given youths' inferior economic circumstance, the social security policies are also influential to youth crime.

2. The focal factor in this study: Youth Allowance in Australia

As shown in several studies, the change in government policy appears to be critical to the extent of youth misbehaviour in crime. In the case of Australia, the abolition of under-18 unemployment benefit in 1987 (due to the reform of taxation system) worsened the financial circumstances of the unemployed youths and led to greater involvement in various categories of crime (Hartley 1989; White 1989). Later in 1991, the Government replaced the existing Unemployment Benefit with two new payments: (1) Job Search Allowance for people being unemployed for less than 12 months, and all unemployed people under 18, and (2) Newstart Allowance for those still unemployed after 12 months; under these reforms, the recipients had to abide by additional obligations and sign an agreement listing the activities they will undertake to improve job prospects. Then in 1996, these two payments were brought together and named as Newstart Allowance; later in 1998, the government moved the young recipients of Newstart Allowance to newly-introduced Youth Allowance. During that period of time, the studies of White et al. (1997) in Melbourne and Vinson *et al.* (1997) in Sydney concluded that young people committed many criminal acts, mainly involving theft and drug dealing, so as to supplement their income and

even in some cases for survival; in the survey conducted by Vinson et al. (1997), over 50 % of the youths engaged in these kind of criminal activities for financial reasons, including “supplement income”, “survival” or “money”.

These studies in Australia, however, have been based on relatively limited data (such as only one or two point estimates from official statistics), from which it is unlikely to infer trends or to make further inferences (Schneider, 2000). Therefore, based on a panel data of statistical areas through 10 years, this paper attempts to measure whether the financial support to youths would discourage their crime tendency. It is assumed that youths are less likely to rely on crime for money once they are financially supported in lives.

It should be noted that the factors discussed above may not have the same influence on four categories of crime. For instance, Raphael and Winter-Ebmer (2001) found that the decline in unemployment rate led to the substantial decline in property crime rates but its effect on violent crime was weak; similarly, in Kelly’s (2000) work, police expenditure, which indeed discouraged property crime, demonstrated null influence on violent crime, and the severe education inequality, which led to higher violent crime, was irrelevant to property crime. That is, as Howsen and Jarrell (1987) concluded in their analysis, economic factors influence criminal behaviour but cannot completely explain the syndrome.

C. Empirical methods

Some researchers in the abovementioned studies explore the causes of crime by using cross-sectional models including basic ordinary least squares (OLS) method (Levitt, 1998; Reilly and Witt, 1992) or two-stage least square (2SLS) approach due to omitted variables or other issues (Gould *et al*., 2002). Further, some studies have used time series data to analyse factors that affect crime (Greenberg, 2001), even considered the lagged effect of factors on crime by using time-series models with relevant autoregressive settings (Detotto and Otranto, 2010); some others used Granger causality approach to investigate the relationship between crime and social-

economic variables (Narayan and Smyth, 2004). Moreover, some researchers separated the data into cross-sectional and time-series dataset and used these datasets to investigate the causes of crime, respectively; it is found that the results varied subject to the nature of the data used (Brush, 2007).

Due to the issue of heteroscedasticity in cross-sectional analyses and the concern of serial correlation in time-series assessments, panel data model, which incorporates both time series and cross-sectional data, has been used in recent crime analyses (Carmichael and Ward, 2001; Entorf and Spengler, 2000; McCarty *et al*., 2012; Papps and Winkelmann, 2000; Samavati, 2006). Panel data (also known as longitudinal data) are repeated measurements on the same individual units (such as person, firm, county, city, or state) at different points in time; that is, the variation over time (i.e. within variation) and the variation across units (i.e. between variation) can be captured. An advantage of panel data is the enhanced precision in estimation resulting from the increase in the number of observations (i.e. pooling several time periods of data for each individual unit); in addition, panel model considers the unobserved time-invariant and individual-specific effect of each observation (i.e. heterogeneous nature across units); panel data is effective in preventing heterogeneity by controlling omitted variables.

Based on the literature review above, this study will apply three panel data models to analyse the effects of socioeconomic factors, demographic factors and particularly youth allowance factors on four types of crime in 149 suburbs of Brisbane, Australia, in ten-year periods.

III. DATA

This paper used panel models to determine the effects of socioeconomic and demographic factors on the different crime categories in the case of Brisbane, Australia. Administrative districts in Australia can be broken down into statistical identifiers: SA4 (Statistical Area 4), SA3 (disaggregated from SA4) and then SA2 (disaggregated from SA3), which is similar in size to suburbs. Given Queensland's low

population density, the scope of this paper was confined to the city of Brisbane, which comprises of five SA4s, equivalent to the sum of 21 SA3s or 162 SA2s. The data of 149 SA2s from 2002 to 2010 was then used for empirical panel analyses after the preliminary data-cleaning process (e.g. deleting missing records of certain locations). Crime data was derived from the Queensland Police Service; economic, social, economic and demographic data were retrieved from the Australian Bureau of Statistics. However, due to data limitation, the datasets of yearly divorce rate and police expenditure per person were not available for each SA2; hence, the yearly divorce rate of Queensland (collected from the official website of Queensland Government Statistician's Office) and the yearly recurrent expenditure on police per person of Queensland (collected from the official website of Productivity Commission of Australian Government) are used as proxy in analyses. The study focused on data from 149 SA2s in Brisbane of Australia for 9 years between 2002 and 2010. In the next sections, the crime rate (as dependent variable) and socioeconomic factors (as independent variables) are further discussed.

A. Dependent variables: Crime rate

Queensland Police department classified crimes into 17 categories (representing crimes reported daily in various locations), including 'Homicide and Murder', 'Arson', 'Weapons Act Offences', 'Assault', 'Robbery', 'Other Offences against Person', 'Other Theft excl. Unlawful Entry', 'Other Property Damage', 'Traffic and Related Offences', 'Unlawful Entry', 'Fraud', 'Drug Offences', 'Liquor excl. Drunkenness', 'Miscellaneous Offences', 'Good Order Offences', 'Unlawful Use of Motor Vehicle', and 'Handling Stolen Goods'.

For the purpose of this study, four types of crime rates, including total crime rate, violent crime rate, property crime rate and drug crime rate, are calculated based on abovementioned crime categories. In general, crime rate is calculated by dividing the number of crimes in each category by total population and then multiplying by 100,000. In this paper, total crime rate, which measures average total crimes per

population of 100,000, is the sum of all the 17 crime categories. Property crimes refer to illegal infringement of properties owned by others that result in monetary or financial losses; property crime rate (the average number of property crimes per population of 100,000) considers five crime categories within this definition, including 'Other Theft excl. Unlawful Entry', 'Other Property Damage', 'Traffic and Related Offences', 'Unlawful Entry and Fraud'.

Violent crimes refer to criminal actions involving violence, threat and danger to individuals and society, and thus violent crime rate, which measures the average number of violent crimes per population of 100,000, considers six crime categories including 'Homicide and Murder', 'Arson', 'Weapons Act Offences', 'Assault', 'Robbery', and 'Other Offences Against the Person'. Drug crime is defined as any violation against the nation's anti-drug laws, and thus drug crime rate (the average number of drug-related crimes per population of 100,000) considers smuggling, sale, transportation and manufacturing of drugs and other crimes directly related to the category of 'Drug Offences'.

As shown in Table 1, in each of the SA2s from 2002 to 2010, there was an average of 31 total crimes, 2 violent crimes, 21.3 property crimes and 3.2 drug crimes per population of 100,000. Figure 1 illustrates that total crime and property crime in the entire Brisbane reduced progressively between 2002 and 2010, but there was no reduction in property crime or drug crime.

Table 1 Descriptive statistics of SA2s in Brisbane (2002-2010)

	Mean	Std.
Crime rate (per 100,000 population)		
Total crime rate	31.10	37.02
Violent crime rate	1.95	2.91
Property crime rate	21.29	20.22
Drug crime rate	3.21	5.29
Economic, social, and deterrence factors		
Unemployment rate (%)	4.36	2.27
Average disposable income (p.a.)	43684.72	7494.60
non-school qualification (%)	50.27	2.88
Divorce rate (%)	3.54	0.38
Police expenditure (p.a.)	336.99	15.65
Demographic factors		
Population density (persons/km2)	1656.82	1033.88
Male population aged 25-29 (%)	4.13	2.48
Male population aged 30-49 (%)	15.09	4.21
Social walfare factors		
Youth allowance (%)	11.42	4.69

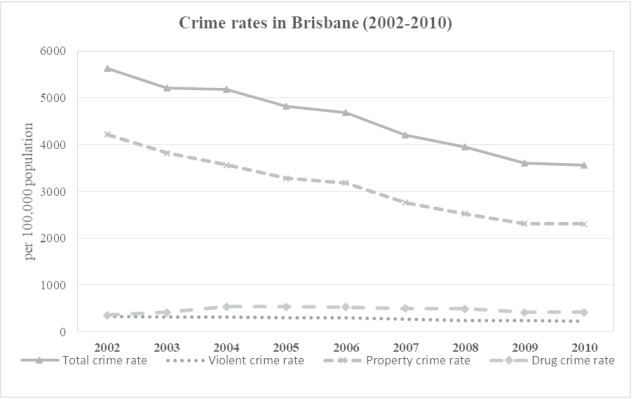


Figure 1 Crime rates in Brisbane, Australia (2002-2010)

B. Independent variables

As discussed in literature review, the criminal behaviours are determined by several types of factors, including socioeconomic and deterrence factors, demographic factors, and social welfare for teens. In the first category, it is assumed in this study that, the higher the "unemployment rate", the more likely people are to commit crime, and in this study the lagged value of unemployment rate is used as an inde-

pendent variable; moreover, although some may suggest the increased income in a given location represents higher expected returns for a crime but higher disposable income provides residents with the means and incentive to prevent crime, thereby reducing opportunities for potential criminal behaviours; hence, in this paper, "average disposable income", as measurements for local income living standard is assumed to discourage crime tendency. Similarly, schooling attainment, which is measured by "the percentage of non-school qualification" (i.e. educational attainments other than those of pre-primary, primary or secondary education) in this study, should lower the crime tendency because it refers to potential legal financial returns. Police expenditure per capita, measured by "recurrent expenditure on police per person" in this paper, indicates the deterrent effect of the criminal justice system. "Divorce rate", indicates the severity of social disintegration, may lead to the increase in criminal behaviours. Given that overall economic performance also has an effect on crime activities (as discussed in Literature), a dummy variable of "financial crisis 2008" (2008 = 1; other years = 0) was considered in this study to examine whether the sub-prime mortgage crisis between the end of 2007 and 2008, which later caused worldwide turmoil and disrupted people's lives, compelled people to commit crimes for reasons of survival.

Regarding demographics, this study evaluates how the male population of various age groups (i.e. the proportion of male population of total population) affects crime, including "age25-29" (i.e. the age group at the stage of being uncertain but starting to get connected at work), and "age30-49" (i.e. the age group likely at the matured stage between work and life). In addition, "population density", which refers to average population per unit geographic area (e.g. square kilometre) within a given time period, may cause alienation in social network and eventually leads to criminal activities.

In addition to the above variables, this paper further considered if the social benefit support to the youths in need of legal income would mitigate the juvenile delinquency. As mentioned previously, from 1st July 1998 Youth Allowance was in-

troduced to offer income support to young people, particularly aged between 15-24, including those looking for work and those being sick; recipients of this allowance may be undertaking full-time study, full-time job search or a combination of approved activities. In order to make sure these youth recipients stay in the right track, they are required to have the activity test (i.e. applying for jobs, getting relevant training or job interviews) to keep getting the allowance; some may be exempted from the activity test due to their personal conditions, such as illness, homelessness and other alike. This paper thus introduced a new variable called "youth allowance" (percentage rate), which measures the percentage of adolescents (aged 15–24) in a given location (i.e. each SA2) who receive Youth Allowance. A higher youth allowance percentage rate means that adolescents are able to manage their expenses in times of need and are less likely to commit crime for money.

As also shown in Table 1, the average unemployment rate in SA2s of Brisbane during this period averaged 4.36% while the average disposable income amounted to AUD 43,684.72. It should be noted that only 11.42% of adolescents received allowances. The population density in SA2s of Brisbane was approximately 1,656.82 people per square kilometre; the size of the male population in the 25–29, 30–49 age groups represented 4.13% and 15.09% of the total population, respectively.

IV. EMPIRICAL MODEL

A. Panel model

Based on the panel data through 10 years (from 2002 to 2010) across 149 suburbs in Brisbane, Australia, this study used three types of panel models to evaluate the effects of socio-economic, demographic factors, and particularly the youth's financial aid on four categories of crime. The fundamental panel models are fixed-effect and random-effect models. Both models assume the randomness of 'individual-level effect' (captured by α_i in models), which refers to the unobserved time-invariant heterogeneity across individual units. The main difference between these two models is the permission of endogeneity.

Fixed-effect model used in this study is formatted as $yu = a_i + x'_u\beta + u_{it}$ (where $u_{it} = a_i + \varepsilon_{it}$), in which i = 1, 2 ⋯ N represents observed units (i.e. SA2 in this study), t = 1, 2⋯T, indicating time periods, x'_{it} representing independent variables (e.g. socio-economic factors and others), and y_{it} indicating dependent variable (i.e. crime rate). The error term (u_{it}) is the sum of time-invariant individual-level effect 【(α】$_i$) and idiosyncratic error (ε_{it}). Fixed-effect model permits a limited form of endogeneity in terms of allowing independent variables (x'_{it}) to be correlated with a_i but still be uncorrelated with i.i.d. error (ε_{it}). For example, independent variables in a crime regression are correlated with unobserved and time-invariant component (e.g. cunning ability), measured by a_i. On the other hand, random-effect model assumes that individual-specific effects (a_i) are distributed independently of x'_{it}, indicating the constraint on endogeneity. The random-effect model, in which a_i is included in the composite i.i.d error term (u_{it}), is structured as $y_{it} = x'_{iu}\beta + u_{it}$ (where $u_{it} = \alpha_i + \varepsilon_{it}$). As a restrictive model, pooled-OLS model, which assumes the exogeneity of independent variables without considering individual-level effect, is formatted as $y_{it} = \alpha + x'_{it}\beta + u_{it}$. For more details on these models, please refers to Cameron and Trivedi (2010) or Wooldridge (2010).

In general, two tests will be used to choose which panel model is more appropriate to the panel data used in research. Lagrange multiplier test proposed by Breusch and Pagan (1980) is used to choose between pooled-OLS and random-effect model; random effect model is more suitable if null hypothesis (H0: Var (a_i) = 0) is rejected. Hausman test proposed by Hausman (1978) is adopted to choose between fixed-effect and random-effect model; fixed-effect is more appropriate if null hypothesis (H0: a_i is uncorrelated with x_{it}) is rejected.

Caution is advised on the use of Hausman test. It should be first noted that RE estimator assumption of null correlation between individual effect and independent variables is too strong (Cameron and Trivedi 2010, p.263), implying that the rejection of null hypothesis may be more likely when there is any possible correlation. Second, fixed-effect models are designed to study the causes of changes within an

observation for entity, so "in the FE model the coefficient of an independent variable with little within variation will be imprecisely estimated and will not be identified if there is no within variation at all" (Cameron and Trivedi, 2010, p.244). In other words, when the within variation is minimal (i.e. smaller than between variation), it would be biased to go for fixed-effect model even if Hausman test supported fixed-effect model. Third, the standard Hausman test requires the RE estimator to be efficient, indicating the idiosyncratic (i.i.d.) assumptions on a_i and ε_{it}, but this assumption is invalid if cluster-robust standard errors were considered (Cameron and Trivedi 2010, p.267). For further discussion, please refer to Bell& Jones (2015) or Bell *et al*. (2019).

B. Empirical settings and process of choosing the panel model for each type of crime

This paper examines the effects of various factors (as independent variables; shown in Table 1) on four types of crime (as dependent variable) in of pooled-OLS, fixed-effect panel and random-effect panel models through the application of Stata software. In order to illustrate the effect of youth allowance on crimes, this study will first present the fundamental panel models and the extended panel models (with 'youth allowance') for comparison purpose.

The natural logarithm (ln) is calculated for four crime rates because Ehrlich (1996) and Lio and Lu (2011) found that the impact of estimation errors can be reduced if the natural logarithm of crime rate is used; moreover, this study considered the effect of 'lagged' value of unemployment rate on crime rates so as to capture the influence of unemployment condition in previous period on crime rates in current period. Due to the use of lagged values, the final sample size in fundamental models is 1097; further due to the missing values in 'youth allowance' in few regions, the sample size in extended models is 1069.

In practice, the error term (u_{it}) is likely to be correlated over time for a given observation (e.g. SA2 region in this study), so this study used cluster-robust stan-

dard errors that cluster on the observation. Given this setting of robust variance estimator, Schaffer and Stillman's (2006) robust Hausman test, based on the concept that a test of fixed versus random effects is also a test of overidentifying restrictions, is used in this study to decide the appropriate panel model for each type of crime.

As shown in Table 2, in the setting of fundamental model (i.e. all the independent variables except youth allowance), the rejected LM (Lagrange multiplier) tests indicated the random-effect model is preferred; in robust Hausman tests, while fixed-effect model is statistically appropriate in 'total crime', 'property crim', and 'violent crime', random-effect model is more suitable in the case of 'drug crime'. In the setting of extended panel model (with 'youth allowance' variable) shown in Table 3, similar results are illustrated in in 'total crime', 'property crim', and 'violent crime'; although the weak significance in robust-Hausman test (p = 0.0714) may to some extent support the choice of fixed-effect model in drug crime when 'youth allowance' is taken into account, this study still chose the random-effect model in drug crime (in extended panel setting) by using 0.05 significance level. Given the results in Tables 2 and 3, the results of fixed-effect models in 'total crime', 'property crim', and 'violent crime' and random-effect models in 'drug crime' will be discussed in next section.

Table 2 Fundamental model: the appropriate panel model for crimes

Model tests / Crime type	Breusch and Pagan LM test		Robust Hausman test	
	chi-bar-square test	prob.	Sargan-Hansen Wald test	prob.
Total crime	2942.24	***	81.85	***
Property crime	2955.30	***	83.12	***
Violent crime	1803.42	***	84.99	***
Drug crime	1535.64	***	13.09	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3 Extended model: the appropriate panel model for crimes

Model tests / Crime type	Breusch and Pagan LM test		Robust Hausman test	
	chi-bar-square test	prob.	Sargan-Hansen Wald test	prob.
Total crime	2853.92	***	77.48	***
Property crime	2860.43	***	79.04	***
Violent crime	1820.66	***	93.32	***
Drug crime	1603.63	***	17.14	*

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Some may concern the potential endogeneity of some variables used in this study, such as unemployment rate, income and police expenditure. The endogeneity problem refers to the situation when an explanatory variable is correlate with the error term. For instance, although unemployment rate is assumed to cause crime, the relationship could also be the opposite (i.e. crimes lead to higher unemployment rates). Following the instruction in Wooldridge (2010, Section 11.2), the test of variable exogeneity involves two steps: (1) estimate the reduced form of a suspected endogenous variable (e.g. unemployment rate) against the rest of exogenous variables (i.e. the other variables used for analysis) in usual panel model; (2) the variable of residuals (retrieved in the previous step) is then added to estimate an augmented panel model; if this residual variable is statistically insignificant (i.e. fail to reject null hypothesis that this variable is exogenous), the once-suspected endogenous variable can be regarded as exogenous. The potential endogenous variables in this study, including unemployment rate, average income and police expenditure, demonstrated its insignificance ($p > 0.10$) in exogeneity tests in both fixed-effect and random effect panel settings.

V. EMPIRICAL RESULTS

As discussed above, this study will first present the fundamental panel models and the extended panel models (with 'youth allowance') so as to illustrate the effect of youth allowance on crimes.

A. Fundamental models

Table 4 presents the results of the appropriate panel model in each type of crimes. As discussed in previous section, fixed-effect panel model was empirically proven to be more appropriate in 'total crime', 'property crime' and 'violent crime', and random-effect in 'drug crime'. Please note that the results of other panel models in these four types of crime are listed in Table A1 in Appendix as reference.

In the panel application of Stata software, three types of R^2 include between R^2 (indicating the variance between observation units this model accounts for), within R^2 (indicating the variance within observation units this model account for), and overall R^2 is a weighted average of these two; 'corr (u_i, Xb)' indicates the correlation between independent variables and individual-specific effect [13], and 'rho' represents the fraction of error variance due to the individual-level term (α_i).

Table 4 Fundamental models

Variables	**Total crime**		**Property crime**		**Violent crime**		**Drug crime**	
	Fixed-effect model		Fixed-effect model		Fixed-effect model		Random-effect model	
	Coef.	Robust std error	Coef.	Robust std error	Coef.	Robust std error	Coef.	Robust std error
Socio-economic factors								
unemploy_rate(lagged)	0.013	0.006 **	0.016	0.006 ***	0.024	0.010 **	0.025	0.010 ***
income	-0.046	0.025 *	-0.046	0.024 **	-0.032	0.051	-0.148	0.038 ***
divorce_rate	0.036	0.012 ***	0.030	0.014 **	0.028	0.021	0.078	0.027 ***
non-school qualification	-0.004	0.004	-0.008	0.005 *	0.003	0.007	0.048	0.007 ***
Demographic factors								
population density	0.116	0.049 **	0.115	0.048 **	-0.007	0.102	0.175	0.022 ***
male 25-29	0.019	0.034	0.033	0.033	0.043	0.064	0.145	0.088 *
male 30-49	-0.060	0.075	-0.064	0.077	-0.326	0.179 *	-0.127	0.148
Deterrence factors								
expenditure_police	-0.064	0.193	-0.049	0.177	-0.305	0.383	-0.662	0.448
Structural factors								
financial_crisis 2008	0.004	0.008	-0.006	0.008	0.006	0.021	0.086	0.023 ***
constant	1.020	1.210	1.013	1.099	1.374	2.295	0.946	2.476
Model evaluation								
R2 (overall)	0.39		0.41		0.09		0.36	
R2 (within)	0.30		0.35		0.08		0.05	
R2 (between)	0.41		0.42		0.07		0.45	
F test of model	23.86 ***		35.57 ***		11.29 ***		--	
Wald test of model	--		--		--		200.69 ***	
corr(u_i, X_b)	0.33		0.33		0.09		0 (assumed)	
rho	0.94		0.92		0.82		0.67	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[13] Please note that this value is assumed to be zero in RE model as discussed in previous section.

A (1). Total crime

As shown in Table 4, in the case of 'total crime', three R^2 indicated that this model can explained 30% of variance in total crime rate within each observation unit (i.e. SA2), 41% of variance in total crime rate between units, and the weighted average of these two R^2 is 39%. In addition, the correlation between individual-specific effect and independent variables (corr (u_i, Xb)=0.33) and high fraction of error variance due to the individual-level term (rho = 0.94) further supported the use of fixed-effect model on total crime rate.

"Unemployment rate (lagged)", "population density" demonstrated expected positive significant effects on total crime rate. That is, being unemployed decreases an individual's marginal returns from legal-earning activities and increases the opportunities in crime engagement; similarly, a densely populated area along with more complex residents' backgrounds and social alienation tends to lead to increase in total crime rate. Moreover, the significant positive effect of "income" on crime implies that people with higher financial resources are less likely to seek out for illegal resources. "Divorce rate" was positively related to total crime rates, which implies that the dissolution of family function may lead to criminal behaviours in general.

A (2). Property crime

As illustrated in Table 4, the empirical fixed-effect results on property crime is similar to the one on total crime. R^2 in FE model are, respectively, 0.36 (overall R^2), 0.35 (within R^2), and 0.44 (between R^2), and the correlation between independent variables and individual-level effect (u_i, Xb)=0.33) and high fraction of error variance due to the individual-level term (rho = 0.92) again supported the use of fixed-effect model on property crime rate.

Similarly to total crimes, property crime is also found to be affected by "unemployment rate (lagged)", "population density", "income" and "divorce rate". In addition, the negative effect of "non-school qualification" (i.e. beyond secondary

education) on property crime indicates that more educational attainment leads to higher earnings as well as the opportunity cost of crime (i.e. the values of stolen items could be much lower than their high salary). It is also argued that people with more years of formal schooling in terms of staying longer in the supervised environment may become more disciplined, moral and risk-averse (given that they may have more financial resources supported by their higher education).

A (3). Violent crime

The caution is needed when explaining the general performance of fixed-effect panel model on violent crime. Although three types of R^2 (i.e. 0.09 overall R^2, 0.08 as within R^2, and 0.007 as between R^2) and the correlation between individual-specific effect and variables (i.e. corr (u_i, Xb) = 0.09) were much lower than the ones in total crime and property crime, the high fraction of error variance due to the individual-level term (rho = 0.82) supported the fixed-effect application.

The positive effect of "unemployment rate" on violent crime implies that the violent misconduct is likely be driven by being away from workforce. The increase in "male30-49" population tend to discourage the violent crime behaviours, probably because males at this age have higher moral status, more reliable material inhibitions (from stable jobs) but relatively decline in the physical strength (compared to the youth)

A (4). Drug crime

In the case of drug crime, random-effect model is chosen based on model tests. While overall-R^2 and between-R^2 were up to 0.36 and 0.45 respectively, the low within-R^2 (0.05; indicating the low variance within the panel units that this model accounted for) implies that the use of fixed-effect model would be inappropriate given that FE model is designed to explore the relationship between dependent and independent variables within an entity. In addition, the rho value (i.e. the portion of individual-specific effect out of total error term) is much lower compared to the other three types of crime.

'Unemployment rate' and 'population density' had positive effect on drug crime, and 'average income' could deter drug crime, which is similar to the findings in other types of crime. It is worth-noted that 'male 25-29', which was not influential to other types of crime, demonstrated its positive effect on 'drug crime'. It is likely that males in this age range are in their early stage of career development and are less stable in mental and financial conditions. This could be associated with the fact that, compared to other age cohorts in Australia, the 20–29 year old age group has been the most over-represented age group in drug use through time; illicit drug use in this age group was up to 27.5% in 2010 [14], and even higher for males (30.5%) compared to females (24.3%) (Australian Institute of Health and Welfare, 2011).

Moreover, although 'financial crisis in 2008' did not have impact on 'total crime', 'property crime', and 'violent crime', this financial turmoil particularly led to the rise in 'drug crime' ($p < 0.01$). During periods of economic stagnation, drug crime increased much more significantly than other crime categories because of the high level of short-term financial returns or quick ease on psychological distress. However, the significant positive effect of "non-school qualification" on drug crime ($p < 0.01$) contradicted to the general belief on the deterring influence of education on crime.

These findings may to some extent be consistent with the trend of drug use in Australia. According to Australian Institute of Health and Welfare (2011), 37.3% of Australians (aged 14 years or over) have used an illicit drug at least once in their lifetime; moreover, the population proportion in illicit drug use increased among those with advantaged social backgrounds. For instance, the illicit drug users with post-school qualification increased from 28.8% in 2007 to 30.3% in 2010. When a specific drug is considered, the cocaine users with post-school qualification increased from 5.2% (2007) to 6.4% (2010) compared to those without post-school

[14] According to Australian Institute of Health and Welfare (2017), this group still makes up the largest proportion (32%) of illicit drug users in Australia in 2016.

qualification from 2.9% (2007) to 3.5% (2010). In a detailed report by Australian Institute of Health and Welfare (2017) in recent years, the overall situation is not getting better; the population proportion of lifetime drug use in Australia was about 43% in 2016, and people with post-school qualifications have a higher rate of lifetime drug use (47%) than those without post-school qualifications (34%).

It should be emphasized that the addictive nature of illicit drug use makes the causes of drug crime more varied and complicated than other crimes. Besides to socio-economic aspects, illicit drug use behaviour is also associated with social interaction (e.g. family background) and particularly psychological factors, such as low emotional control or pressure (Shedler and Block, 1990), which are not considered in this study (due to the lack of relevant data). These unobserved but pervasive psychological factors are not likely to be related to individual differences across regions (i.e. fixed effect), and this could be the reason why random-effect model is more empirically applicable in drug crime. As reported by Australian Institute of Health and Welfare (2011), due to addiction, illicit drug users were more likely to report high or very high levels of psychological distress compared with those who had not used an illicit drug. The detailed survey in 2016 by Australian Institute of Health and Welfare (2018) revealed that 22% of illicit drug users claimed to have high or very high levels of psychological stress (compared to 9.7% of non-drug users).

B. Extended model: youth financial aid

Given that Australian youths in 'cash crisis' tend to resort to crime activities for money, this study further extends the model by adding 'youth allowance' (i.e. the percentage of local teenagers receiving official financial aids) to see if this variable would add explanation to the variation in different types of crime. As discussed in the section of model tests, while fixed-effect model is appropriate in total crime, property crime and violent crime, random-effect model is suitable to drug crime. Please note that the results of other panel models in these four types of crime are listed in Table A2 in Appendix as reference.

Table 5 Extended model (with 'youth allowance')

Variables	Total crime			Property crime			Violent crime			Drug crime		
	Fixed-effect model			Fixed-effect model			Fixed-effect model			Random-effect model		
	Coef.	Robust std error		Coef.	Robust std error		Coef.	Robust std error		Coef.	Robust std error	
Socio-economic factors												
unemploy_rate(lagged)	0.014	0.006	**	0.017	0.006	***	0.022	0.010	**	0.037	0.010	***
income	-0.047	0.026	*	-0.048	0.026	*	-0.038	0.052		-0.123	0.039	***
divorce_rate	0.042	0.013	***	0.030	0.015	**	0.031	0.021		0.096	0.029	***
non-school qualification	-0.007	0.005		-0.009	0.005	*	-0.003	0.008		0.043	0.008	***
Demographic factors												
population density	0.095	0.046	**	0.106	0.047	**	-0.043	0.088		0.163	0.028	***
male 25-29	0.001	0.043		0.015	0.044		-0.043	0.066		0.193	0.072	***
male 30-49	-0.065	0.078		-0.052	0.077		-0.314	0.183	*	-0.176	0.123	
Deterrence factors												
expenditure_police	0.101	0.193		0.059	0.186		0.001	0.396		-0.675	0.428	
Structural factors												
financial_crisis 2008	-0.004	0.010		-0.013	0.010		-0.008	0.022		0.072	0.023	***
Youth's financial condition												
youth_allowance	-0.055	0.029	*	-0.033	0.027		-0.078	0.041	*	-0.153	0.049	***
constant	0.163	1.206		0.446	1.153		-0.195	2.347		0.826	2.320	
Model evaluation												
R2 (overall)	0.35			0.38			0.01			0.33		
R2 (within)	0.30			0.35			0.09			0.07		
R2 (between)	0.37			0.40			0.03			0.42		
F test of model	24.04		***	33.61		***	11.24		***	--		
Wald test of model	--			--			--			160.14		***
corr(u_i, X_b)	0.37			0.36			-0.24			0 (assumed)		
rho	0.94			0.93			0.85			0.69		

As shown in Table 5, in the case of total crime, the variables, which were influential in fundamental model, remained significant in extended model; this scenario is also applied to the other three types of crime. As discussed earlier, Youth Allowance refers to the payment for young people aged 15 to 24 who are studying, undertaking training or an Australian Apprenticeship, looking for work, or sick. This study further measures the variable of 'youth allowance' as the ratio of adolescents (aged 15–24) receiving Youth Allowance to the population at this age range in each location (i.e. each SA2). A higher youth allowance percentage rate means that adolescents are able to manage their expenses in times of need and are less likely to commit crime for money.

More importantly, 'youth allowance' variable had a discouraging effect on total crime ($p < 0.10$), violent crime ($p < 0.10$) and particularly drug crime ($p < 0.01$). Teenagers aged 15-24 receive this financial support are under the monitor mecha-

nism of this program; that is, the recipients of this allowance need to abide by relevant rules (such as looking for jobs or interview) and have activity tests periodically (also formally known as Mutual Obligation Requirement) to make sure they are on the right path in life and thus lower the likelihood of misconduct or even crime commitment.

VI. CONCLUSION

This paper explores the relationship between the factors in social, economic, demographic and social welfare aspects and four types of crime through the application of three panel models (pooled, fixed effect and random effect) based on the panel data of SA2s in Brisbane, Australia, from 2002 to 2010.

It is found that different types of crime were associated with different factors. The factors, which affected each type of crime in fundamental model, remained influential in extended model; it implies the consistent influence of these variables on these four types of crime. Moreover, the variables used in this study accounted for approximately 30 to 40% of the variation in 'total crime', 'property crime' and 'drug crime', which is close to the results obtained in previous studies (Choe, 2008; Neumayer, 2005). Nevertheless, this model performance is not observed in 'violent rate', possibly because violent crime is also driven by other variables which is not yet taken into account in this study; for instance, the meta-analysis conducted by Hsieh and Pugh (1993) revealed that violent crime is likely to be driven by the aspect of social 'inequality' such as income inequality (rather than the income 'level' considered in this study); moreover, hotter temperature is proved to be associated with higher rates of violent crime (Rotton and Cohn 2000, 2004).

Among these variables, it should be noted that "unemployment rate", which indicates a low opportunity cost for committing crime, has a prevailing positive influence on crime across these empirical models. Similarly, "income" also has deterring influence on all types of crime, except for violent crime. When faced with this situation, the government should respond by stimulating economic activities, subsidising

the unemployed, improving skill training and generating employment opportunities. As the unemployment rate drops and income rises, people face a higher opportunity cost of committing crime, which should suppresses rational potential criminals' motivations.

This paper also found that higher population density is associated with a significant increase in total crime, property crime and drug crime possibly due to social alienation. By the same token, "divorce rate", as an indicator of family disruption, exhibited a positive effect on criminal acts, likely because high divorce rate in neighbourhoods indicates the interference in social linkage between individuals and local communities (as well as wider society); as pointed out by Sampson (1986), compared to married people, divorced people are alienated from the participation in social activities. Given these findings, governments should focus more on narrowing the urban-suburban division, and advocating community engagement in terms of building up a strong and supportive personal relationship among residents so as to prevent anti-social behaviour as well as reduce the fear of crime.

In the category of age variables, while the increase in males aged 25-29 led to the rise in drug crime likely due to the high percentage drug use in Australians' late 20s, the increase in males aged 30-49 discouraged the tendency of violent crime possibly because of the work-life balance and mental stability that males have at this age cohort. However, this variable of middle adulthood ("male30-49") does not alter the variation in drug crime possibly due to addiction and reliance on drugs; that is, the maturity with aging may not deter or discourage the possible exposure to drugs and relevant crime commitment. According to the recent report of National Drug Strategy Household Survey in 2016, more people in their 40s used illicit drugs in 2016 than in 2013 (significantly increased from 13.6% to 16.2%), particularly males in their 40s (increased from 15.4% to 20%). Given that drug crime is less likely to be associated with specific age groups, the government can reduce drug crime by raising legal awareness, allocating adequate law enforcement budgets or assigning appropriate number of patrol officers to help people with drug crime tendency with

detoxification.

However, drug crime could be driven by not only socio-economic factors considered in this study but also psychological factors (i.e. low emotional control or psychiatric diagnoses), given that addiction behaviours, such as smoking, binge drinking or drugs, are strongly related to mental conditions. According to Australian Institute of Health and Welfare (2018), illicit drug users with post-school qualification were diagnosed or treated for a mental illness increased from 19% in 2013 to 26.5% in 2016. This may to some extent explain why "non-school qualification" was positively related to drug crime, although this variable remains a deterring force against property crime. In passing, "financial crisis 2008", which caused economic turmoils as well as individuals' psychological distress, may thus lead the rise in drug crime (rather than other types of crime).

"Youth allowance" (i.e. the portion of teens aged 15-24 receiving allowance in each SA2) is a variable introduced in this paper. It assumes that adolescents with access to allowances should be less motivated to rely on deviant activities or even commit crimes to solve their 'cash crisis'. This social-welfare indicator was found to have significant and consistent negative effect on total crime ($p < 0.10$), property crime ($p < 0.10$), and particularly strong restraining influence on drug crime ($p < 0.01$). This finding implies that adolescents, who may be compelled to resolve to misconduct and particularly drug-related crime (e.g. robbery, drug use or even drug trafficking) for money, are more likely to be restrained to stay in the right path when they are financially supported and periodically supervised by the social welfare program of the government. Besides government's policies, schools or parents should educate teenagers with the right attitude towards drug and alcohol use. "Youth allowance" had no clear impact on property crime possibly because property crime encompasses multiple crime categories (e.g., transportation-related offences).

It should be noted that "police expenditure" did not reveal its influence in discouraging criminal behaviours across models. This may be attributed to the use of panel model; Cornwell and Trumbull (1994) presented empirical evidence that the

influence of justice system to deter crime is much weaker in the setting of panel model (taking into account the endogeneity) than previous studies based on conventional OLS regression.

The limitations of this study and further applications and should be recognized. The crime and socioeconomic data used in this study was considered as secondary data. It would be ideal to collect a more thorough data set from 2002 to the latest year, but the missing data of socio-economics in some SA2s inevitably shortened the size of panel data; in addition, Queensland Police only retained the recorded crime for the latest five years and thus the gap of crime data from 2010 to 2014 could not be filled. In addition, the insignificance of "police expenditure" could also be resulted from the limitation of data; as mentioned in Data section, the police expenditure is mainly determined on State basis, indicating the lack of this data for each suburb; the use of "police expenditure (in state of Queensland)" as a proxy in empirical analyses may not capture the difference across suburbs and thus not able to explain the variations in four types of crime.

Moreover, Becker's model has demonstrated that arrest rate, conviction rate and severity of punishment – all have deterrent effects against crime, but these factors were not taken into consideration in the present paper simply because these data were not available. It is believed that the empirical model can be more robust if the arrest rate, conviction rate and severity of punishment can be incorporated into the regression model in further studies.

In recent years, there have been few irrational criminals whose behavioural patterns do not fit in the scope of traditional theories and models, as discussed in Parisi and Smith (2005). Considering that such criminals do not commit crime for financial, political or social reasons, their behaviour and its underlying cause should be analysed further on an individual basis. This is an area worth of further exploration in future research.

Appendix

In the setting of fundamental variables, the results of pooled-OLS and random-effect models in 'total crime', 'property crime' and 'violent crime' as well as the results of pooled-OLS and fixed-effect models in 'drug crime' are listed in Table A1 as reference. The results of these models in extended setting are also listed in Table A2.

Table A1. The fundamental models in four types of crime

Variables	Total crime				Property crime				Violent crime				Drug crime			
	pooled-OLS model		random-effect model		pooled-OLS model		random-effect model		pooled-OLS model		random-effect model		pooled-OLS model		fixed-effect model	
	Coef.	Robust std error	Coef.	Robust std error	Coef.	Robust std error	Coef.	Robust std error	Coef.	Robust std error	Coef.	Robust std error	Coef.	Robust std error	Coef.	Robust std error
Socio-economic factors																
unemploy_rate(lagged)	0.047	0.013 ***	0.020	0.006 ***	0.040	0.014 ***	0.022	0.005 ***	0.059	0.012 ***	0.041	0.008 ***	0.051	0.012 ***	0.002	0.014
income	-0.130	0.051 **	-0.071	0.022 ***	-0.131	0.049 ***	-0.070	0.021 ***	-0.145	0.051 ***	-0.094	0.035 ***	-0.130	0.052 ***	-0.108	0.048 **
divorce_rate	0.020	0.017	0.031	0.012 **	0.019	0.017	0.025	0.014 *	-0.004	0.024	0.014	0.020	0.074	0.031 **	0.089	0.028 ***
non-school qualification	0.020	0.006 ***	0.001	0.004	0.012	0.006	-0.003	0.004	0.028	0.007 ***	0.015	0.006 ***	0.059	0.006 ***	0.034	0.010 ***
Demographic factors																
population density	0.162	0.025 ***	0.169	0.024 ***	0.159	0.027 ***	0.167	0.023 ***	0.141	0.016 ***	0.138	0.019 ***	0.166	0.018 ***	0.103	0.136
male 25-29	0.257	0.069 ***	0.072	0.033 **	0.270	0.065 ***	0.086	0.031 ***	0.180	0.076 **	0.143	0.048 ***	0.202	0.074 ***	0.028	0.130
male 30-49	-0.314	0.154 **	-0.070	0.061	-0.330	0.150 **	-0.080	0.060	-0.305	0.173	-0.279	0.117 **	-0.208	0.169	-0.124	0.208
Deterrence factors																
expenditure_police	0.021	0.349	-0.006	0.188	0.060	0.352	0.007	0.172	0.132	0.388	-0.118	0.333	-0.885	0.467 *	-0.689	0.471
Structural factors																
financial_crisis 2008	0.037	0.016 **	0.009	0.008	0.017	0.018	-0.002	0.008	0.029	0.027	0.016	0.022	0.115	0.026 ***	0.067	0.024 ***
constant	-0.425	1.905	0.281	1.137	-0.307	1.902	0.308	1.025	-2.622	2.009	-0.787	1.738	1.612	2.477	1.888	2.752
Model evaluation																
R2 (overall)	0.49		0.42		0.48		0.43		0.37		0.36		0.37		0.30	
R2 (within)	--		0.29		--		0.34		--		0.07		--		0.06	
R2 (between)	--		0.44		--		0.45		--		0.43		--		0.38	
F test of model	26.40 ***		--		29.41 ***		--		32.57 ***		--		31.23 ***		5.80 ***	
Wald test of model	--		299.19 ***		--		440.61 ***		--		207.64 ***		--		--	
corr(u_i, Xb)	--				--		--		--		--		--		0.32	
rho	--		0.91		--		0.90		--		0.73		--		0.74	

Table A2. The fundamental models in four types of crime

Variables	Total crime				Property crime				Violent crime				Drug crime			
	pooled-OLS model		random-effect model		pooled-OLS model		random-effect model		pooled-OLS model		random-effect model		pooled-OLS model		**fixed-effect model**	
	Coef.	Robust std error	Coef.	Robust std error	Coef.	Robust std error	Coef.	Robust std error	Coef.	Robust std error	Coef.	Robust std error	Coef.	Robust std error	Coef.	Robust std error
Socio-economic factors																
unemploy_rate(lagged)	0.051	0.016 ***	0.021	0.006 ***	0.042	0.017 ***	0.022	0.005 ***	0.067	0.014 ***	0.042	0.008 ***	0.064	0.014 ***	0.016	0.015
income	-0.107	0.048 **	-0.069	0.023 ***	-0.109	0.046 **	-0.069	0.022 ***	-0.135	0.053 ***	-0.096	0.037 ***	-0.105	0.053 **	-0.086	0.051 *
divorce_rate	0.032	0.018 *	0.037	0.012 ***	0.028	0.018	0.027	0.014 *	0.001	0.026	0.016	0.021	0.086	0.034 ***	0.108	0.029 ***
non-school qualification	0.016	0.007	-0.001	0.005	0.008	0.008	-0.004	0.005	0.026	0.008 ***	0.012	0.006 *	0.057	0.008 ***	0.029	0.011 ***
Demographic factors																
population density	0.167	0.032 ***	0.171	0.027 ***	0.166	0.034 ***	0.173	0.026 ***	0.133	0.025 ***	0.134	0.027 ***	0.153	0.027 ***	0.055	0.129
male 25-29	0.255	0.080 ***	0.073	0.040	0.270	0.074 ***	0.086	0.041 **	0.179	0.091 **	0.112	0.059 *	0.221	0.089 ***	0.072	0.106
male 30-49	-0.344	0.161 **	-0.078	0.064	-0.361	0.154 **	-0.078	0.063	-0.311	0.189 *	-0.265	0.131 **	-0.243	0.185	-0.182	0.180
Deterrence factors																
expenditure_police	0.026	0.348	0.086	0.188	0.031	0.341	0.048	0.176	0.201	0.414	0.020	0.353	-0.910	0.500 *	-0.604	0.454
Structural factors																
financial_crisis 2008	0.033	0.020	0.004	0.009	0.011	0.022	-0.006	0.009	0.033	0.028	0.012	0.022	0.107	0.027 ***	0.048	0.026 *
Youth's financial condition																
youth_allowance	-0.066	0.072 *	-0.043	0.026	-0.053	0.067	-0.023	0.025	-0.066	0.080	-0.048	0.043	-0.132	0.086	-0.185	0.058 ***
constant	-0.641	1.967	-0.283	1.137	-0.270	1.884	0.044	1.055	-3.150	2.249	-1.585	1.876	1.459	2.718	1.425	2.595
Model evaluation																
R2 (overall)	0.46		0.40		0.46		0.42		0.35		0.33		0.3399		0.23	
R2 (within)	--		0.29		--		0.35		--		0.08		--		0.08	
R2 (between)	--		0.42		--		0.43		--		0.39		--		0.28	
F test of model	23.59 ***		--		26.31 ***		--		21.71 ***		--		21.64 ***		6.58 ***	
Wald test of model	--		289.72 ***		--		430.95 ***		--		166.14 ***		--		--	
corr(u_i, Xb)	--		--		--		--		--		--		--		0.2822	
rho	--		0.91		--		0.90		--		0.75		--		0.76	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

References

Allen, R. C. 1996. "Socioeconomic Conditions and Property Crime: A Comprehensive Review and Test of the Professional Literature," A*merican Journal of Economics and Sociology*, vol. 55, no.3, pp. 293~308.

Amato, P. R. 2001. "Children of Divorce in the 1990s: An Update of the Amato and Keith (1991) Meta-Analysis," *Journal of family psychology*, vol.15, no.3, pp. 355~370.

Anderson, D. A. 1999. "The Aggregate Burden of Crime," *The Journal of Law and Economics*, vol. 42, no. 2, pp. 611~642.

Anderson, D. A. 2012. "The Cost of Crime," *Foundations and Trends in Microeconomics*, vol. 7, no. 3, pp. 209~265.

Andresen, M. A. 2012. "Unemployment and Crime: A Neighborhood Level Panel Data Approach," *Social Science Research*, vol. 41, no. 6, pp. 1615~1628.

Australian Institute of Health and Welfare. 2011. 2010 National Drug Strategy Household Survey report. Drug Statistics Series no. 25. Cat. no. PHE 145. Canberra: AIHW.

Australian Institute of Health and Welfare. 2017. National Drug Strategy Household Survey 2016: Detailed Findings. Drug Statistics Series no. 31.Cat. no. PHE 214. Canberra: AIHW

Australian Institute of Health and Welfare. 2018. Australia's Health 2018. Australia's Health Series no. 16. AUS 221. Canberra: AIHW.

Avio, K. L. 1988. "Measurement Errors and Capital Punishment," *Applied Economics*, vol. 20, no.9, pp. 1253~1262.

Bailey, A.W. 1992. "Teenagers' Employment, Earnings, and Spending," *Journal of Home Economics*, vol. 84, no. 2, pp. 20~24.

Becker, G. S. 1968. "Crime and Punishment: An Economic Approach," *Journal of Political Economy*, vol. 76, no. 2, pp. 169~217.

Belk, R. W., Rice, C. and Harvey, R. 1985. "Adolescents' Reported Saving, Giving, and Spending as a Function of Sources of Income," in Hirschman E. C. and

Holbrook M. B. eds., *NA - Advances in Consumer Research Volume 12* (Provo, UT: Association for Consumer Research), pp. 42~46.

Bell, A., Fairbrother, M. and Jones, K. 2019. "Fixed and Random Effects Models: Making an Informed Choice," *Quality & Quantity*, vol. 53, no. 2, pp. 1051~1074.

Bell, A. and Jones, K. 2015. "Explaining Fixed Effects: Random Effects Modeling of Time-Series Cross-Sectional and Panel Data," *Political Science Research and Methods*, vol. 3, no. 1, pp. 133~153.

Bennett, T., Holloway, K. and Farrington, D. 2008. "The Statistical Association between Drug Misuse and Crime: A Meta-Analysis," *Aggression and Violent Behavior*, vol. 13, no. 2, pp. 107~118.

Bernasco, W., de Graaff, T., Rouwendal, J. and Steenbeek, W. 2017. "Social Interactions and Crime Revisited: An Investigation using Individual Offender Data in Dutch Neighborhoods," *Review of Economics and Statistics*, vol. 99, no.4, pp. 622~636.

Blau, J. R. and Blau, P. M. 1982. "The Cost of Inequality: Metropolitan Structure and Violent Crime," *American Sociological Review*, vol. 47, no. 1, pp. 114~129.

Bodman, P. M. and Maultby, C. 1997. "Crime, Punishment and Deterrence in Australia," *International Journal of Social Economics*, vol. 24, no.7/8/9, pp. 884~901.

Borland, J. and Hunter, B. 2000. "Does Crime Affect Employment Status? The case of Indigenous Australians," *Economica*, vol. 67, no. 265, pp. 123~144.

Brook, J. S., Whiteman, M., Finch, S. J. and Cohen, P. 1996. "Young Adult Drug Use and Delinquency: Childhood Antecedents and Adolescent Mediators," *Journal of the American Academy of Child & Adolescent Psychiatry*, vol. 35, no.12, pp.1584~1592.

Breusch, T. S. and Pagan, A. R. 1980. "The Lagrange Multiplier Test and its Applications to Model Specification in Econometrics," *Review of Economic Studies*,

vol. 47, no. 1, pp. 239~253.

Brush, J. 2007. "Does Income Inequality Lead to More Crime? A Comparison of Cross-Sectional and Time-Series Analyses of United States Counties," *Economics Letters*, vol. 96, no. 2, pp. 264~268.

Cáceres-Delpiano, J. and Giolito, E. 2012. "The Impact of Unilateral Divorce on Crime," *Journal of Labor Economics*, vol. 30, no. 1, pp. 215~248.

Cameron, A. C. and Trivedi, P. K. 2010. *Microeconometrics Using Stata, Revised Edition* (College Station, TX: Stata Press).

Carmichael, F. and Ward, R. 2001. "Male Unemployment and Crime in England and Wales," *Economics Letters*, vol. 73, no. 1, pp. 111~115.

Cheng, C. and Long, W. 2018. "Improving Police Services: Evidence from the French Quarter Task Force," *Journal of Public Economics*, vol. 164, pp.1~18.

Choe, J. 2008. "Income Inequality and Crime in the United States," *Economics Letters*, vol. 101, no. 1, pp. 31~33.

Collins, D. and Lapsley, H. M. 2008. *The Costs of Tobacco, Alcohol and Illicit Drug Abuse to Australian society in 2004/05* (Canberra: Commonwealth of Australia).

Cornwell, C. and Trumbull, W. N. 1994. "Estimating the Economic Model of Crime with Panel Data," *The Review of Economics and Statistics*, vol. 76, no. 2, pp. 360~366.

Craig, S. G. 1987. "The Deterrent Impact of Police: An Examination of a Locally Provided Public Service," *Journal of Urban Economics*, vol. 21, no. 3, pp. 298~311.

Cullen, J. B. and Levitt, S. D. 1999. "Crime, Urban Flight, and the Consequences for Cities," *The Review of Economics and Statistics*, vol. 81, no. 2, pp.159~169.

Danes, S. M. 1994. "Parental Perceptions of Children's Financial Socialization," *Financial Counseling and Planning*, vol. 5, no.1, pp. 127~149.

Dawkins, M. P. 1997. "Drug Use and Violent Crime among Adolescents," *Adolescence*, vol.32, no.126, pp. 395~405.

Detotto, C. and Otranto, E. 2010. "Does Crime Affect Economic Growth?" *Kyklos*, vol. 63, no.3, pp. 330~345.

Edlund, L., Li, H., Yi, J. and Zhang, J. 2007. "Sex Ratios and Crime: Evidence from China's One-Child Policy," IZA Discussion Papers, no. 3214, Institute of the Study of Labor (IZA), Bonn. Available at: https://www.econstor.eu/handle/10419/34901.

Ehrlich, I. 1973. "Participation in Illegitimate Activities: A Theoretical and Empirical Investigation," *Journal of Political Economy*, vol. 81, no. 3, pp. 521~565.

Ehrlich, I. 1996. "Crime, Punishment, and the Market for Offenses," *Journal of Economic Perspectives*, vol. 10, no.1, pp. 43~67.

Entorf, H. and Spengler, H. 2000. "Socioeconomic and Demographic Factors of Crime in Germany: Evidence from Panel Data of the German States," *International Review of Law and Economics*, vol. 20, no. 1, pp. 75~106.

Gazel, R. C., Rickman, D.S. and Thompson, W.N. 2001. "Casino Gambling and Crime: A panel Study of Wisconsin Counties," *Managerial and Decision Economics*, vol. 22, no.1/3, pp. 65~75.

Glaeser, E.L. and Sacerdote, B. 1999. "Why is There More Crime in Cities?" *Journal of Political Economy*, vol.107, no. S6, pp. S225~S258.

Glaeser, E. L., Sacerdote, B. and Scheinkman, J. A. 1996. "Crime and Social Interactions," *The Quarterly Journal of Economics*, vol. 111, no. 2, pp. 507~548.

Gould, E. D., Weinberg, B.A. and Mustard, D. B. 2002. "Crime Rates and Local Labor Market Opportunities in the United States: 1979–1997," *Review of Economics and Statistics*, vol. 84, no.1, pp. 45~61.

Greenberg, D. F. 2001. "Time Series Analysis of Crime Rates," *Journal of Quantitative Criminology*, vol.17, no. 4, pp. 291~327.

Habibullah, M. S and Law, S.H. 2008. "Property Crime and Macroeconomic Variables in Malaysia: Some Empirical Evidence from a Vector Error-Correction Model," MPRA Paper no. 12112. Available at: https://mpra.ub.uni-muenchen.de/12112/

Hartley, R. 1989. "You Don't Cope, You Struggle," *Family Matters: Australian Institute Family Studies Newsletter*, no. 23, pp. 6~9.

Hirschi, T. and Gottfredson, M. 1983. "Age and the Explanation of Crime," *American Journal of Sociology*, vol. 89, no. 3, pp. 552~584.

Howsen, R. M. and Jarrell, S. B. 1987. "Some Determinants of Property Crime: Economic Factors Influence Criminal Behavior but Cannot Completely Explain the Syndrome," *American Journal of Economics and Sociology*, vol. 46, no. 4, pp. 445~457.

Hsieh, C. C. and Pugh, M. D. 1993. "Poverty, Income Inequality, and Violent Crime: A Meta-Analysis of Recent Aggregate Data Studies," *Criminal Justice Review*, vol. 18, no. 2, pp.182~202.

Ihlanfeldt, K. and Mayock, T. 2010. "Panel Data Estimates of the Effects of Different Types of Crime on Housing Prices," *Regional Science and Urban Economics*, vol. 40, no. 2, pp. 161~172.

James, A. and Smith, B. 2017. "There Will be Blood: Crime Rates in Shale-Rich US Counties," *Journal of Environmental Economics and Management*, vol. 84, pp.125~152.

Kapuscinski, C. A, Braithwaite, J. and Chapman, B. 1998. "Unemployment and Crime: Toward Resolving the Paradox," *Journal of Quantitative Criminology*, vol. 14, no. 3, pp. 215~243.

Kelly, M. 2000. "Inequality and Crime," *Review of Economics and Statistics*, vol. 82, no. 4, pp. 530~539.

Krambia-Kapardis, M. 2017. "Fraud and Corruption: Protagonists in Creating a Financial Crisis," in Spinellis, C., Theodorakis, N., Billis, E. and Papadimitrakopoulos G. eds., *Europe In Crisis: Crime, Criminal Justice, and the way Forward* (Athens: Ant. N. Sakkoulas Publishers), pp. 563~582.

Levitt, S. D. 1998. "Juvenile Crime and Punishment." *Journal of Political Economy*, vol. 106, no. 6, pp. 1156~1185.

Levitt, S. D. 1998. "Why Do Increased Arrest Rates Appear to Reduce Crime: De-

terrence, Incapacitation, or Measurement Error?" *Economic Inquiry*, vol. 36, no. 3, pp. 353~372.

Levitt, S.D. 2017. "The Economics of Crime," *Journal of Political Economy*, vol. 125, no. 6, pp. 1920~1925.

Lin, M.J. 2009. "More Police, Less Crime: Evidence from US State Data," *International Review of Law and Economics*, vol. 29, no. 2, pp. 73~80.

Lochner, L. and Moretti, E. 2004. "The Effect of Education on Crime: Evidence from Prison Inmates, Arrests, and Self-Reports," *The American Economic Review*, vol. 94, no. 1, pp.155~189.

Lofstrom, M. and Raphael, S. 2016. "Crime, the Criminal Justice System, and Socioeconomic Inequality," *Journal of Economic Perspectives*, vol. 30, no. 2, pp.103~126.

Lu, M.Y. and Tung, Y.Y. 2010. "The Relationships between Money Attitudes and Delinquency of Junior High School Students in Taiwanese City Areas," [台灣都市區域國中生的金錢態度與偏差行爲之關聯性研究]. *Journal of Research in Delinquency and Prevention [青少年犯罪防治研究期刊]*, vol. 2, no. 2, pp.21~62.

Lio, M.C. and Lu, C.C. 2011. "Income Inequality and Crime: A Study Based on Regional Dynamic Panel Data from Taiwan," [所得分配不均與犯罪:台灣縣市動態追蹤資料分析], *Taiwan Economic Reivew [經濟論文叢刊]*, vol. 39, no. 2, pp. 243~276.

McCarty, W. P., Ren, L. and Zhao, J. S. 2012. "Determinants of Police Strength in Large US Cities during the 1990s: A Fixed-Effects Panel Analysis." *Crime& Delinquency*, vol. 58, no. 3, pp.397~424.

Machin, S., Marie, O. and Vuji, S. 2011. "The Crime Reducing Effect of Education," *The Economic Journal*, vol. 121, no. 552, pp. 463~484.

Machin, S. and Meghir, C. 2004. "Crime and Economic Incentives," *Journal of Human Resources*, vol. 39, no. 4, pp.958~979.

Moss, H. B., Chen, C. M. and Yi, H.Y. 2014. "Early Adolescent Patterns of Alcohol,

Cigarettes, and Marijuana Polysubstance Use and Young Adult Substance Use Outcomes in a Nationally Representative Sample," *Drug and Alcohol Dependence*, vol. 136, no. 1, pp. 51~62.

Narayan, P. K. and Smyth, R. 2004. "Crime Rates, Male Youth Unemployment and Real Income in Australia: Evidence from Granger Causality Tests," *Applied Economics*, vol. 36, no. 18, pp. 2079~2095.

Neumayer, E. 2005. "Inequality and Violent Crime: Evidence from Data on Robbery and Violent Theft," *Journal of Peace Research*, vol. 42, no. 1, pp.101~112.

Nordin, M. and Almén, D. 2017. "Long-Term Unemployment and Violent Crime," *Empirical Economics*, vol. 52, no. 1, pp.1~29.

O'Neill, B. 1992. "Youth, Money, and Financial Planning," *Journal of Home Economics*, vol. 84, no. 3, pp.12~16.

Papps, K. and Winkelmann, R. 2000. "Unemployment and Crime: New Evidence for an Old Question," *New Zealand Economic Papers*, vol. 34, no.1, pp.53~71.

Parisi, F. and Smith, V. L. 2005. *The Law and Economics of Irrational behavior* (California: Stanford University Press).

Peri, G. 2004. "Socio-Cultural Variables and Economic Success: Evidence from Italian Provinces 1951-1991," *The B.E. Journal of Macroeconomics*, vol. 4, no. 1, pp.1~36

Prichard, J. and Payne, J. 2005. "Alcohol, Drugs and Crime: A Study of Juveniles in Detention," Research and Public Policy Series no. 67 (Canberra: Australian Institute of Criminology).

Raphael, S. and Winter-Ebmer, R. 2001. "Identifying the Effect of Unemployment on Crime," *The Journal of Law and Economics*, vol. 44, no.1, pp. 259~283.

Reilly, B. and Witt, R. 1992. "Crime and Unemployment in Scotland: An Econometric Analysis Using Regional Data," *Scottish Journal of Political Economy*, vol. 39, no. 2, pp. 2l3~228.

Rotton, J. and Cohn, E. G. 2000. "Violence is a Curvilinear Function of Temperature in Dallas: A Replication," *Journal of Personal and Social Pychology*, vol.78,

no. 6, pp. 1074~1081.

Rotton, J. and Cohn, E. G. 2004. "Outdoor Temperature, Climate Control, and Criminal Assault: The Spatial and Temporal Ecology of Violence," *Environment and Behavior*, vol. 36, no. 2, pp. 276~306.

Samavati, H. 2006. "Economics of Crime: Panel Data Analysis of Bank Robbery in the United States," *Atlantic Economic Journal*, vol. 34, no. 4, pp.455~466.

Sampson, R. J. 1986. "Crime in Cities: The Effects of Formal and Informal Social Control," *Crime and Justice*, vol. 8, pp. 271~311.

Schaffer, M. and Stillman, S. 2006. "XTOVERID: Stata module to calculate tests of overidentifying restrictions after xtreg, xtivreg, xtivreg2, xthtaylor," Statistical Software Components S456779, Boston College Department of Economics, revised 15 Jan 2016.

Schneider, J. 2000. "The increasing financial dependency of young people on their parents," *Journal of Youth Studies*, vol. 3, no. 1, pp. 5~20.

Shedler, J. and Block, J. 1990. "Adolescent drug use and psychological health: A longitudinal inquiry," *American psychologist*, vol. 45, no. 5, pp. 612.

Stolzenberg, L. and D'Alessio, S. J. 2007. "The Effect of Divorce on Domestic Crime," *Crime & Delinquency*, vol. 53, no. 2, pp. 281~302.

Taniguchi, T. A. and Salvatore, C. 2012. "Exploring the Relationship between Drug and Alcohol Treatment Facilities and Violent and Property Crime: A Socioeconomic Contingent Relationship," *Security Journal*, vol. 25, no. 2, pp. 95~115.

Tham, H. and Von Hofer, H. 2009. "Individual Prediction and Crime Trends," *European Journal of Criminology*, vol. 6, no. 4, pp. 313~335.

Tomasic, R. 2011. "The Financial Crisis and the Haphazard Pursuit of Financial Crime," *Journal of Financial Crime*, vol. 18, no. 1, pp. 7~31.

Ulmer, J. T. and Steffensmeier, D. J. 2014. "The Age and Crime Relationship: Social Variation, Social Explanations," in Beaver, K., Boutwell, B. and Barnes, J.C. eds., *The Mature versus Biosocial Debate in Criminology: On the Origins of Criminal Behavior and Criminality* (Newbury Park, CK: Sage Publications

Inc.), pp. 377~396.

Van de Weijer, S.G.A, Thomberry, T.P., Bijleveld, C.C. and Blokland, A. A. 2015. "The Effects of Parental Divorce on the Intergenerational Transmission of Crime," *Societies*, vol. 5, no.1, pp. 89~108.

Vinson, T., Abela, M. and IIutka, R. 1997. *Making Ends Meet: A Study of Unemployed Young People Living in Sydney*. Uniya Research Report No.1 (Sydney: Uniya Jesuit Social Justice Centre).

White, R. 1989. "Making Ends Meet: Young People, Work and the Criminal Economy," *Australian & New Zellland Journal of Criminology*, vol. 22, no. 3, pp. 136~150.

White, R., Aumair, M., Harris, A. and McDonncll, L. 1997. *Any Which Way You Can: Youth Livelihoods, Community Resources and Crime* (New South Wales, Australia: The Australian Youth Foundation).

Williams, K. R. and Flewelling, R. L. 1988. "The Social Production of Criminal Homicide: A Comparative Study of Disaggregated Rates in American Cities," *American Sociological Review*, vol. 53, no. 3, pp. 421~431.

Wooldridge, J. M. 2010. *Econometric Analysis of Cross Section and Panel Data* (Cambridge, MA: MIT press).

澳洲布里斯本不同類別犯罪之社會經濟因素：縱橫面分析

彭蒂菁
國立臺北大學 不動產與城鄉環境學系 副教授
黃俊凱
國立東華大學 經濟學系 碩士

中文摘要

本研究透過經濟學的角度，以2002至2010年澳洲布里斯本149個行政區爲分析對象，採用三類追蹤資料模型，探討各類社會經濟因素對四類犯罪（一般刑案、暴力犯罪、財產犯罪以及毒品犯罪）的影響。實證結果顯示，一般認知的社會經濟因素以及人口結構因素，像是失業率、收入水準以及人口密度，確實左右各類犯罪的動向。就人口結構而言，「25-29歲男性人口比例」增加，帶動毒品犯罪增加，可能跟澳洲吸毒人口以年輕人爲主有關；「30-49歲男性人口比例」愈高，由於這類年齡層人口的犯罪機會成本較高，因此如同預期，降低社會中暴力犯罪的案件，但對毒品犯罪卻無制衡力，可能由於毒品成癮並不侷限於特定年齡。

本文發現，在澳洲青年津貼政策之下，「青少年擁有零用錢比例」增加，能夠遏止各類犯罪，尤其是毒品犯罪。換言之，儘管青少年無法藉由工作來獲取所得，也有基本的所需，父母若沒給予零用錢來滿足孩子，他們只能藉由賺取非法利得來平衡他們的所需。如果青少年在基本需求上金錢無虞，並能受到政府社會福利定期監督，就能大幅減少他們年少犯罪以及後續犯罪的可能。希望藉由本文之結論與建議，提供政府相關單位在研擬犯罪防治上給予參考並有效解決犯罪問題。

關鍵詞：青少年零用錢、社會經濟因素、不同類別犯罪、毒品犯罪、澳洲布里斯本