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Vocational Education and Training: A Pathway to the Straight and Narrow

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* This paper uses age-specific, postcode-level data on crime statistics from the Victorian Crime Statistics Agency and the NSW Bureau of Crime Statistics and Research, postcode-level vocational education and training participation data from the National Centre for Vocational Education Research (NCVER) and population estimates from the Australian Bureau of Statistics (ABS). We appreciate the help of each of these agencies in making the data available. Financial support for this research was provided by the Faculty of Business and Economics, University of Melbourne. The findings and views reported in this paper, as well as any errors, are our own and should not be attributed to the Victorian Crime Statistics Agency, NSW Bureau of Crime Statistics, NCVER, ABS, the Melbourne Institute or the University of Melbourne. We thank David Ribar, Melbourne Institute staff and participants at the 2015 North American meetings of the Regional Science Association for helpful comments and suggestions. Correspondence should be sent to <cainp@unimelb.edu.au>.

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Abstract

Education is often claimed to reduce social exclusion and crime, yet there is little empirical evidence beyond that for increased schooling. In this study, we estimate the crime-reducing effects of participating in post-secondary vocational education and training (VET) between ages 16 and 44, exploiting a natural experiment in Australia that increased VET participation in the state of Victoria, but not in the neighbouring state of New South Wales. Using postcode (zipcode) level administrative data and difference-in-differences estimation, we find that increased VET participation is associated with reduced person, drug and property crime. We find much larger effects for mature-age people (26-44) than for young people (16-25), possibly because crime at this age is more closely linked to legitimate labor market opportunities. These results provide plausibly causal evidence that extending opportunities for later-life education and training can have substantial public benefits.

JEL classification: I20, J31

Keywords: Vocational education and training, VET, crime, education

Introduction

The crime-reducing effect of education is a commonly cited spillover used to justify public subsidies. There are several channels through which education is thought to reduce crime. First, education can increase future earnings and social status from legitimate work, in turn leading to substitution away from illegitimate forms (Lochner and Moretti, 2004; Trzesniewski et al., 2006; Machin et al., 2011). Second, being in a classroom environment establishes and rewards pro-social norms that can improve behaviour outside of the classroom (Akers, 2011). Third, education may develop preferences, such as patience or risk aversion, that reduces the likelihood of crime (Lochner and Moretti, 2004). Finally, time in the classroom may have an incapacitating effect on crime (Anderson, 2014). Empirical evidence to date is supportive, but concentrated on the crime-reducing effects of schooling (Lochner and Moretti, 2004; Machin et al., 2011, 2012; Cook and Kang, 2013; Anderson, 2014; Hjalmarsson et al., 2015; Jha, 2015; Landers et al., 2015).

In this study, we extend current evidence by exploiting a natural experiment to estimate the crime-reducing effects from participation in post-secondary vocational education and training (VET). VET is a form of tertiary education that provides job-specific training in technical and professional occupations. As an accessible form of education for people of all ages and abilities, the crime-reducing effect of postsecondary VET may be large. Post-secondary VET provides opportunities for young early school leavers to re-engage in study, second-chance options for adults with little formal education and pathways for people to re-enter the labour market or retrain for an alternative job.[1] To date, the only evidence of the crime-reducing effect of post-secondary VET is from targeted interventions that include short-term vocational training rolled-out as part of a suite of measures. These include Jobs Corps (Schochet et al., 2008); JOBSTART (Cave et al., 1993) and prisoner rehabilitation (Wilson et al., 2000; Tyler and Kling, 2006).[2] While these programs are associated with reduced crime, they do not provide strong causal evidence on the crime-reducing effect of VET participation.

Causal evidence is needed because despite the opportunities that VET affords people to right their life course, there are reasons to believe that its crime-reducing benefits may be small or non-existent. In particular, any benefits from improved employment prospects may be offset

[1] See Jacobson et al. (2005); Jenkins (2006); Lee and Coelli (2010); Coelli and Tabasso (2015) for evidence on the labour market outcomes of post-secondary VET.

[2] In the case of in-prison programs, the evidence is also only correlational because of a reluctance to randomize treatment (Wilson et al., 2000; Lochner, 2010).

by increased crime from the concentration of disadvantaged people. Such peer effects have been found in response to interventions that have targeted disengaged youth (Rodriguez-Planas, 2012) and people living in poor areas (McCord, 1992; Kling et al., 2005). In a similar context, concentrating juveniles in school has been shown to increase violent crimes (Jacob and Lefgren, 2003; Luallen, 2006). Also, any incapacitation effect from VET is likely to be weak because part-time study is common and there is no legal requirement for VET students to attend classes.

In this study, we estimate plausibly causal relationships between post-secondary VET participation and crime in Australia, exploiting a 75% expansion in VET participation in the state of Victoria between 2010 and 2013 associated with the early adoption of a national reform that replaced supply-driven VET funding models in each state with a voucher. If VET participation does reduce crime, then we should observe it under the large expansion that occurred in Victoria. We use difference-in-differences estimation, using the neighbouring state of New South Wales (NSW) to construct counterfactual outcomes. VET participation in NSW followed business-as-usual growth rates over this period because it continued to operate its supply-driven funding model.[3] This can be thought of as a natural experiment because the reason for the earlier adoption in Victoria was not related to differences in crime, but more likely related to political reasons. We use postcode (zipcode) level administrative VET enrollment and crime offender data linked with time-varying postcode economic and demographic data. A feature of our analysis is estimation of effects across three age groups: young-age (16-25), prime-age (26-34) and mature-age (35-44). By estimating the crime-reducing effects of VET participation across age groups between 16 and 44, we shed light on the spillovers from public investments in life-long education.

We find 4.5%, 11.3% and 12.8% reductions in person, property and drug crime rates respectively associated with the 75% increase in the VET participation in Victoria. Given the large cost to the community of drug crimes, including lost productivity, health and rehabilitation costs, this represents an important saving to the community. Overall, we estimate that for every dollar spent in expanded VET participation in Victoria, the community saved 18 cents (2015 Australian dollar terms) in avoided crime costs. Importantly, most of the crime-reducing effects are associated with increased prime-age and mature-age VET participation, which may

[3] Australia has six states and two territories and Victoria and New South Wales are the most populous states with 5.9 million and 7.6 million respectively. Together, their populations account for almost 60% of Australia's 23.7 million people (Australian Bureau of Statistics, 2015). As well as sharing a border, they have similar economic, socio-demographic and political structures and history. Until 1851, Victoria was administered as part of the NSW colonial government.

be because crime involvement among young people is more likely to be associated with peer effects than illegitimate career paths (Gomez-Smith and Piquero, 2005; DeLisi, 2006; DeLisi and Piquero, 2011). We also find that expanded VET participation reduces female crime by more than male crime, possibly because female VET participation is more likely to represent a pathway back to any or full-time employment.[4] Given recent expansions in the public-funding of post-secondary VET in many countries, these results provide timely evidence on an important public benefit.[5]

In the section to follow, we provide background information on crime and education in Australia and outline the VET voucher scheme. This section is followed by a description of the data and research methods and a discussion of the results. We conclude the paper by explaining how our findings fit into the existing body of knowledge with implications for policy.

Policy background

The education system in Australia is similar to those in other English-speaking countries. Upper-secondary education is unstreamed with a curriculum that is heavily focused on preparation for higher education, but with options for students to take vocational upper-secondary courses. Upper-secondary attainment in Australia is around the OECD average at 78%, but attainment of tertiary education is higher – 45% compared to 39% (Pont et al., 2013).

Post-secondary VET in Australia is the main channel for further education for early school leavers, for school graduates who are not going to university and for mature-age people returning to study. VET qualifications in Australia are nationally accredited by the federal government in consultation with employer groups, which ensures uniformity of training across states. Courses are designed to prepare people for work in specific occupations in both trade and non-trade related areas (for example, IT, business, retail, health and community service workers). Qualifications come in a range of levels from foundation courses that are below upper-secondary equivalent (International Standard of Education Classification (ISCED) 1997 level 2C) through to Diploma. The large range of course levels available make them accessible for people of all educational backgrounds. Typically, completion of a VET course takes between 12 to 18 months

[4]Females are more likely to be out of work or in part-time work prior to entering VET (see Table A3 in appendix A).

[5]For example, England and the United States have increased public spending in recent times to make post-secondary VET highly affordable or free under the Skills for Sustainable Growth and America's College Promise respectively.

of full-time equivalent study (12-15 hours per week). There is no requirement for training to occur in the workplace, except for apprenticeships and traineeships that comprise only a small part of Australian VET sector. Among those 16-44 in the states of Victoria and NSW, the proportion is around 20% for males and around 10% for females (Table A3 in the appendix).

VET is highly subsidized in Australia, with the vast majority of students enrolling in a publicly subsidized course. In such courses, fees are capped at a modest and relatively flat levels, regardless of the course studied and the characteristics of the student. For example, in 2011 in Victoria, students paid a fee of up to $A1.51 per contact hour, with a maximum fee set at $A875 per year.[6]

The VET voucher

Historically, public funding of VET in each state was based on a centralised, supply-driven model. Under this model, governments funded a fixed number of places across various courses at public colleges according to past enrollments and government skill forecasts.[7] The limited number of publicly-funded places available were generally allocated to students on a first-come-first-served basis, although preference was given to recent early school leavers in both Victoria and NSW. For those who missed out, an alternative was to enroll in a full-fee-paying course, either with a public or private college.

In 2008, as part of a national agreement, state, territory and federal governments committed to introducing demand-driven reforms in VET to increase workforce education levels and improve the responsiveness of the sector to skill demands.[8] In essence, these reforms replaced state supply-driven funding models with voucher schemes that linked funding to student course choice, including courses with private colleges.

Each state and territory government designed and implemented its own voucher scheme. Victoria was the first state to introduce a voucher scheme from July 2009, although it's full force wasn't experienced until the start of the 2010 academic year. South Australia followed in July 2012, Tasmania, Northern Territory and Queensland in July 2013, New South Wales in January 2014, Australian Capital Territory in February 2015 and Western Australia in July

[6]Diploma level fees were higher, up to $A3.79 per hour with a maximum total fee of $A2000. However, students are entitled to an income-contingent loan for Diploma courses.

[7]Although funding was allocated to private colleges for the provision of training associated with apprenticeships and traineeships.

[8]As outlined in the Council of Australian Governments National Agreement for Skills and Workplace Development, signed November 29 2008, (https://www.coag.gov.au/node/294).

2016. While it is difficult to know exactly what was behind the earlier introduction in Victoria than in NSW, a possible explanation is that at the time the national agreement was signed (November 2008), the NSW government was embroiled in corruption scandal.[9] Regardless, it is safe to conclude that crime reduction was not an important factor.

In this study, we estimate impacts in Victoria because its voucher scheme was an uncapped entitlement and provided students with greater freedom to use the voucher to enroll in their course of choice, including with private colleges. In other states, the voucher remained subject to budgetary restrictions and could only be redeemed on specific courses that were determined by government. The result was that the voucher in Victoria induced a much larger increase in enrollments than in other states.

In 2013, the last year of our our analysis, there were two other changes that may have affected VET participation in Victoria. The first was similar national reforms in the university sector where the number of publicly-funded places became uncapped after the introduction of a national entitlement.[10] In general, the uncapping of publicly-funded places in universities reduced the minimum academic performance required for course admission, which may have led relatively high achieving post-secondary students to swtich from VET to university study. The second change was further VET reforms in Victoria that included greater targeting of subsidy levels and fee deregulation. To the extent that these changes affected the composition of students in VET, they may have also affected impacts on crime. This is tested in the sensitivity analysis.

Data

The focus of this study is to estimate the effect of VET participation on crime, exploiting a natural experiment in Australia that increased VET participation in the state of Victoria, but not in the neighbouring state of NSW between 2010 and 2013. To do this, we compile rich postcode (zipcode) level VET participation and crime rate data between 2006 and 2013 for those aged 16 to 44 by gender in both states. We use postcode level data because it is the most disaggregate level available. Extending the data collection to encompass four years of pre-reform data (2006 to 2009) allows us to control for state-specific pre-reform trends in crime that may extend into the post-reform period. This is discussed in detail in the econometric

[9] It lead to the resignation of two premiers in 18 months (September 2008 and December 2009) and the prosecution of a number of government ministers.

[10] Universities in Australia are equivalent to colleges in the United States that offer four-year bachelor degrees.

modeling section below.

A novel part of our analysis is the estimation of effects across three age groups: young-age (16-25); prime-age (26-34) and mature-age (35-44). We also estimate effects by gender and across three major crime categories – person, property and drug. Minor offenses are omitted because they are highly heterogenous, which makes them difficult to group in a way that will preserve offender anonymity and because they are likely to be relatively unaffected by increases in education participation.

Postcode crime and VET participation rates are derived from administrative data sources (discussed below) and population counts from 2006 and 2011 national household censuses. For non-census years, population estimates were generated by linearly interpolating the 2006 and 2011 census data. For each of the 1,100 postcodes (approximately equal numbers in each state), we have 18 observations, one for each combination of age, gender and crime category. In the raw data provided, some combinations are blank because the number of offenses were not recorded. These missing cells are mainly in rural postcodes where there is low population density and few recorded offenses. In our main results, we treat these observations as missing and exclude them from the analysis. As part of the robustness checks, we also estimate models using imputed values for these missing cells.

VET enrollment data

VET data is from the VET Provider Collection (VETPC), an annual administrative collection of all publicly-funded VET enrollments in Australia, which importantly includes detailed student information such as residential address at the time of enrollment, date of birth and gender. VET participation in this study is the proportion of the 16-44 population enrolled in VET during the calendar year, including those who are continuing in previously commenced courses. Using a unique student and course identifier, we exclude multiple course enrollments by the same student in a given year.

A limitation of the VETPC data is that, while it includes information on all publicly-funded and fee-for-service enrollments with public colleges, it only includes publicly-funded enrollments in private colleges. Therefore, estimated increases in VET participation associated with the introduction of the voucher in Victoria may over-estimate the true increase in participation rates. However, the extent of any over-estimate is likely to be small because fee-for-service enrollments with private colleges were only a small part of the VET sector prior to the reforms

(Pink, 2013).[11]

Crime data

Crime data is from state government agencies that are responsible for data collection; the Victorian Crime Statistics Agency and NSW Bureau of Crime Statistics and Research. To examine effects for sub-groups in the population, each agency provided us with major crime category data by gender and age categories. Importantly, each agency uses comparable crime classification systems, which means that there are similar crime rates between the two states (see Table A1 in appendix A).[12] In both states, crimes against the person category is dominated by offenses related to assault; while drug crimes category is dominated by offenses related to drug use and possession (Victoria Police, 2013; Goh and Ramsey, 2014). Theft is the most common property crime offense; however, bulgary and property damage are also important for males in both states (Victoria Police, 2013; Goh and Ramsey, 2014).

Crime in this study is offense count data. Offense data potentially gives a clearer picture of the effects of education on crime compared to data using arrests, convictions or incarcerations. This may be especially true for youth, against whom the police are less likely to take court action. Offender data is criminal incidents that are reported and processed by police for which there is an alleged offender, which is someone for whom legal action is taken for a criminal offense, including non-court legal action such as a warning or fine. Offenses committed in a year for which there is no alleged offender are not included in the offense data for that year. If in subsequent years such offenses are 'cleared' because an alleged offender is identified, then these offenses are recorded in the data retrospectively. Offenders that are alleged to have committed multiple crimes in separate incidents within a given year will have each incident recorded as separate offenses. In cases where there are multiple alleged offenders related to an incident, each will be counted in the data as separate incidents.

Descriptive analysis

Consistent with the supply-driven VET funding models that operated in Victoria and NSW, Figure 1 shows only minor differences in VET participation rates between the two states pre-

[11] Data from the VETPC collections shows that fee-for-service enrollments with public colleges accounted for less than 5% of enrollments in 2008.

[12] Differences in crime categories are very minor; for example, theft of a bicycle is not recorded in the NSW crime data.

reform. However, from 2010 there is a large increase in VET participation in Victoria, but not in NSW, that coincides with the introduction of the voucher in Victoria.[13] Using unconditional difference-in-differences, we estimate that the voucher is associated with a 75% increase in the Victorian VET participation rate of 16-44 year-olds in 2010-13, relative to 2006-09. Importantly, we find large increases across gender and age categories. On average, we find that the enrollment response was stronger for males than females (97% increase compared to 53%) and the response of young people stronger than for prime-age and mature age (132% increase compared to 50% and 40% respectively). Importantly, the voucher was associated with widespread increases in postcode-level VET participation across the state, including in both metropolitan and rural areas, which means that our results are generalizable and not limited to specific geographical regions.

Compared to the large post-reform increase in VET participation in Victoria relative to NSW, the post-reform crime changes depicted in Figure 1 are relatively small and difficult to decipher, partly because of apparent diverging state-specific pre-reform crime trends. Regression models of crime estimated over the pre-reform period confirm diverging trends pre-reform between the two states.[14] Diverging pre-reform trends aside, there does appear to be a fall in property crime and an increase in crimes against the person in Victoria compared to NSW that coincide with the introduction of the voucher. However, any conclusions are premature at this stage because these raw statistics do not adjust for divergence in demographic and economic conditions that could have affected crime over the period of analysis, or pre-reform trends that may have continued post-reform. These issues are addressed by the econometric approach discussed below.

Econometric approach

A key challenge when attempting to estimate the causal impacts of education participation on crime is controlling for unobserved factors that may be correlated with both. In line with previous studies that have examined the relationship between education and crime, we exploit a natural experiment that affected VET participation across space and apply difference-in-

[13]There is a small apparent increase in rates in NSW for the 16-25 age group, which is possibly related to an increase in federal government funding for VET that was distributed to all states as part of the response to the Global Financial Crisis.

[14]This is confirmed by F-tests that show statistically significant (at 95% significance) differences in state-specific time trends for each crime category.

differences estimation. In this case, we estimate the impacts on crime between 2010 and 2013 from increased VET participation in Victoria associated with the introduction of an uncapped VET voucher. Counterfactual outcomes are constructed using crime rates from NSW where its supply-driven VET funding model remained in place. Specifically, we estimate the following equation for each of the three crime categories:

$$LogCrime_{ist} = \alpha + \gamma Treatment_{st} + \beta X_{it} + \theta T_{st} + \delta T_{st}^2 + \zeta_i + \lambda_t + \nu_{ist} \quad (1)$$

where $LogCrime_{ist}$ is the log of the rate of crime in postcode i in state s and year t; $Treatment_{st}$ is the treatment indicator or a dummy indicator for Victoria interacted with post-reform dummy;[15] X_{it} are postcode characteristics; T_{st} is a diverging state-specific time-trend or a dummy indicator for Victoria interacted with a yearly time-trend variable; ζ_i and λ_t are postcode and year fixed effects; and ν_{ist} is a stochastic error term.

Postcode characteristics comprise controls for demographic and economic changes. Specifically, they include controls for contemporaneous changes in postcode ethnicity and race using data from the national household census, changes in postcode earnings using data from the Australian Tax Office and changes in unemployment using data from the Australian Department of Employment. Postcode earnings is total income from all taxpayers residing in the postcode and postcode unemployment rates are those reported at the Small Local Area, a geographic region that is larger than a postcode, but smaller than a municipality (county). This time-varying information helps us to control for any diverging state-specific crime trends that may have coincided with the implementation of the reforms.

The inclusion of diverging state-specific time trends means that we also adjust for unobserved differences in state post-reform crime trajectories that are a continuation of trends observed in the pre-reform period (as identified in the previous section)(Mora and Reggio, 2012). The inclusion of a quadratic term introduces greater flexibility in allowing the model to adjust for non-linear divergence in crime trajectories between the states. In practice though, results using a linear time trend are much the same.[16]

When we estimate a pooled version of this model (over age categories and gender), we also include age and gender fixed effects. To estimate results by gender and age categories, we run

[15] Because we have time and postcode fixed effects, we cannot include separate post-reform and state indicators because of collinearity.

[16] Results available from the corresponding author.

model (1) on separate sub-samples.

Results

Key results from the estimated conditional difference-in-differences model are presented in Table 1. A full set of results (for the entire sample) is presented in Table A2. Standard errors are cluster-robust standard errors with clustering at the state level and reported significance levels are based on critical values from the empirical T distribution with G-1 degrees of freedom.[17] An issue with clustering at the state level is that the number of groups (G) is small, so that the asymptotics have not kicked in, which in some settings may mean that the estimated standard errors are biased (Cameron and Miller, 2015). As a test of robustness, we also follow the recommendations of Cameron and Miller (2015) and estimate significance levels using wild bootstrapping, which has been shown to perform well when the number of clusters is small, including for less than 10 clusters (Cameron et al., 2008). These results are presented as part of the sensitivity analysis that follow.

We find that that increases in VET participation in Victoria following the introduction of a VET voucher is associated with significant reductions in personal, property and drug crime between 2010 and 2013. Because our dependent variable is in log form, the estimated treatment effects in Table 1 can be interpreted as percent changes in the crime rate. We estimate that the reform is associated with 4.5%, 11.3% and 12.8% reductions in person, property and crime rates respectively. Given that the reform is associated with a 75% increases in VET participation, these estimates translate to 0.6%, 1.5% and 1.71% reductions in personal, property and drug crimes for a 10% expansion in the VET participation rate. The estimated negative effect of VET on drug crimes is new and contrasts to the only previous study that we are aware of on the relationship between education and drug crime by Anderson (2014), who found no significant effect on drug crimes from increases in minimum schooling.

While we cannot rule out other possible explanations, the larger effects for drug and property crime compared to person crime may be associated with anticipated and/or realized improvements in employment prospects from VET. As point out by Levitt and Venkatesh (2000), the relatively low earnings of drug dealers combined with the risks involved means that they may be enticed to leave the drug trade by improvements in legitimate employment opportunities.

[17] Where G is the number of clusters. This is done in STATA using the vce(cluster) command.

Not only may this lead to direct reductions in trafficking offenses, but also indirect reductions in possession and use through the disruptions in supply networks. This interpretation is consistent with findings from Ihlanfeldt (2007), who found modest improvements in job accessibility of young males living in disadvantaged neighbourhoods substantially reduced the amount of drug crime. Another possible explanation is that enrolling in a VET course may also act as a commitment device by introducing day-to-day structure to the lives of people who may otherwise be at risk of habitual drug use; raising their social status, self-esteem, well-being and life outlook.

We find larger effects among prime-age (26-34) and mature-age (35-44) than among young-age (16-25). Despite the more than doubling of the VET participation rate for young people in Victoria, the only significant reduction in crime is a 9.9% reduction in drug crime. This equates to a 0.75% reduction in the drug crime rate for a 10% expansion in VET participation associated with the voucher.[18] This is small compared to 3% and 4.4% estimated reductions in drug crime for prime-age and mature-age groups associated with a 10% expansion in VET participation. The smaller crime-reducing effects of VET for young people may be because crime at this age is driven more by social networks than future labour market opportunities (Gomez-Smith and Piquero, 2005; DeLisi, 2006; DeLisi and Piquero, 2011).

By gender, we find comparable reductions in personal crime, but much larger reductions in property and drug crimes for females. For females, we estimate a 3.34% reduction in property crimes and a 2.43% reduction in drug crimes for a 10% expansion of VET participation associated with the voucher. In contrast, reductions in property and drug crimes for males are estimated to be 0.65% and 1.23%. The greater reductions in female crime may be because the voucher is more important in engaging women than men in work. Pre-reform, descriptive statistics presented in appendix A (Table A3) show that female VET students in Victoria are less likely than males to be in work (38% compared to 40%) and much less likely to be in full-time work (26% compared to 43%). The gender employment discrepancies among prime-age and mature-age students are even larger – 37% compared to 44%.

Compared to previously estimated effects from increases in compulsory schooling in Australia, the property crime effects estimated in this study appear modest (1.4% reduction in the crime rate for a 10% increase in VET participation). Our own estimates from results reported

[18] This is based on unconditional difference-in-differences estimate of a 132% increase in VET participation for those 16-25.

in Jha (2015), suggest a 7% reduction in the 15 to 17 year-old crime rate associated with a 6% increase in schooling between 2010 and 2012.[19] The relatively modest effect for property crime estimated in this study may be because the incapacitation effect from VET is weak compared to schooling.

Modest reductions in property crime do not mean there are inconsiderable crime-reducing benefits to the community from increased VET participation. On the contrary, the high cost of crime to the community means that even small reductions can have large payoffs. Based on per offense cost estimates for Victoria from Smyth (2011) (see appendix A), we estimate (in 2015 terms) a $A72m saving (in medical costs, improved productivity, avoided property losses and higher well-being) associated with the crime reductions reported in this study.[20] Compared to the $A400m extra growth in VET spending in Victoria relative to NSW in 2010-13 (Productivity Commission, 2014), this represents an 18 cent saving to the community in the cost of crime for every extra dollar spent on VET. Much of the estimated saving is due to lower drug offenses ($A59m), with $A3.1m and $A9.8m saved from lower personal and property crime respectively.

Robustness checks

The results presented in the previous section are based on a number of modeling and data choices. In this section, we test the robustness of our results to alternative choices. In the first instance, we test the robustness of our results to an alternative treatment of missing cells, which in the standard analysis are omitted. Results presented in Table 2 show that replacing the missing cells with mean pre-reform or post-reform postcode values, depending on which time period the cell falls within, produce similar results. This suggests that the omission of missing observations are not seriously biasing the results. The vast majority of the missing cells are in sparsely populated rural areas. An alternative approach to imputing the missing values is to just estimate the model using postcodes that fall within the metropolitan areas of Melbourne and Sydney, the two capital cities of Victoria and NSW. Results are again much the same as the standard results.

As described previously, there are other policy changes that may have affected VET partic-

[19] Own estimates are based on a reported a 19% reduction in the number of property offenses from a 6% increase in schooling. The effects of increased schooling estimated by Jha (2015) are higher than those estimated by a closely related study by Anderson (2014) on arrests, but once corrections are made for arrest rates, results from the two papers are comparable.

[20] These are based on estimated 43, 232 and 70 fewer crimes per 100,000 for personal, property and drug offences, which are calculated by applying the conditional difference-in-differences crime rate reductions for 2010-13 to business-as-usual estimates in Victoria that are derived from NSW 2010-13 crime growth rates.

ipation in 2013. We test whether these have influenced our results by re-estimating our model without 2013 data. Results presented in Table 2 suggest that these other reforms had little impact on our results.

Another decision that we made was to conduct the analysis at the postcode level. However, there is no reason to believe that crime is restricted to the postcode of residence, so that analysis on a larger geographical scale could produce different results. We test this by re-estimating the main results using data aggregated to the Local Government Area (LGA) level. An LGA represents the boundaries of local (municipal) government, of which there are around 200 in both Victoria and NSW. As expected, increasing the geographical area over which the analysis is conducted does increase the magnitude of the estimated effects, although estimated with less precision. If anything, these results suggest that our postcode level analysis may have under-estimated the true effects.

Finally, as mentioned previously, the small number of clusters may mean that reported significance levels are based on biased cluster-robust standard errors. To test this, we also estimate significance levels using wild bootstrapping, as suggested by Cameron and Miller (2015), which performs well when the number of clusters is small, including for less than 10 clusters (Cameron et al., 2008). The p-values from the wild bootstrapping are presented in square parenthesis in Table 2 and are smaller than those estimated in the standard results. This suggests that the significance levels are conservative estimates.

Conclusion

In the twenty-first century, education is seen as central to enabling people to work and contribute positively to community life. Those without necessary skills and qualifications face diminished life prospects and risk alienation from mainstream society. For this reason, improving access to education is a popular policy response, but beyond school, there is little evidence of the crime-reducing effects of education. In this study, we fill this gap in the literature by showing that increasing access to postsecondary vocational education and training does significantly reduce property crime, drug crime and crime against the person. Importantly the crime-reducing effects of VET appear to be greater among prime and mature-age people (26-44) and among females.

These results suggest that expanding access to VET to up-skill and re-skill people throughout a life-course can have considerable public spillovers in reduced crime. This is timely evidence

given that many countries are turning to VET to help retrain people displaced by rapid structural changes that have occurred since the Global Financial Crisis.[21] Although the magnitude of the property crime effects appear small relative to increased schooling (Jha, 2015), given the high costs of crime, small reductions are still estimated to have substantial cost savings for the community. Without evidence on the spillover effects of VET, as provided in this study, it is difficult for governments to justify expanded funding in tough economic times. A case in point is the pairing-back of public-funding to VET that occurred in Victoria in 2013 following the expansion in 2010-2012.

The finding that VET participation reduces drug crime, especially among prime and mature-age groups is an important result. As far as we are aware, only Anderson (2014) has examined the relationship between education and crime, focusing on the impacts of schooling. This finding adds weight to previous studies that showed high rates of crime in areas with relatively few job opportunities (Ihlanfeldt, 2006, 2007) and among unemployed people (Raphael and Winter-Ebmer, 2001). Although we cannot identify the mechanism of the negative relationship between VET and crime, our findings raise the prospect that drug rehabilitation programs may benefit from the inclusion of vocational training.

[21] Also known as the Great Recession.

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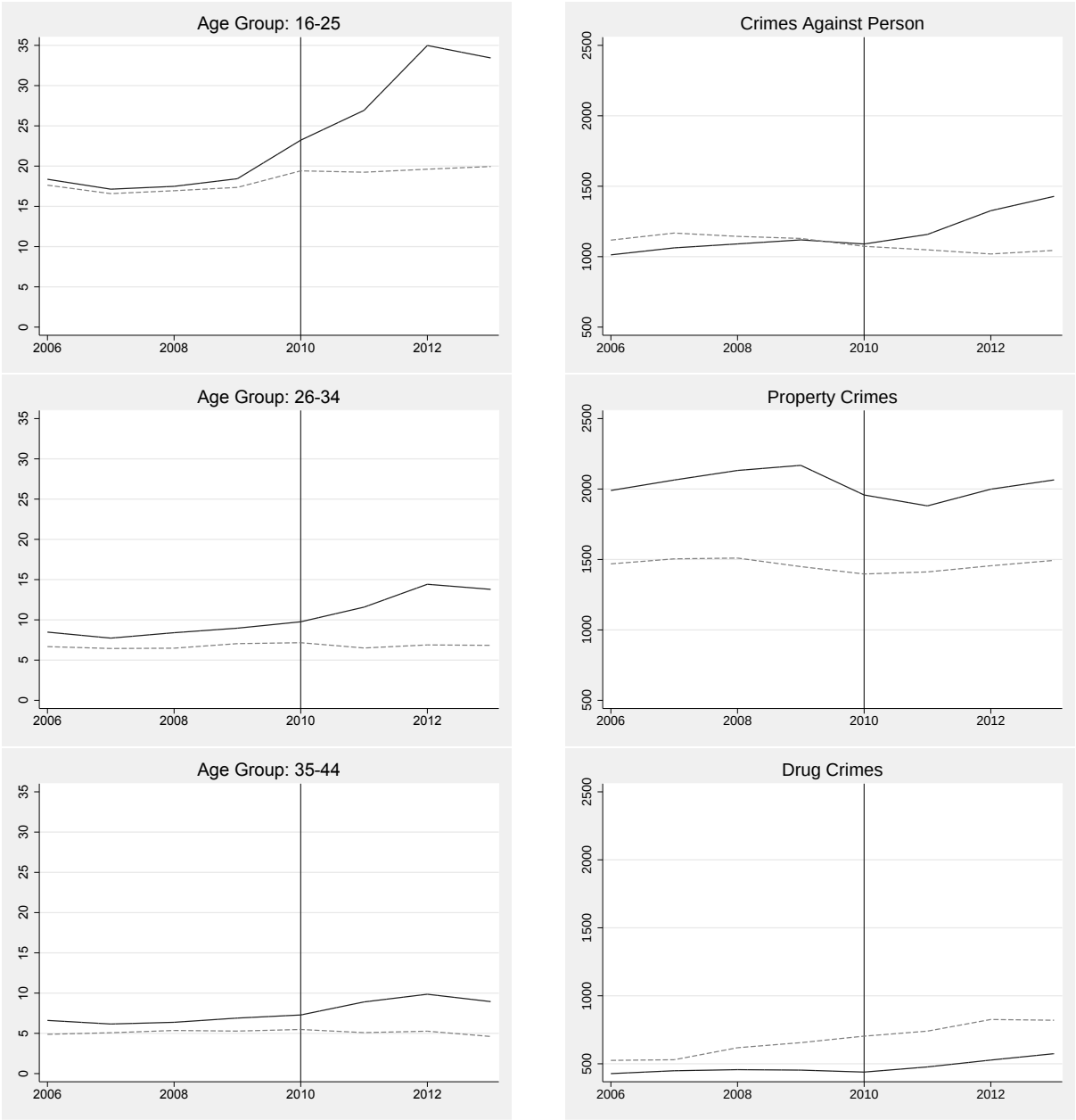

Figure 1: Average VET participation (%) and crime rates (per 100,000)

Table 1: **Impacts of increased VET participation on crime rates in Victoria, 2010-2013**

	Crime Category		
	Person	Property	Drug
All	-0.045*	-0.113**	-0.128**
	(0.005)	(0.005)	(0.002)
N	35,371	35 908	26, 902
Offence by gender			
Female	-0.026**	-0.180**	-0.129***
	(0.002)	(0.005)	(0.000)
N	14,048	14,969	9,696
Male	-0.045**	-0.063**	-0.120**
	(0.002)	(0.002)	(0.003)
N	21,323	20,939	17,206
Offence by age category			
16-24	0.009	-0.008	-0.099***
	(0.007)	(0.010)	(0.001)
N	12,108	13,008	9,642
25-34	-0.058**	-0.214***	-0.149***
	(0.004)	(0.000)	(0.002)
N	11,337	11,689	8,866
35-44	-0.049**	-0.108**	-0.177***
	(0.002)	(0.005)	(0.000)
N	11,926	11,211	8,394

Results generated using conditional difference-in-differences estimation. Dependent variable is log of crime rates and controls include time-varying postcode factors such as population density, demographic and economic variables; quadratic time trends; postcode and time fixed effects. The pooled model also includes age and gender fixed effects. Estimated coefficients represent change in the crime rate post-reform (2010-2013) associated with increases in the VET participation rate of 75% overall, 97% for males, 53% for females, 132% for 16-24 year-olds, 50% for 25-34 year-olds and 40% for 35-44 year-olds.
Cluster-robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 2: **Impacts of increased VET participation on crime rates in Victoria, 2010-2013, alternative models**

	Crime Category		
	Person	Property	Drug
Standard results			
All	-0.045*	-0.113**	-0.128**
	(0.005)	(0.005)	(0.002)
N	35,371	35 908	26, 902
Alternative models			
Imputed missing cells[a]	-0.012**	-0.086**	-0.112***
	(0.000)	(0.002)	(0.001)
N	43,879	43,879	38,157
Urban areas[b]	-0.031*	-0.118**	-0.139**
	(0.004)	(0.005)	(0.005)
N	23,678	24,793	18,651
Exclude 2013[c]	-0.068**	-0.098**	-0.105**
	(0.004)	(0.004)	(0.004)
N	30,826	31,354	23,314
LGA aggregated data[d]	-0.125	-0.118*	-0.202*
	(0.023)	(0.011)	(0.017)
N	8,927	8,857	8,076
Wild bootstrapped s.e.[e]	-0.045***	-0.113***	-0.128***
	(0.002)	(0.001)	(0.001)
	[0.004]	[0.004]	[0.004]
N	35,371	35 908	26, 902

Results generated using conditional difference-in-differences estimation. Dependent variable is log of crime rates and controls include time-varying postcode factors such as population density, demographic and economic variables; quadratic time trends; postcode and time fixed effects. The pooled model also includes age and gender fixed effects. Estimated coefficients represent change in the crime rate post-reform (2010-2013) associated with increases in the VET participation rate of 75% overall.

Cluster-robust standard errors are in parenthesesl. *** p<0.01, ** p<0.05, * p<0.1.

[a]Missing observations for each crime category are replaced by the pre or post-reform postcode crime rate. [b]Crime rates in state capital cities – Melbourne and Sydney. [c]2013 includes the effects other reforms that affected VET participation. [d]Local Government Area (LGA) are municipality/county disricts that are larger than postcodes (around 200 in each state). [e]Estimated on demeaned data using 5000 draws using the cgmwildboot program provided by Judson Caskey (https://sites.google.com/site/judsoncaskey/data). This program follows the approach outlined in Cameron, Gelbach and Miller (2008) using Rademacher weights.

Appendix A

Table A1: **Mean crime rates per 100,000**

	Victoria		**NSW**	
	2006-09	2010-13	2006-09	2010-13
Male				
Crimes against the person				
16-25	4239	5765	3344	3273
26-34	3763	5213	2763	2955
35-44	2153	3119	2119	1992
Property crimes				
16-25	8138	9089	4517	4423
26-34	4792	5716	2332	2495
35-44	2164	2762	1514	1714
Drug crimes				
16-25	1539	2077	1442	2077
26-34	1487	1957	1388	1957
35-44	910	970	891	970
Female				
Crimes against the person				
16-25	993	1279	759	850
26-34	582	1148	494	574
35-44	630	561	419	423
Property crimes				
16-25	1716	2121	1057	1031
26-34	1037	1226	614	707
35-44	636	769	473	551
Drug crimes				
16-25	359	500	240	463
26-34	368	349	246	327
35-44	311	223	155	250

Table A2: **Full results for pooled sample**

	Crime Category		
	Person	Property	Drug
Age fixed effects (ref. case: 16-25)			
26-34	-0.455*	-0.593***	0.373
	(0.058)	(0.007)	(0.070)
35-44	-0.878*	-1.276**	0.162
	(0.106)	(0.036)	(0.145)
Female fixed effect	-1.266*	-1.123**	-1.037
	(0.113)	(0.068)	(0.235)
Total income	0.004	0.004	0.012
	(0.003)	(0.004)	(0.002)
Unemployment rate	0.006	0.006	0.010*
	(0.006)	(0.007)	(0.001)
Population			
density (per km^2)	3.679**	0.595	1.173**
	(0.061)	(1.002)	(0.051)
Rate who are citizens	0.002	0.002	0.004**
	(0.001)	(0.001)	(0.000)
Rate who are indigenous	-0.001	-0.001	0.001
	(0.001)	(0.001)	(0.000)
Rate whose main ancestry is: (ref. case: Not stated)			
Oceanian	-0.002	-0.002*	-0.003
	(0.001)	(0.000)	(0.001)
North-West European	-0.001	-0.001**	-0.003**
	(0.000)	(0.000)	(0.000)
Southern and Eastern European	-0.003	-0.003	-0.001
	(0.001)	(0.002)	(0.001)
North African and Middle Eastern	-0.002*	-0.004	-0.001**
	(0.000)	(0.001)	(0.000)
South-East Asian	-0.003	-0.003*	-0.003
	(0.002)	(0.000)	(0.001)
North-East Asian	-0.002	-0.003	-0.001
	(0.001)	(0.001)	(0.001)
Southern and Central Asian	-0.002**	-0.003	-0.001
	(0.000)	(0.001)	(0.001)
People of the Americas	-0.018*	-0.013	-0.020**
	(0.001)	(0.003)	(0.001)
Sub-Saharan African	-0.003	-0.005	-0.003
	(0.007)	(0.008)	(0.004)
Diverging state trend	0.007	0.039*	-0.066**
	(0.004)	(0.004)	(0.002)
Diverging state trend^2.	0.007**	-0.002	0.009**
	(0.000)	(0.000)	(0.000)
Year fixed effects (ref. case: 2006)			
2007	0.033	-0.012*	0.131**
	(0.015)	(0.001)	(0.009)

(—Continued on next page—)

Table A2 – Continued from previous page

	Crime Category		
	Person	Property	Drug
2008	-0.029	-0.054*	0.216**
	(0.014)	(0.005)	(0.015)
2009	-0.065	-0.109	0.245**
	(0.012)	(0.025)	(0.007)
2010	0.268**	-0.005	0.022
	(0.008)	(0.003)	(0.013)
2011	0.175***	-0.049	0.035
	(0.002)	(0.025)	(0.011)
2012	0.096	-0.023	0.055
	(0.018)	(0.014)	(0.021)
2013	-0.413**	-0.126	0.328**
	(0.021)	(0.036)	(0.022)
Treatment†	-0.045*	-0.113**	-0.128**
	(0.005)	(0.005)	(0.002)
Constant	8.231***	8.652***	5.674**
	(0.069)	(0.037)	(0.095)
N	35,371	35,908	26,902
R-squared	0.536	0.530	0.410
Number of postcode	1,128	1,114	1,095

Dependent variable is log of standardised (by population of age-group in postcode) crime rate.
†: Treatment is defined as the state of Victoria relative to the state of NSW in 2010-2013, or a binary indicator of Victoria interacted with a post-reform dummy.
Cluster-robust standard errors are in parenthesesl. *** p<0.01, ** p<0.05, * p<0.1.

Table A3: **Mean characteristics of VET students**

	Victoria		**NSW**	
	2006-09	2010-13	2006-09	2010-13
Male				
Live in rural or remote area	0.30	0.27	0.31	0.32
Apprentice or trainee	0.17	0.20	0.20	0.23
English is a second language	0.16	0.17	0.19	0.18
Age	25.88	25.63	24.27	24.00
Highest education qualification				
Diploma and above	0.03	0.02	0.03	0.03
Upper-secondary school or equiv.	0.49	0.52	0.45	0.48
Below upper-secondary school	0.48	0.45	0.52	0.50
Employment status prior to enrolment				
Full-time employed	0.43	0.43	0.43	0.41
Part-time employed	0.19	0.18	0.13	0.13
Not employed	0.38	0.39	0.44	0.45
Socio-economic disadvantage of area[†]				
Bottom quintile	0.04	0.05	0.13	0.13
2nd quintile	0.14	0.13	0.21	0.22
3rd quintile	0.19	0.18	0.21	0.22
4th quintile	0.30	0.34	0.22	0.21
Highest quintile	0.32	0.30	0.23	0.22
Female				
Live in rural or remote area	0.29	0.25	0.31	0.32
Apprentice or trainee	0.14	0.13	0.11	0.12
English is a second language	0.20	0.21	0.22	0.22
Age	27.07	26.40	25.99	25.78
Highest education qualification				
Diploma and above	0.04	0.03	0.04	0.04
Upper-secondary school or equiv.	0.57	0.61	0.49	0.53
Below upper-secondary school	0.39	0.36	0.47	0.43
Employment status prior to enrollment				
Full-time employed	0.26	0.22	0.26	0.23
Part-time employed	0.34	0.33	0.23	0.24
Not employed	0.40	0.45	0.52	0.53
Socio-economic disadvantage of area[†]				
Bottom quintile	0.05	0.05	0.13	0.13
2nd quintile	0.12	0.11	0.21	0.22
3rd quintile	0.17	0.17	0.22	0.22
4th quintile	0.32	0.36	0.22	0.20
Highest quintile	0.34	0.31	0.22	0.22

[†]National quintile of socio-economic disadvantage of the student's postcode of residence, based on an index that includes information on the employment, income, occupation and education status of people living in the postcode (Australian Bureau of Statistics 2012, cat. no. 2033.0.55.001.)

Table A4: **Victorian crime costs estimates 2019-10**[†]

	Total cost $A2015m	Number of predicted offenses[‡]	$A2015m per offence
Crimes agains the person			
Homicide	443	194	2,282,655
Assault	227	208,143	1,092
Sexual Assault	82	46,388	1,762
Robbery	91	19,390	4,710
Total	843	274,115	3,076
Property crimes			
Burglary	406	112,446	3,613
Theft of vehicles	149	15,078	9,861
Theft from motor vehicle	166	127,218	1,305
Theft from shops	321	2,132,600	150
Other theft	72	141,955	505
Property damage	407	225,088	1,809
Arson	1,215	9,102	133,452
Deception	2,387	76,556	31,185
Total	5,123	2,840,043	1,804
Drug crimes	522	14,583	35,804

Source: Smyth, R. (2011). Costs of Crime in Victoria, Department of Economics Discussion Paper 25/11, Monash University.

[†]Origianal cost estimates are in $A2010. We convert them into $A2015 using the consumer price index from the Australian Bureau of Statistics (2016), Consumer price index, Australia, cat. no. 6041.0, ABS, Canberra. [‡]Based on the actual reported offenses from Police Victoria and scaled by a multiplier to adjust for unreported crimes.