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The deterrent effect of higher fines on recidivism: Driving offences

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Each year in New South Wales more than 50,000 persons convicted by a court receive a fine as their principal penalty. Little is known about the deterrent efficacy of these penalties. This study investigates whether fine amount has an impact on reoffending. The study examines the history and subsequent reoffending of 70,000 persons who received a court imposed fine for a driving offence between 1998 and 2000. The problem of selection bias that has handicapped deterrence research in the past has been addressed by the use of two-stage models. The results provide little evidence to suggest the presence of marginal deterrent effects from court-imposed fines on driving offenders; the most consistent predictors of returning to court were individual attributes of offenders. As a result, it is suggested that substantial increases in fines and licence disqualifications would have limited potential in deterring recidivist offenders.

INTRODUCTION

Fines are the most common penalty imposed in New South Wales for criminal convictions. In 2005, a total of 56,528 people appearing before NSW Local Courts received a fine as their principal penalty. This represents just over half of all persons appearing before the Local Courts. The average fine amount imposed by the Local Courts has increased at double the inflation rate over the last decade, rising from $358 in 1993 to $608 in 2005 (NSW Bureau of Crime Statistics and Research 2006). Despite the frequency with which fines are imposed and the increase in their magnitude, we know very little about the effectiveness of financial penalties in reducing recidivism rates of convicted offenders. Few studies have been conducted in this area and those that have been conducted have produced equivocal findings.

Gordon and Glaser (1991) note several reasons why financial penalties are an appealing alternative to other sanctions. Firstly, fines are generally less costly to administer and can provide revenue that, in some cases, exceeds their administrative costs. Secondly, monies paid to the court can be redirected to the victim of an offence in order to pay financial restitution for any physical or psychological harm incurred. Thirdly, fines are a flexible penalty that can be adjusted to reflect both the severity of the crime and the offender's financial circumstances. In doing so, they provide an effective sanction for retribution but one which does not place an unjust burden on the offender. Finally, the use of financial penalties avoids many of the debilitating social costs that are attached to incarceration. For example, an individual who is imprisoned for an offence will often have to give up their job, leaving dependents with reduced income and making it more difficult for the offender to successfully return to the community. Fines, on the other hand, permit the offender to remain in the community and in employment, and in doing so, reduce the need for social support.

The purpose of the present study is to investigate the efficacy of financial penalties in reducing recidivism rates of offenders convicted of driving offences. Driving offences can be considered a good offence type to test deterrence hypotheses because they do not attract the same moral condemnation as other types of crime (such as assault or robbery) and are therefore potentially more responsive to changes in the probability and severity of formal punishment (Andenaes 1966; Chambliss 1967; Nagin 1998; Zimring & Hawkins 1973). Furthermore, because very few people in Australia are gaoled for driving offences, we can be confident that any reduction in recidivism is due to deterrence rather than incapacitation.

This bulletin begins by outlining the major tenets of deterrence theory before reviewing previous empirical research that has examined the deterrent effect of punishment severity. Because few studies have considered the effect of financial penalties on recidivism, the literature reviewed in this section is a broad overview of work that has been conducted on the marginal deterrent effect of different sanctions and/or sanction levels. The limitations of previous research in this area are identified and methods for overcoming these problems are discussed. The data and statistical techniques used in the current study are then presented, followed by a summary and discussion of the major findings of this work.

DETERRENCE RESEARCH

Deterrence theory, based on a rational choice paradigm of decision making, proposes that an offender will engage in criminal behaviour if they believe that the benefits they will derive from the crime outweigh the costs associated with legal sanctioning if caught. The effectiveness of legal sanctions in achieving a deterrent effect is thought to depend upon the certainty, severity and celerity of punishment. If people perceive it likely that they will be caught for an offence and receive harsh and swiftly delivered punishment upon conviction then they will be less likely to offend (Becker 1968; Gibbs 1975; Zimring & Hawkins 1973). A vast number of studies, of varying quality, have been undertaken to test hypotheses generated by deterrence theory. These studies have provided good evidence for a deterrent effect created by increases in the certainty of punishment, at least in the short-term (e.g. Henstridge, Homel & MacKay 1997; Ross 1984; Sherman 1990; Voas and Hause 1987; Voas, Holder & Gruenewald 1997). The deterrent efficacy of increases in punishment severity, however, is very much less clear.[1]

Deterrence and punishment severity

Earlier studies on deterrence and the severity of formal punishment dealt predominantly with the impact of capital punishment on homicide rates and most of them were conducted in the United States (US). This focus on the US stems primarily from the fact that (1) there is variability across US States in the uptake and application of the death penalty which allows for cross-sectional comparisons across jurisdictions and (2) a moratorium on executions existed in the US from 1968 through to 1977, after a US Supreme Court decision ruled capital punishment unconstitutional, thus permitting longitudinal, time-series analyses of the effectiveness of different punishment regimes. The majority of these studies have found little evidence that the use of capital punishment can have a positive impact on murder and/or manslaughter rates (for a review see Chan & Oxley 2004).

In light of these findings, many criminologists, sociologists and behavioural scientists have been quick to dismiss the severity of punishment as unimportant in deterring offenders (e.g. Sanson et al. 1996). This would seem somewhat premature. The fact that capital punishment is not effective in reducing homicides says nothing about the deterrent effect of milder forms of punishment or about the deterrent efficacy of other types of legal sanctions. Capital punishment is, in most cases, reserved only for the most serious crimes, such as murder, which violate the moral code of society. Most people refrain from committing these types of crimes, not because the costs associated with the formal sanctioning process are too great, but because they believe the act to be immoral or inherently wrong and one that will be harshly judged by other members of society (Andenaes 1966; Gibbs 1975). Other less serious types of crime may not invoke the same moral contempt and it is therefore possible that increases in penalty severity for these offences do exert a significant deterrent effect.

Most studies of the deterrent effect of non-capital sanctions investigate the effect on aggregate crime rates of changes in the likelihood of prison or prison sentence length. A review of this research by von Hirsch and his colleagues (1999) found only weak, negative correlations. Von Hirsch et al. (1999), however, were cautious in their conclusions regarding the marginal deterrent effect of imprisonment because the majority of studies they reviewed suffered from several methodological weaknesses. Some studies failed to control for factors other than punishment severity that are known to influence crime. Other studies used poor measures of the factors they were trying to control for. Many studies used the size of the prison population as a measure of penalty severity, but this variable confounds punishment certainty and severity. A tough jurisdiction, where a large proportion of offenders are sentenced to custody and to long prison terms, could still have a relatively small prison population if the risk of detection, apprehension and conviction is low. Finally, the bulk of the empirical research available on the effectiveness of imprisonment as a deterrent has adopted an ecological approach and a major problem with this type of research is the reciprocal relationship that potentially exists between sanction levels and crime rates (i.e. simultaneity bias, see Nagin 1998 for further explanation).

Spelman (2000), in his review of the literature on imprisonment and crime, identifies four recent studies that successfully dealt with many of the problems associated with earlier ecological research on the efficacy of prison. All four of these studies found that higher rates of imprisonment were associated with reduced crime levels. On the basis of these studies Spelman concluded that a one per cent increase in the US prison population would reduce aggregate-level crime rates from anywhere between 0.16 and 0.31 per cent. These results appear to support the deterrence hypotheses but they might be a result of incapacitation. In other words, the lower crime rates found in States that have higher prison populations may be due to the fact that these States have a larger proportion of their offender population behind bars where they cannot offend.

Given the methodological problems encountered when attempting to assess the deterrent efficacy of imprisonment, it is useful to consider the impact of non-custodial penalties on the likelihood of reoffending. The evidence supplied by these few studies is, however, far from conclusive.

For example, Yu (1994) examined the court files of almost 14,000 New York drivers with at least one conviction for drink-driving and found evidence to suggest that financial sanctions are the most effective and consistent factor in reducing recidivism. In contrast, Mann et al. (1991) observed in their sample of Ontario drink-drivers that higher fines, at least for first- time offenders, were associated with an increase in the number of accidents and charges during the follow-up period. Similarly, a matching study conducted by Kraus (1974), which examined the efficacy of fines relative to probation for male juvenile offenders in NSW, found no significant deterrent effect of financial penalties. In fact, this analysis showed that some juveniles (viz. those charged with stealing offences) who received a monetary penalty tended to have higher rates of offending after sentencing and were committed to detention more often than those who received probation only. Additional research reveals that higher fines are associated with decreased recidivism but only for certain groups of offenders (viz. those with concurrent convictions; Homel 1980).

Each of the studies described in the previous paragraph examines the effect of judicial penalties on reoffending rates by comparing different degrees or types of sanctions rather than examining alternatives to legal sanctions or the imposition of sanctions where none existed previously. Thus, they present evidence on the marginal (rather than the absolute) deterrent effects of punishment. One problem confronting this type of research is that many of the factors influencing the type and severity of the penalty imposed upon a particular offender can also affect reoffending. For example, an offender given a high monetary penalty or a long supervision order could have numerous prior convictions of a serious nature and therefore be at a greater risk of reoffending, irrespective of the penalty amount they receive. To conclude that higher fines or longer probation periods are ineffective deterrents, because recidivism rates are higher amongst these groups of offenders, is problematic. Gordon and Glaser (1991) highlight this issue in their research on the use and effects of financial penalties in Los Angeles municipal courts. In this study, the authors used information contained in probation files to examine the imposition of different penalties and their relative effectiveness in deterring further offending. Their sample was restricted to 824 cases where a person was sentenced to probation alone or probation in combination with another sanction (e.g. fine or gaol). Regression models were constructed to predict three post-sentencing outcomes (rearrest within two years, incarceration within two years and probation revocation before the end of the term) using information on characteristics of the offender, the nature of the offence and the type of sanction imposed by the court. These analyses showed that fines were associated with a lower likelihood of post-sentencing arrest or probation revocation relative to a gaol term and to probation alone. However, the fine amount (amongst those receiving a fine) showed no statistically significant relationship with post-sentencing arrest or incarceration. Further analyses conducted by Gordon and Glaser (1991) also showed that, on the whole, less severe penalties tended to be given to offenders who were considered ‘low risk’ (i.e. those with no prior convictions and no drug problems), while offenders who were at higher-risk of further offending – younger, poorly educated, with drug problems or with prior convictions – received harsher penalties. Given these latter findings, the deterrent effects attributed to penalties may in fact have been due, in part, to the characteristics of the individuals receiving those sanctions. That is, those receiving more severe penalties may have also been at a higher risk of reoffending.

This methodological problem, known as selection bias, is thought to be widespread in the criminological literature (Smith & Paternoster 1990) and is a likely reason for the inconsistencies found in deterrence research on punishment severity, particularly those which have considered the extent to which financial penalties are an effective deterrent. The only way to conclusively establish a causal relationship between penalty severity and recidivism would be to conduct an experiment in which different sanctions and/or sanction levels are randomly allocated to offenders. This would ensure that offenders receiving different penalties do not vary systematically and that any subsequent reduction in recidivism could be accurately attributed to the penalty type assigned. Although experiments are the most methodologically sound means by which to investigate the differential impact of penalties on reoffending rates, ethical concerns and practical difficulties in randomising punishment prevent the use of this paradigm in recidivism research. Most studies have employed statistical controls to separate out the effects of penalties from those exerted by offender characteristics or have attempted to match offenders on extraneous characteristics thought to influence the likelihood of re-offending. The validity of these methods relies on the extent to which the variables included in the regression models or in the matching process control for all relevant differences between the offender groups receiving various treatments.

One of the more rigorous Australian studies is that conducted by Tait (2001). He argued that (1) the random allocation of defendants to magistrates in a large proportion of NSW local criminal courts and (2) the variability across magistrates in the type and magnitude of penalties they impose made it possible to conduct an indirect experimental approach to assess the effects of different penalties on recidivism. After controlling for a range of extraneous factors, he found evidence of a relationship between the sentence imposed and reoffending, but the effect of different sanctions varied by the type of offence. For more serious offences, magistrates using a lower ratio of prison to supervisory orders (community service or probation) had, on average, a three per cent lower reconviction rate, suggesting that prison is less effective than community sanctions in reducing reoffending for this offender group. For less serious offences, bonds and dismissals were more effective in preventing an offender from returning to court than were low-level fines. For the middle offence severity group, however, there appeared to be no relationship between the kind of sanction imposed and the likelihood of reoffending (though Tait acknowledges that this latter result is most likely due to the fact that there was insufficient variation in the penalties imposed by the magistrate for this middle-group of offenders). Tait concluded from his analysis that, in general, the level of the fine did not matter and for some offences, higher fines actually increased the odds of an offender returning to court.

While this indirect experimental approach overcomes many of the methodological weaknesses that plague other research on the deterrent effect of criminal sanctions, only broad comparisons across courts in terms of the proportion of sentences involving particular penalties (e.g. high-level v low-level fines) could be made. Furthermore, Tait's analysis assumed that cases were randomly allocated to magistrates. Tait confirmed that magistrates within each court had a similar mix of cases in terms of the distribution of offence types, but it is possible that the offender cohorts varied systematically on other extraneous factors. It is also possible, as Tait (2001) notes in his discussion of the study's findings, that any effects attributable to the sanctions imposed may in fact be due to magistrate style. For example, magistrates who provide a fairer process by listening to defendants might also be more likely to impose bonds or dismissals without convictions rather than fines, and it may be this perception of fairness that produced the observed difference in reoffending, rather than the sanction itself. This would be particularly relevant to lower level non-custodial penalties.

THE CURRENT STUDY

The purpose of this study is to contribute to the debate on punishment severity by assessing the deterrent effect of fines. It should be emphasized from the outset that the present study looks only at the effect of higher fines on the people who receive those fines. It is, in other words, a test of specific deterrence rather than of general deterrence. The study results can tell us nothing about whether higher fines result in generally higher compliance with the law. As discussed above, a major problem faced by researchers attempting to assess the relative effectiveness of different penalties or penalty amounts is that factors influencing the type and severity of the penalty imposed on a particular offender can also affect reoffending. Past studies have attempted to deal with this problem by including statistical controls in multivariate regression models predicting reoffending. However, if the control variables included in these regression models are inadequate, the omitted variables will be reflected in the model's residuals and any correlated variable (such as the level of a sanction imposed at the reference offence) will be capturing part of the effect of the omitted or mismeasured variables.

The implications of this bias for deterrence research can be made clearer through the following example. Suppose that a defendant's level of social support in the community is an important factor in the risk of reoffending. Because this information is not easily measurable, it would be rarely included in regression models as a control variable. However, a magistrate may have access to this type of information at the time of sentencing and could impose a monetary penalty that reflects the extent to which such support is available (e.g. we might expect that a defendant who has more social support would be less motivated to reoffend and would therefore receive a lower penalty). If social support significantly affects recidivism risk and is also correlated with the fine imposed by the court, then the variable measuring 'fine amount' in a regression model predicting reoffending would act as a proxy for social support. The extent to which this type of missing information affects our conclusions regarding the deterrent efficacy of more severe penalties depends on the magnitude of the selection effect. If the omitted or mismeasured information is substantial and also correlated with recidivism, then any inferences drawn from the analysis could be biased or even spurious.

The current study employs statistical techniques which have been specifically designed to capture the influence of unmeasured variables related both to the sanction level imposed by a court and the likelihood of reoffending. These techniques, used by Smith and Paternoster (1990) but developed by Heckman (1979), generally consist of a two-stage process (i.e. estimation of simultaneous regression models). Note that the techniques employed here also deal with the problem of endogeneity[2]. The first stage involves the construction of a selection equation that utilises information about the process by which defendants are 'selected' on the variable of interest. In our study, a probit regression model is specified which predicts the severity of the penalty imposed by the court and includes variables thought to affect this process. Information derived from this first equation is then included in an outcome equation predicting recidivism, in order to correct for potential biases arising from mismeasured or omitted variables. In employing these statistical techniques, this research constitutes a more valid test of deterrence hypotheses regarding punishment severity.

DATA AND VARIABLES

Data used in this analysis comes from the Bureau of Crime Statistics and Research's Reoffending Database (ROD). This database includes information on all criminal court appearances determined in the NSW Supreme, District, Local and Children's Court (excluding appearances for minor regulatory offences such as parking fines) and links court appearance records for the same individual (for further discussion of this matching process see Weatherburn, Lind & Hua 2003). For the current study, only court appearance records for persons convicted in the Local Court between 1998 and 2000 of a driving offence were examined. This included drink-driving (low-range, mid-range and high-range prescribed concentration of alcohol (PCA) offences)[3], drive whilst disqualified, speeding and 'other driving' offences[4]. If an offender appeared on more than one occasion during the study period for one of these driving offences, the most recent appearance was selected as the reference offence. The sample was further restricted to persons convicted of one of these offences as their principal offence and who received a fine as their most serious penalty (for further discussion of the Bureau's penalty hierarchy see NSW Criminal Courts Statistics 2005, p. 141). The number of persons included in each of the resulting offender subsets ranged from 7,000 to 15,000.

While the primary focus of this analysis was the efficacy of fines, many of the offenders included in our sample also received a licence disqualification penalty from the court. In the case of drink-driving and drive whilst disqualified, almost all offenders received a licence disqualification in addition to their fine[5]. Given the frequency with which licence sanctions are imposed for driving offences and evidence suggesting that licence disqualification is an effective sanction for deterring driving offenders from further offending (Mann et al. 1991; Siskind 1996; Zaal 1994), the impact of this penalty type on reoffending rates is considered alongside fines.

The independent variables used in the analysis are shown in Table 1. Means of the independent variables are presented separately for each of the six offender groups. As can be seen from Table 1, the gender and age composition of the offender groups is similar, with the vast majority of offenders being male and the average age of offenders ranging between 29 and 36 years. Relative to other offences, the drive whilst disqualified and 'other driving' offender groups include a higher proportion of Indigenous people and a higher proportion of people with a previous appearance for a driving offence. The drive whilst disqualified and exceed speed limit offender groups contain fewer people from regional areas. Other individual-level variables include: the number of charges in the current court appearance and the number of prior court appearances for driving offences within five years of the reference offence. Offence-relevant variables include total fine amount imposed for the reference offence, total licence disqualification period imposed for the reference offence, delay (number of days from offence to determination) and a binary variable indicating whether or not the offender pleaded guilty to the reference offence. In addition to these individual variables, aggregate data were available to measure the level of disadvantage[6] and the charge rate index (based on the number of charges determined in the Local Court per 100,000 population) in the postcode where the defendant resided.

The outcome measure used in this study was a count variable indicating the number of reappearances before the court for any new driving offences within five years of their reference offence being determined.

BIVARIATE RESULTS BY REAPPEARANCE

Tables contained in the Appendix (see Tables A1-A2) show a comparison of means by reappearance for the variables used in the models. When grouped by reoffending status observed over the five

Table 1: Means of variables used in the analysis by offender group

Variable	*Low-range PCA (n=7,072)*	*Mid-range PCA (n=21,610)*	*High-range PCA (n=10,145)*	*Drive whilst disqualified (n=11,978)*	*Exceed speed limit (n=7,383)*	*'Other driving' offences (n=15,353)*
Total fine ($)	437	696	1031	767	291	698
Total disqualification (mths)	4.83	9.42	19.63	14.11	0.67	5.19
Prior driving offences (0=no, 1=yes)	0.17	0.13	0.13	0.43	0.18	0.26
Age (years)	30	31	34	29	36	30
Gender (0=female, 1=male)	0.88	0.86	0.86	0.87	0.90	0.83
Disadvantage	994	995	988	971	1006	967
Indigenous (0=Non-Indigenous, 1=Indigenous)	0.05	0.06	0.08	0.10	0.01	0.12
Regional (0=metro, 1=regional)	0.42	0.41	0.44	0.32	0.32	0.37
Delay (days)	48	51	61	87	210	122
Plead guilty (0=no, 1=yes)	0.91	0.92	0.92	0.73	0.55	0.61
Charge rate index	38.4	38.6	39.8	41.2	35.1	43.0
Concurrent offences	1.21	1.26	1.33	1.67	1.11	2.12
No. of prior driving offences (5yr)	0.21	0.15	0.15	0.61	0.25	0.40
No. of subsequent driving offences within 5 yrs	**0.39**	**0.35**	**0.31**	**0.94**	**0.31**	**0.84**

years following the reference offence, the means of the reappearance (R) and no reappearance (NR) subgroups for each offence are significantly different in 92% of comparisons (p-value<0.01). The standout discriminator is priors, followed by age. The R groups all have higher levels of priors and lower mean age. Equality of means can be very strongly rejected for the R and NR groups in regard to priors. Indeed, there may be a danger that priors act as a proxy for all omitted information when modelling recidivism.

There are some other points to note about the R and NR groups. The proportions of each offender group reappearing within five years for driving offences are in general under 0.50, and around 0.25 for the PCA groups. The R groups were given, on average, significantly higher fines and higher licence disqualification periods. They contained significantly higher proportions of males and Indigenous offenders and their postcodes of residence showed more disadvantage and higher average charge rates. The R groups were more likely to be in the high penalty group at the reference offence. They also showed marginally lower delay, were less likely to plead guilty and had a higher mean number of concurrent offences.

STATISTICAL MODELS AND RESULTS

As discussed above, Smith and Paternoster (1990) suggest that the most appropriate method to control for selection bias in recidivism analyses is to simultaneously estimate two regression equations: a selection equation and an outcome (or recidivism) equation. Three specific methods are proposed by Smith and Paternoster to estimate these equations: the Heckman 2-Step Model, Enhanced Ordinary Least Squares method and the Instrumental Variable approach (or 2-Stage Least Squares).

The Heckman 2-Step Model involves the use of a selection equation and a Heckman-type adjustment, lambda, (where lambda = rho*sigma) in the outcome equation. The Heckman selection model utilises simultaneous estimation of the two equations, where the outcome regression model can be denoted by:

$$r = z'\beta + u_1 \qquad (1)$$

and the probit model for selection can be given by:

$$\Pr(Y=1|X) = \Phi(x_i'b) \text{ where } Y \text{ is an indicator of } y^* = x'\beta + u_2 > 0 \qquad (2)$$

where Φ is the standard cumulative normal probability distribution and the following holds:

$$u_1 \sim N(0,\sigma^2)$$
$$u_2 \sim N(0, 1)$$

and the correlation between the error terms:

$$\text{corr}(u_1, u_2) = \rho.$$

When $\rho = 0$, OLS regression provides unbiased estimates, when ρ is non-zero the OLS estimates are biased.

The Enhanced Ordinary Least Squares approach uses the specified selection equation to produce conditional residuals as a proxy for the missing information (or an index derived from these residuals). These conditional residuals are then used as an additional independent variable in the recidivism equation. In the Instrumental Variable approach, predicted values from the selection or first stage regression equations are used as instrumental variables in the outcome or recidivism equation. For simplicity, only the methodology and results from the Heckman 2-Step model are presented in detail here. However, the findings from the Enhanced Ordinary Least Squares and Instrumental Variable approaches are presented in the Appendix and any major differences in the results from these models are highlighted in the discussion.

HECKMAN 2-STEP MODEL

As described earlier, the measure of reoffending utilised in this analysis was a count of subsequent court appearances for any driving-related offence within five years of the reference offence. The results from the analyses are discussed below. All analyses described in this section and presented in the Appendix were conducted using STATA 8.1 software.

The selection equation

The first step in the Heckman 2-Step analysis is to specify a model for the process by which offenders are 'selected' to receive a relatively severe penalty for their reference offence (drink-driving, drive whilst disqualified, speeding or 'other driving' offence). The distributions of fines and licence disqualifications, as expected, were highly right-skewed. Thus the means were well above the medians. By classifying offenders who received both a fine and licence disqualification above the mean of their offender group as a 'high penalty' subgroup, we are able to construct a simple penalty severity partition into 'high' and 'low', which takes both penalty types into account. The 'high penalty' subgroup generally comprised 15 to 20 % of the offenders in each group[7]. If the court imposed penalty is to reflect aspects of offence severity and provide a level of deterrence, then covariates related specifically to the reference offence and the individual need to be included as regressors, as well as any societal/institutional controls that may be relevant. Since each driving offence is modelled separately, severity of the reference offence will be reflected through concurrent offences (which include counts of the principal driving offences plus other lesser offences), whilst priors, age, gender and Indigenous status are used to cover attributes of the individual. The remainder of the covariates relate aspects of location and court process to the penalty.

A probit equation was then estimated in which penalty type (high v. low) was specified as the dependent variable and factors thought to be influential in the sentencing process were the independent variables.

Variables included in vector X from equation (2) considered to have direct and indirect influence on penalty severity are:

- x_1 The defendant's age;
- x_2 Gender;
- x_3 The level of disadvantage at defendant's postcode;
- x_4 Indigenous status;

x_5 Binary variable indicating whether the defendant resided in a regional area (i.e. outside of Sydney, Newcastle and Wollongong);

x_6 Delay from offence to determination;

x_7 Plea submitted for the reference offence;

x_8 The charge rate index in the postcode where the defendant resided as at the reference offence;

x_9 Number of concurrent offences; and

x_{10} Number of prior driving offences recorded.

The composition of X is unlikely to be comprehensive because the level of penalty imposed by the magistrate may be influenced by other factors not available in the secondary data available from court records[8]. Some variables are proximal (x_1, x_2 and x_9) allowing us to test for an individual's likelihood of receiving a high penalty, whilst others are distal (x_3, x_4, x_5, x_7 and x_8) allowing us to control for a judicial process that may be prejudicial or spatially biased.

The results from the probit equation estimated for each of the offender groups are presented in Tables 2a and 2b.

The selection equations in Tables 2a and 2b show that, as expected, the severity of the penalty imposed for a driving offence is related to both attributes of the individual and aspects of the reference offence.

Table 2a: Probit models for 'high penalty' imposed by the court for PCA offences

	Low-range PCA			*Mid-range PCA*			*High-range PCA*		
Variable	***Coeff.***	***Std. error***	***p-value***	***Coeff.***	***Std. error***	***p-value***	***Coeff.***	***Std. error***	***p-value***
Age	0.004	0.002	0.056	0.002	0.001	0.096	-0.002	0.001	0.262
Gender	0.305	0.073	0.000*	0.269	0.035	0.000*	0.187	0.048	0.000*
Disadvantage	-0.001	0.0004	0.000*	-0.0009	0.0002	0.000*	-0.0004	0.0003	0.136
Indigenous	0.060	0.090	0.508	0.013	0.046	0.773	-0.047	0.059	0.425
Regional	-0.130	0.044	0.003*	-0.088	0.023	0.000*	-0.056	0.033	0.095
Delay	-0.001	0.0003	0.002*	-0.0006	0.0001	0.000*	-0.0005	0.0001	0.001*
Plead guilty	-0.493	0.062	0.000*	-0.619	0.036	0.000*	-0.573	0.051	0.000*
Charge rate index	-0.003	0.002	0.032*	-0.002	0.001	0.037*	-0.002	0.001	0.047*
Concurrent offences	0.696	0.029	0.000*	0.584	0.015	0.000*	0.422	0.018	0.000*
Prior driving offences	0.561	0.032	0.000*	0.693	0.022	0.000*	0.553	0.033	0.000*
Constant	-0.556	0.415	0.180	-0.626	0.215	0.004*	-0.700	0.306	0.022*
Non-selection hazard	**-0.327**	**0.071**	**0.000***	**-0.312**	**0.039**	**0.000***	**-0.190**	**0.052**	**0.000***

** Statistically significant at the 0.05 level*

Table 2b: Probit models for 'high penalty' imposed by the court for non-PCA offences

	Drive whilst disqualified			*Exceed speed limit*			*'Other driving' offences*		
Variable	***Coeff.***	***Std. error***	***p-value***	***Coeff.***	***Std. error***	***p-value***	***Coeff.***	***Std. error***	***p-value***
Age	0.005	0.002	0.001*	-0.025	0.002	0.000*	0.005	0.001	0.000*
Gender	0.281	0.050	0.000*	0.231	0.067	0.001*	0.222	0.037	0.000*
Disadvantage	-0.0005	0.0002	0.033*	-0.0002	0.0003	0.506	-0.0006	0.0002	0.002*
Indigenous	0.012	0.050	0.811	-0.089	0.178	0.616	0.137	0.039	0.001*
Regional	0.162	0.032	0.000*	0.034	0.042	0.418	-0.111	0.027	0.000*
Delay	-0.0006	0.0001	0.000*	-0.001	0.0002	0.000*	-0.001	0.0001	0.000*
Plead guilty	-0.117	0.034	0.000*	0.141	0.039	0.000*	0.117	0.027	0.000*
Charge rate index	-0.003	0.001	0.001*	0.0005	0.002	0.772	-0.001	0.001	0.392
Concurrent offences	0.319	0.013	0.000*	0.209	0.034	0.000*	0.237	0.010	0.000*
Prior driving offences	0.239	0.015	0.000*	-0.133	0.035	0.000*	-0.009	0.015	0.562
Constant	-1.551	0.263	0.000*	-0.375	0.391	0.338	-1.243	0.218	0.000*
Non-selection hazard	**-0.464**	**0.104**	**0.000***	**-0.289**	**0.173**	**0.095**	**-0.515**	**0.108**	**0.000***

** Statistically significant at the 0.05 level*

Concurrent offences were the strongest predictors of more severe fines/disqualifications. The next most noteworthy predictor was prior driving offences, which was positively related to higher penalties for drink-driving and drive whilst disqualified offences, but had a negative significant coefficient for speeding offences and was not significant for 'other driving' offences. The Indigenous variable was not significant in drink-driving, drive whilst disqualified and speeding offences. Age was a significant predictor of penalty severity in non-PCA offences, whilst gender was significant in all models (males attract higher penalties). Offenders from more disadvantaged postcodes received higher penalties (apart from speeding and high-range drink-driving offences which showed insignificant coefficients). The coefficients for the charge rate index suggest that offenders from areas with high charge rates tend to attract less severe penalties for drink-driving and drive whilst disqualified offences. The guilty plea was also associated with lower penalties for drink-driving and drive whilst disqualified offences, but was associated with higher penalties for speeding and 'other driving' offences. Lengthier delay[9] was associated with less severe penalties across the six offences. The performance of the regional variable was largely dependent on the offence (for example, regional drive whilst disqualified offenders incurred more severe penalties than metro offenders, whilst the reverse occurred for drink-driving and 'other driving' offenders).

If the variables included in the selection equation are comprehensive, we should be able to efficiently predict the likelihood of a high penalty being imposed. This will mean that our predicted likelihood is close to the observed likelihood and that the amount of missing information contained within the error term will be relatively small. The significance of the Heckman 2-Step Lambda statistic (i.e. coefficient of non-selection hazard or Inverse Mills Ratio) is the simplest way to test whether omitted information presents as a problem for the specified model. In the probit selection model, this statistic is calculated from the predicted values by dividing their standard normal probability density function by the cumulative normal density function $[\lambda(\tilde{y}^*_i) = \varphi(\tilde{y}^*_i)/\Phi(\tilde{y}^*_i)]$. It represents a positive non-linear index of the amount of missing information (omitted variables). If the Heckman Lamda statistic is not statistically significant, then selection bias is not a concern and an Ordinary Least Squares (OLS) or probit model should provide unbiased estimates for the recidivism analysis.

As seen from Tables 2a and 2b, the lambda statistic (non-selection hazard) is highly significant in all but one of our selection models (lambda was only significant at the 0.10 level for speeding offences). This is consistent with the view that unmeasured variables that increase the likelihood of receiving a high penalty are significantly associated with a greater likelihood of reappearing before the court. Thus a Heckman-type adjustment should be included in the outcome equation to correct for the bias arising from these omitted or mismeasured variables.

The outcome equation

The second step in the Heckman 2-Step analysis is to specify an outcome equation (to be estimated concurrently with the selection equation) predicting the likelihood of reappearing before the court. Many of the same independent variables that were included in the selection model are also included in this outcome model. It is also important that the selection equation contains at least one variable not related to the dependent variable in the outcome equation so as to avoid problems of multicollinearity in the Heckman procedure. Delay, postcode charge rate, plea and concurrent offences[10] were used as predictors of penalty severity but not included in the reoffending outcome equation. They are thought to have an obvious strong relationship as to whether or not a defendant receives a relatively high penalty at the finalisation of the reference offence but, arguably, no obvious relationship to reoffending risk.

The outcome equation also includes information regarding the level of penalty imposed by the court, as indicated by the total fine amount (in dollars) and the total licence disqualification period (in months) imposed for the reference offence, as well as additional information derived from the selection model to account for selection bias. The dependent variable in the outcome equation is a count variable indicating the number of reappearances (r = 0,1,2 …etc.) before the court for a new driving offence during the five-year follow-up period.

Variables included in vector **Z** from equation (1), considered to have direct influence on court reappearance are:

- z_1 Total fine ($);
- z_2 Total disqualification (months);
- z_3 Prior driving offence indicator (conviction in five years to reference offence);
- z_4 Age;
- z_5 Gender;
- z_6 The level of disadvantage of defendant's postcode;
- z_7 Indigenous status; and
- z_8 Binary variable indicating whether the defendant resided in a regional area (i.e. outside of Sydney, Newcastle and Wollongong).

Results from this model are shown in Tables 3a and 3b. As can be seen from these tables, persons who are young or Indigenous have a significantly higher probability of subsequent offending, controlling for other factors[11]. The exception is speeding offences. Neither age nor Indigenous status is a significant predictor of returning to court for persons convicted of these offences. Also, generally speaking, the probability of recidivism is higher among those who live in disadvantaged and non-regional areas.

The critical coefficients for our deterrence hypotheses are the coefficients for 'total fine' and 'total disqualification'. Tables 3a and 3b show that neither of these statistics is negatively significant in any of our estimated models. Thus, neither the fine amount nor the length of licence disqualification are significant predictors of the probability of returning to court

Table 3a: Heckman 2-step consistent estimator models predicting any new appearance for a PCA offence utilising information on the selection process

	Low-range PCA			Mid-range PCA			High-range PCA		
Variable	*Coeff.*	*Std. error*	*p-value*	*Coeff.*	*Std. error*	*p-value*	*Coeff.*	*Std. error*	*p-value*
Total fine	0.0001	0.0001	0.154	-0.00006	0.00004	0.097	0.00001	0.00003	0.702
Total disqualification	0.004	0.003	0.243	-0.0001	0.0009	0.893	-0.0008	0.0009	0.363
Prior driving offence	0.086	0.066	0.190	-0.004	0.035	0.919	0.055	0.042	0.191
Age	-0.006	0.003	0.035*	-0.007	0.001	0.000*	-0.003	0.002	0.089
Gender	-0.089	0.119	0.452	0.100	0.050	0.047*	0.122	0.054	0.023*
Disadvantage	-0.0007	0.0004	0.094	-0.001	0.0002	0.000*	-0.0009	0.0002	0.000*
Indigenous	0.359	0.113	0.001*	0.368	0.052	0.000*	0.308	0.056	0.000*
Regional	-0.022	0.063	0.725	-0.186	0.031	0.000*	-0.074	0.035	0.034*
Constant	1.743	0.432	0.000*	2.086	0.214	0.000*	1.489	0.261	0.000*

** Statistically significant at the 0.05 level*

Table 3b: Heckman 2-step consistent estimator models predicting any new appearance for a non-PCA driving offence, utilising information on the selection process

	Drive whilst disqualified			Exceed speed limit			'Other driving' offences		
Variable	*Coeff.*	*Std. error*	*p-value*	*Coeff.*	*Std. error*	*p-value*	*Coeff.*	*Std. error*	*p-value*
Total fine	-0.00005	0.00005	0.347	0.00007	0.00007	0.312	0.00004	0.00005	0.409
Total disqualification	0.00008	0.002	0.966	0.014	0.004	0.000*	-0.0001	0.002	0.932
Prior driving offence	0.002	0.067	0.973	0.337	0.075	0.000*	0.331	0.062	0.000*
Age	-0.014	0.003	0.000*	-0.0002	0.005	0.970	-0.020	0.003	0.000*
Gender	0.094	0.110	0.392	0.060	0.101	0.552	0.022	0.087	0.799
Disadvantage	-0.001	0.0004	0.009*	-0.001	0.0003	0.003*	-0.001	0.0003	0.000*
Indigenous	0.287	0.098	0.003*	0.370	0.228	0.105	0.466	0.083	0.000*
Regional	-0.284	0.066	0.000*	-0.080	0.057	0.158	-0.302	0.061	0.000*
Constant	3.070	0.460	0.000*	1.621	0.392	0.000*	3.524	0.382	0.000*

** Statistically significant at the 0.05 level*

for a new driving offence, controlling for other relevant factors. In fact, the coefficient for 'total fine' is negative (i.e. in the expected direction for a deterrent effect) only for the mid-range PCA and drive whilst disqualified offences. However, the effect even for these groups is weak and not statistically significant at the 0.05 level. Again, the exception to this is persons convicted of speeding offences. For this offender group there is a significant, positive association between licence disqualification and recidivism, indicating that a longer period of licence disqualification actually increases the probability of subsequent driving offending.

SUMMARY AND DISCUSSION

The primary purpose of these analyses was to investigate the marginal deterrent efficacy of financial penalties for criminal driving offences. This study not only provides much needed empirical research in an area where few studies have previously been conducted but also addresses the problem of selection bias that has constrained deterrence research in the past.

The analyses reported here indicate that for almost all models designed to predict driving offence recidivism (with the exception of speeding offences) selection bias does exist. This means that an ordinary least squares or logistic/probit regression could potentially lead to biased or spurious estimates when assessing the deterrent efficacy of the penalty amount. The present analysis, which corrected for this bias, failed to find any evidence for a significant relationship between fine amount and the likelihood that an offender will return to court for a new driving offence[12]. Nor was there any evidence from our analyses to suggest that longer licence disqualification periods reduced the likelihood of an offender reappearing before the courts. The only significant effect of penalty type occurred in relation to speeding offences. In this instance, longer licence disqualification periods appear to increase the risk of subsequent offending; a finding that runs contrary to deterrence hypotheses.

It is important to note, however, that the statistical procedure used in these analyses (i.e. the Heckman 2-Step model) has one very important assumption which, if violated, can affect the validity of our conclusions; namely that the disturbance terms of the first stage and the outcome models have a bivariate normal distribution. Our reliance on this untestable assumption (Ettner 2004) is reduced by virtue of the fact that we have variables that predict penalty severity but do not impact on reappearance. In our selection equations, delay, postcode charge rate, plea and concurrent offences were used as predictors of penalty severity but were not included in the reoffending outcome equation. It is also worth noting that further analyses, using two other statistical procedures proposed by Smith and Paternoster (1990) to account for selection bias (Enhanced Ordinary Least Squares/Enhanced Probit method and the Instrumental Variable approach), produce similar results to those presented here. A summary of the findings from these additional analyses appear in the Appendix to this bulletin (see Tables A3-A4).

If we ignore the selection bias, we would be making an assumption that there are no omitted variables that influence penalty severity and reoffending for these driving offences. For a comparison of the results from estimating an Ordinary Least Squares and Probit models using the same independent variables, but ignoring selection bias issues, see Tables A5-A6. Ignoring selection bias we are led to believe that higher fines are significantly associated with higher reoffending, but can easily see that the issue is not so clear-cut once selection bias is taken into account. As shown in Tables A3 and A4, the coefficient for fine amount is generally not significant in the models correcting for selection bias, indicating that the level of fine imposed by the court has no marginal deterrent effect on driving offence recidivism. The exception to this is low-range and mid-range drink-driving offences. For these offences, the coefficient is significant and in the direction anticipated by deterrence theory (i.e. negative); but only for outcome models estimated using the Instrumental Variable approach. For licence disqualification, the findings are somewhat mixed. The Instrumental Variable models suggest a significant deterrent effect for longer licence disqualifications, at least for those persons convicted of speeding and 'other driving' offences. However, the Enhanced Ordinary Least Squares/Probit models are consistent with the earlier results obtained using the Heckman 2-step model in showing a criminogenic effect of longer licence disqualification periods for these and other offences (including low-range drink-driving). In general, there is little that would suggest a marginal deterrent effect of court-imposed fines and licence disqualification for persons convicted of driving offences.

The most consistent predictors of returning to court were individual attributes of the offender. Having no prior offending history was generally the strongest indicator that a convicted driving offender would desist from committing further offences. Age, gender and Indigenous status were also significant predictors of whether or not an offender would return to court, with persons who are young, Indigenous or male being more likely to reappear for a new driving offence. In terms of the aggregate-level variables, there was also evidence to suggest that those residing in more advantaged areas and regional areas had a lower likelihood of reappearing for a new driving offence.

The lack of evidence for a marginal deterrent effect of fines found in the current study is consistent with much of the deterrence research on punishment severity. Few deterrence studies have found significant correlations between the severity of criminal sanctions and subsequent offending. Those that have, tend to find that any change in reoffending resulting from harsher penalties is relatively small in magnitude (see von Hirsch et al. 1999 for a review). There are three main reasons identified in the research literature why variations in fine amount might have limited efficacy in deterring offenders:

1. The vast majority of potential offenders may be deterred by the anticipated informal social sanctions associated with public exposure of the offence rather than the formal punishment prescribed by legislatures;
2. There may be no marginal deterrent effect of higher fines at existing fine levels; and
3. Many offenders may discount the penalty because they believe the risk of detection and apprehension by police to be very low.

One area where the current findings differ from previous work in this area is in regard to the effectiveness of licence disqualification. Previous drink-driving research has suggested that longer licence disqualifications can have a beneficial effect on recidivism (e.g. Mann et al. 1991; Siskind 1996); whereas the current results suggest that longer licence disqualifications have little to no deterrent effect and, in fact, for some driving offences, may actually increase the risk of reoffending. While it is possible that these discrepancies are due to the failure of previous research to adequately address selection bias issues in recidivism studies, a more likely explanation is the differences in the definition of reoffending. In our study we used any new appearance before the court for a driving offence within the defined follow-up period. Other studies have compared drink-driving offence rates while under disqualification from driving with rates during legal periods of driving or have simply used road accident rates pre- and post-disqualification as the outcome measure in their analyses. These latter measures are arguably more sensitive measures of actual levels of reoffending than are court appearance rates. Future research should examine this issue in greater detail.

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NOTES

1. Note that very little work has been conducted thus far on the role of celeritous punishment in controlling crime and therefore deterrence research investigating this aspect of punishment is not reviewed here.

2. If we were to use single stage models (such as probit or OLS) where all penalty- related independent variables (such as concurrent offences, delay, plea and priors) are included, along with the omitted variable problem due to the selection bias issue, there is likely to be another problem, that of the 'endogenous regressor'. That is, concurrent offences, delay, plea and priors will be influencing the level of the penalty, so we cannot include them as independent regressors, since they are likely to be correlated with another regressor in the same equation. The Heckman 2-Step method and the Instrumental Variable (IV) approach are used to overcome this problem.

3. A low-range PCA offence is an offence where a driver is found to have a Blood Alcohol Concentration (BAC) over 0.05g/100ml. For mid-range and high-range PCA offences the lower BAC limits are 0.08g/100ml and 0.15g/100ml respectively.

4. 'Other driving' offences include: Drive without a licence (5,316); Registration offences (4,148); Regulatory driving offences (5,632); Driving licence offences (250) and Roadworthiness offences (7). Drive without a licence offenders were considered a miscellaneous offender group and was not considered for inclusion with set of drive whilst disqualified offenders. The latter group would have all previously offended to incur the disqualification, whereas drive without a license offenders may never have driven previously or incurred a prior penalty.

5. A small proportion of persons convicted of speeding or other driving offences received both a fine and a licence disqualification (16% and 20% respectively).

6. The SEIFA index of disadvantage was used here. Lower values on this index indicate higher levels of disadvantage amongst the specified population (see Australian Bureau of Statistics 2006)

7. This partitioning could cause a problem where the offenders are given a very high fine instead of licence suspension because this would result in an offender being classified in the 'low' penalty subgroup. Other more complicated methods of partitioning which took this situation into account were trialled but failed to yield more efficient models.

8. For example we can control directly for Indigenous status, but only indirectly for other attributes such as ethnicity through disadvantage and we are not able to control for other factors such as the level of social support.

9. Note that length of delay (number of days from offence to determination) could be an indicator of the vigour with which an infringement is being contested or may in part be due to cases being adjourned until a defendant has completed a relevant rehabilitation program. Successful completion of these programs may then be taken into account during the sentencing process. However it must be remembered that all offenders were convicted in these groups, meaning longer delay was associated with lower penalties.

10. Whilst delay, postcode charge rate and plea relate only to the reference case outcome, it could be argued that concurrent offences may be a proxy for 'propensity to offend' and therefore should be included as a predictor of reoffending. Concurrent offences are correlated strongly with fine and disqualification amounts and since the concurrent offences are a strong independent predictor of selection for a high penalty this variable should be in the selection equation and not the outcome equation.

11. Here it should be noted that the significant relationship between Indigenous status and reoffending could in part be due to the prior offending measure included in our models. Previous research conducted by the Bureau has suggested that the significant relationship between Indigenous status and recidivism can be accounted for by the extensive criminal record of Indigenous offenders. Once prior offending is adequately controlled for there is no evidence to suggest that Indigenous people are at higher risk of reappearing before the courts (Snowball & Weatherburn 2006). However, in the outcome models a binary variable was used in our analyses to represent prior appearance history, whereas in the selection equations a five year count of all prior appearances was used. This binary indicator in the outcome equation may not be sensitive enough to control for the differences between Indigenous and non-Indigenous offenders.

12. As an aside to the deterrence issue some interesting results observed from the selection equations warrant a mention. As expected, the penalty severity of fine/disqualification relates strongly to concurrent offences and prior driving appearances, but not to Indigenous status. Males are significantly more likely to receive a high penalty, as are defendants who have their offence determined more speedily and defendants who plead guilty to a drink-driving or drive whilst disqualified offence. Finally, the severity of the penalty imposed by the court varies according to characteristics of the location where the offender resides. Although there are some variations across offender groups, in general, defendants from metropolitan areas, areas of greater disadvantage and areas with a lower charge rate are more likely to receive a high penalty.

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APPENDIX

Table A1: Comparison of means for PCA offences by reappearance

	Low-range PCA (n=7,072)			Mid-range PCA (n=21,610)			High-range PCA (n=10,145)		
Variable	*Mean R*	*Mean NR*	*p-value*	*Mean R*	*Mean NR*	*p-value*	*Mean R*	*Mean NR*	*p-value*
Proportion reappearing for a drive offence within 5 years	**0.27**	**0.73**		**0.25**	**0.75**		**0.24**	**0.76**	
Total fine ($)	491	417	0.000	741	680	0.000	1077	1017	0.000
Total disqualification	6.12	4.35	0.000	10.69	8.99	0.000	20.62	19.32	0.000
Prior driving offence	0.26	0.14	0.000	0.19	0.12	0.000	0.17	0.12	0.000
Age (years)	28	30	0.000	29	31	0.000	32	35	0.000
Gender	0.91	0.87	0.000	0.91	0.84	0.000	0.89	0.85	0.000
Disadvantage	983	998	0.000	986	998	0.000	978	991	0.000
Indigenous	0.09	0.03	0.000	0.10	0.04	0.000	0.13	0.06	0.000
Regional	0.41	0.43	0.253	0.40	0.42	0.013	0.44	0.44	0.750
High penalty	0.21	0.11	0.000	0.22	0.16	0.000	0.20	0.17	0.000
Delay	51	47	0.082	55	49	0.025	61	61	0.975
Plead guilty	0.88	0.92	0.000	0.90	0.93	0.000	0.91	0.93	0.007
Charge rate index	40.5	37.6	0.000	40.1	38.0	0.000	41.5	39.3	0.000
Concurrent offences	1.34	1.16	0.000	1.39	1.22	0.000	1.44	1.29	0.000
Prior driving offences	0.33	0.17	0.000	0.23	0.13	0.000	0.20	0.13	0.000

Table A2: Comparison of means for non-PCA offences by reappearance

	Drive whilst disqualified (n=11,978)			Exceed speed limit (n=7,383)			'Other driving' offences (n=15,353)		
Variable	*Mean R*	*Mean NR*	*p-value*	*Mean R*	*Mean NR*	*p-value*	*Mean R*	*Mean NR*	*p-value*
Proportion reappearing for a drive offence within 5 years	**0.50**	**0.50**		**0.19**	**0.81**		**0.43**	**0.57**	
Total fine ($)	801	731	0.000	347	277	0.000	775	642	0.000
Total disqualification	14.36	13.85	0.012	1.30	0.52	0.000	6.26	4.39	0.000
Prior driving offence	0.47	0.39	0.000	0.34	0.14	0.000	0.38	0.18	0.000
Age (years)	29	30	0.000	32	36	0.000	29	32	0.000
Gender	0.89	0.86	0.000	0.92	0.89	0.000	0.87	0.81	0.000
Disadvantage	966	976	0.000	996	1008	0.000	959	974	0.000
Indigenous	0.12	0.08	0.000	0.03	0.01	0.000	0.18	0.07	0.000
Regional	0.30	0.34	0.000	0.28	0.33	0.000	0.33	0.39	0.000
High penalty	0.15	0.13	0.003	0.16	0.12	0.000	0.17	0.13	0.000
Delay	82	93	0.000	199	213	0.001	101	138	0.000
Plead guilty	0.69	0.77	0.000	0.45	0.58	0.000	0.56	0.64	0.000
Charge rate index	42.0	40.5	0.000	36.5	34.7	0.000	44.8	41.6	0.000
Concurrent offences	1.72	1.62	0.000	1.20	1.09	0.000	2.26	2.02	0.000
Prior driving offences	0.72	0.51	0.000	0.53	0.18	0.000	0.62	0.24	0.000

The following tables compare the results of predictive models of reoffending using the selected independent variables described earlier in this bulletin and several different approaches to estimate the equations. The results shown in Tables A3 and A4 are the outcome equations from four different modelling approaches proposed by Smith and Paternoster (1990) to control selection bias: the Heckman 2-Step Model (h), the Instrumental Variable model (iv), the Enhanced Probit model (pe) and the Enhanced Ordinary Least Squares model (oe). For each offence grouping, the sign of the coefficient for the variables contained in the model is shown and if the coefficient is significant at the 0.05 level, then this is also indicated in the table. Tables A5 and A6 show the results from estimating Probit (p) and Ordinary Least Squares (o) models, using the same independent variables but ignoring selection bias issues.

Table A3: Models of association between independent variables and subsequent offending utilising information on the selection process

	Low-range PCA (n=7,072)		*Mid-range PCA (n=21,610)*		*High-range PCA (n=10,145)*	
Variable	***+ Coeff.***	***- Coeff.***	***+ Coeff.***	***- Coeff.***	***+ Coeff.***	***- Coeff.***
Total fine	h pe oe	iv*	oe	h iv* pe	h iv pe oe	
Total disqualification	h iv* pe* oe*		iv* pe oe	h		h iv pe oe
Prior driving offence	h pe* oe*	iv*	pe* oe	h iv*	h iv pe oe	
Age		h* iv* pe* oe*		h* iv* pe* oe*		h iv* pe* oe*
Gender	iv pe* oe	h	h* iv* pe* oe*		h* iv pe* oe*	
Disadvantage		h iv* pe*oe*		h* iv* pe* oe*		h* iv* pe* oe*
Indigenous	h* iv* pe* oe*		h* iv* pe* oe*		h* iv* pe* oe*	
Regional		h iv pe* oe*		h* iv* pe* oe*		h* iv* pe* oe*

** Statistically significant at the 0.05 level*

Table A4: Models of association between independent variables and subsequent offending utilising information on the selection process

	Drive whilst disqualified (n=11,978)		*Exceed speed limit (n=7,383)*		*'Other driving' offences (n=15,353)*	
Variable	***+ Coeff.***	***- Coeff.***	***+ Coeff.***	***- Coeff.***	***+ Coeff.***	***- Coeff.***
Total fine	iv pe	h oe	h iv* pe* oe*		h iv* pe* oe*	
Total disqualification	h iv	pe oe	h* pe* oe*	iv*	pe* oe	h iv*
Prior driving offence	h iv* pe* oe*		h* iv* pe* oe*		h* iv* pe* oe*	
Age		h* iv* pe* oe*	iv	h pe* oe*		h* iv* pe* oe*
Gender	h iv* pe oe		h pe* oe*	iv	h iv* pe* oe*	
Disadvantage		h* iv* pe* oe*		h* iv pe* oe*		h* iv* pe* oe*
Indigenous	h* iv* pe* oe*		h iv* pe* oe*		h* iv* pe* oe*	
Regional		h* iv* pe* oe*		h iv* pe* oe*		h* iv* pe* oe*

** Statistically significant at the 0.05 level*

Table A5: Models of association between independent variables and subsequent offending, ignoring selection

	Low-range PCA (n=7,072)		Mid-range PCA (n=21,610)		High-range PCA (n=10,145)	
Variable	***+ Coeff.***	***- Coeff.***	***+ Coeff.***	***- Coeff.***	***+ Coeff.***	***- Coeff.***
Total fine	p* o*		p* o*		p* o*	
Total disqualification	p* o*		p* o*		o	p
Prior driving offence	p* o*		p* o*		p* o*	
Age		p* o*		p* o*		p* o*
Gender	p* o*		p* o*		p* o*	
Disadvantage		p* o*		p* o*		p* o*
Indigenous	p* o*		p* o*		p* o*	
Regional		p* o*		p* o*		p* o*

** Statistically significant at the 0.05 level*

Table A6: Models of association between independent variables and subsequent offending, ignoring selection

	Drive whilst disqualified (n=11,978)		Exceed speed limit (n=7,383)		'Other driving' offences (n=15,353)	
Variable	***+ Coeff.***	***- Coeff.***	***+ Coeff.***	***- Coeff.***	***+ Coeff.***	***- Coeff.***
Total fine	p* o*		p* o*		p* o*	
Total disqualification		p o	p* o*		p* o	
Prior driving offence	p* o*		p* o*		p* o*	
Age		p* o*		p* o*		p* o*
Gender	p* o*		p* o*		p* o*	
Disadvantage		p* o*		p* o*		p* o*
Indigenous	p* o*		p* o*		p* o*	
Regional		p* o*		p* o*		p* o*

** Statistically significant at the 0.05 level*

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