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The Long-Term Effects of Random Breath Testing in Four Australian States: A Time Series Analysis

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Title and Subtitle

THE LONG-TERM EFFECTS OF RANDOM BREATH TESTING IN FOUR AUSTRALIAN STATES: A TIME SERIES ANALYSIS

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Abstract

The aim of this study was to estimate the long-term effectiveness of random breath testing (RBT), using time series analyses of statistical data on accidents and police enforcement in four Australian states: New South Wales (RBT introduced December 17, 1982), Queensland (December 1, 1988), Western Australia (October 1, 1988), and Tasmania (January 6, 1983). Daily accident data were analysed, utilising a log-linear model that controlled for a range of seasonal, weather, economic and road user factors, and decomposed the overall impact of RBT into three components: an Introduction effect (with a decay period that could be estimated), a Program effect (not enforcement related), and the effects of ongoing enforcement (with provision for lagged effects of different durations representing "residual deterrence"). RBT had an immediate, substantial and permanent impact on accidents in all states except Tasmania, where there was a substantial initial impact that could not be demonstrated to have persisted beyond about three months The Tasmanian result may reflect the shape of the time series, with steep declines in the 1970s followed by a levelling off in accidents in the 1980s, as well as low accident numbers, giving limited statistical power. It may also be related to low levels of media publicity, despite relatively high levels of enforcement. Results were most clear for New South Wales, where RBT reduced fatal accidents initially by 48% and by 15% on a permanent basis. However, RBT in New South Wales almost ceased to have any impact on some series of accidents in the late 1980s due to the decay in the Introduction effect, and was "saved" only by increased levels of enforcement that had a substantial "residual deterrent" effect. It was estimated from the models that an increase of 1000 in the daily testing rate corresponded to a decline of 6% in serious accidents and 19% in single-vehicle night-time accidents. These effects were additional to those quoted above, but the relationships were non-linear, with diminishing returns as the change in number of daily tests was made larger. No clear relationships between enforcement levels and accidents were found for other states, with the partial exception of Tasmania. RBT achieved accident reductions approximately 50% higher than the de facto programs in Western Australia and Queensland, while the .05 law in New South Wales and Queensland achieved results similar in size to de facto RBT. The major recommendation is that all states should increase highly visible stationary RBT to a level equivalent to one test per licence holder per year. This could be accomplished in a cost effective manner by using general duties police and highway patrol vehicles, and by utilising the management techniques embodied in the random roadwatch program.

Keywords

Random breath testing, traffic law enforcement, alcohol-related accidents, drinking and driving, time series analysis.

NOTES:

(i) FORS reports are disseminated in the interest of information exchange.

(ii) The views expressed are those of the authors and do not necessarily represent those of the Commonwealth Government.

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EXECUTIVE SUMMARY

This study is about the long-term effectiveness of random breath testing, as judged by time series analyses of statistical data on accidents and police enforcement in four Australian states: New South Wales (RBT introduced December 17, 1982), Queensland (RBT introduced December 1, 1988), Western Australia (RBT introduced October 1, 1988), and Tasmania (RBT introduced January 6, 1983). This report, which focuses on the statistical evidence, is designed to be read in conjunction with a sequel, that explores in more detail police enforcement practices in the various jurisdictions.

Analytic Methods

Although considerable research on random breath testing has been conducted in Australia, there are few studies that use rigorous time series methods to assess the impact of RBT and other legal interventions on accidents, especially controlling for economic factors such as unemployment rates that are known to have a marked impact on road usage and accidents. This study is innovative in that analyses were based on daily accident data, allowing the introduction of controls for weather conditions, day of week, and public holidays. Change in a time series is not evidence of causality unless the change can be detected in the first post-intervention observation, and so daily data - the lowest level of temporal aggregation - are the ideal (and most natural) unit for analysis. Since daily accident data follow a Poisson distribution, log-linear methods are appropriate, provided residuals exhibit no evidence of autocorrelation.

Serious and fatal accidents were analysed because of their importance and because of the role of alcohol. Single vehicle night-time accidents were used as a more accurate surrogate for alcohol-related accidents, in preference to accidents involving a controller with a positive blood alcohol concentration. BAC data were not considered sufficiently accurate, particularly in the late 1970s and early 1980s. Only accident incidents were analysed, not persons involved in accidents. Accident data were analysed over as long a time period as possible, with most series commencing between 1976 and 1980 and concluding in 1991 or 1992.

Major factors controlled included seasonal effects, daily weather patterns, indices of economic and road use activity, alcohol consumption, and the day of the week. The mathematical model applied to data from each state (where data quality permitted) allowed for the decomposition of the overall impact of RBT into three components: an "introduction effect" that could be short-lived; a "program effect" that represents the ongoing impact of the existence of RBT, independent of levels of enforcement; and a component that represents the effects of changes in ongoing enforcement levels. A further feature of the model was a capacity to estimate the lagged effect of enforcement; that is, the period of time after a given RBT operation over which the apparent effect on accidents could be discerned. This analytic approach has not been used previously in its full form in accident research, so the present study represents a significant methodological advance.

Research Questions

The design of the study involved a comparison of two states that could be said to be "revolutionary" in the way they introduced RBT, and two states that could be said to be "evolutionary" in their approach. New South Wales and Tasmania both introduced RBT at nearly the same time in a "boots and all" fashion, in the sense that RBT did not follow a period of "de facto" RBT and was enforced intensively once it was introduced. The major difference was that New South Wales spent millions of dollars on media publicity, while Tasmania spent virtually nothing, relying on press coverage and "word of mouth."

Western Australia and Queensland introduced RBT much later than Tasmania and New South Wales, and in both states RBT represented a development of the earlier de facto programs rather than being an entirely new form of enforcement. In addition, the "evolutionary" states did not devote the same level of resources for enforcement and publicity as the "revolutionary" states.

Specific research questions addressed by the study were:

(a) What are the size and duration of the impact of RBT in the "revolutionary" states that introduced RBT "boots and all" (New South Wales and Tasmania) and in the "evolutionary" states that introduced de facto RBT before full RBT (Queensland and Western Australia)?

(b) Did the small state of Tasmania achieve a similar impact as New South Wales with similar approaches to enforcement but markedly different levels of media publicity?

(c) What have been the effects of ongoing RBT enforcement on accidents?

(d) What have been the relative effects of de facto and full RBT in the "evolutionary" states?

Impact of RBT

Depending on which accident series was examined, the initial impact of RBT ranged from 48% for fatal accidents in New South Wales to 13% for all serious accidents in Western Australia. Only for single-vehicle night-time accidents in Queensland was it not possible to establish a significant effect for RBT, and this almost certainly reflects the combination of relatively low accident frequencies and the shortness of the series. Table S.1 reproduces Table 7.1 in Chapter 7, which summarises the sizes of the initial impacts and the duration of the Introduction effects in the four states.

Table S.1. Summary of Size of the Initial Impact of RBT and the Duration of the Introduction Effect for the Four States

State	Type of Accident	Initial Impact	Duration of Introduction Effect[1]	Accidents Prevented in First Year
New South Wales	All serious	19%	15 months	522[2]
	Fatal	48%	4.5 months	204[2]
	Single-vehicle night-time	26%	10 years	686[2]
Tasmania[5]	All serious	24%	1 year	36[3]
Western Australia	All serious	13%	Ongoing	334[4]
	Fatal	28%	Ongoing	72[4]
	Single-vehicle night-time	26%	Ongoing	212[4]
Queensland	All serious	19%	Ongoing	789[4]
	Fatal	35%	Ongoing	194[4]

1 Duration of effect until impact reduced to 5% of initial value.

2 For the period December 17, 1982 to January 31, 1983.

3 These savings occurred in the first three months, after which no benefits of RBT could be measured.

4 These are the mean savings per year. Actual annual estimates fluctuate slightly around the mean.

5 Launceston and Hobart regions

In New South Wales and Western Australia the impact of RBT on single-vehicle night-time accidents was clear, with a 26% initial reduction that appeared to be sustained on an indefinite basis, although in New South Wales the effect declined to only 3% in 1989, reflecting the decay in the Introduction effect that had not at that time been counteracted by the effects of the increase in enforcement from late 1987. The reduction in single-vehicle night-time accidents achieved by RBT increased again to 22% in 1992, reflecting higher enforcement levels. In Western Australia and Queensland the permanence of the effects for most accident series examined perhaps reflects more the simplified nature of the model for these states than a definite long-term effect.

In summary, the impact of RBT in all states except Tasmania was (a) instantaneous; (b) substantial; and (c) permanent, although in New South Wales the magnitude of the effect varied greatly over time. In New South Wales (d) the effects were amplified and RBT "saved" in the long-term through substantial increases in enforcement from 1987.

New South Wales results were not as clear cut for serious and fatal accidents as for single-vehicle night-time accidents, at least in terms of the duration of the impact, but this can be explained in terms of the fact that the two former series are not as clearly alcohol-related as the latter (and also by the lower power of the analysis for fatals). The fact that only relatively small and inconsistent effects that were not strongly statistically significant could be discerned for the control series of accidents (vehicle-to-vehicle accidents during school hours) reinforces the conclusion that RBT had a permanent causal impact on alcohol-related accidents.

Despite a substantial initial impact in Tasmania, it was not possible to show that RBT had any effect on serious and fatal accidents after about three months. Possible reasons for this result were: (a) there were fewer than two fatal and serious accidents per day in the two regions analysed, compared with more than 20 throughout most of the 1970s and 1980s in New South Wales, resulting in a lack of statistical power; (b) the marked downturn in accidents that preceded RBT in the 1970s was not sustained into the 1980s, making it very difficult to measure the impact of any countermeasure in the 80s; and (c) despite high levels of enforcement there was no massive media campaign, unlike New South Wales. The long-term effects of RBT in each state except Tasmania are summarised in Table S.2.

Table S.2 Long-Term Effects of RBT in New South Wales, Western Australia, and Queensland

	New South Wales (17/12/82 - 31/12/92)		**Western Australia** (1/10/88 - 31/12/92)		**Queensland** (1/12/88 - 31/12/92)	
Type of accident	% reduction[1]	Total accidents prevented	% reduction	Total accidents prevented	% reduction	Total accidents prevented
All serious accidents	3 - 18%	6742	13%	1443	19%	3217
Fatal accidents	17 - 42%	1487	28%	307	35%	789
SVNT accidents	3 - 26%	3246	26%	902	--	--

Note: SVNT accidents are single-vehicle night-time accidents.

1 The percentage reduction in accidents varied each year (including the period from December 17, 1982 to December 31, 1982 as a "year"), and only the range is shown. See Table 3.8 for further details.

Effects of Ongoing RBT Enforcement

Increased levels of enforcement in New South Wales since 1987 had a very clear and dramatic effect on serious and single vehicle night-time accidents. The model for all serious accidents indicated that an increase of 1000 in the daily testing rate corresponded roughly to a decline of 6% in accidents. The relationship for single-vehicle night-time accidents was stronger, with an increase of 1000 tests each day corresponding to a 19% reduction in accidents. However, from the models the relationship between changes in daily testing rates and accident reductions was not linear, so that there is an element of "diminishing returns" as daily enforcement levels increase. This is particularly the case with single-vehicle night-time accidents. This means that care must be taken in making predictions about the effects of increases in testing levels, especially when extrapolating outside the range of the data (about 2000 to 6000 tests per day)

The analyses also indicated that RBT has a "residual deterrent effect" that is of great importance. The residual deterrent effect of any given RBT operation as estimated from the models persisted for at least six months for all serious accidents, and in the case of single vehicle night-time accidents for about 18 months. These estimates are broadly consistent with the findings of survey research (Homel, 1988; Homel, Carseldine and Kearns, 1988) that suggest that exposure to random breath testing does have an effect for some time after it occurs, although the behavioural impact is subject to decay if not reinforced by further doses.

The reality of constant decay in the deterrent effect of RBT, and the need to remedy this with continued high levels of visible and unpredictable enforcement, highlights the importance of setting appropriate or optimal levels of testing. The analyses suggest that if there is some "optimum" level of enforcement beyond which accident reduction benefits are not commensurate with the costs of enforcement, it is greater than the approximately 6300 tests per day conducted by New South Wales police in 1995.

It is noted that these results have been achieved in New South Wales through a combination of careful choice of sites for stationary testing, signs proclaiming that random testing is in operation, and the increased use of general duties police for RBT. This last factor highlights the *routinisation* of RBT operations in that state and a move away from the "booze bus" model emphasised in Victoria.

There was some limited evidence for the effects of RBT enforcement levels in the Launceston region of Tasmania. It was not possible to conclude that variations in enforcement levels in Queensland or Western Australia contributed much to reductions in accidents. This could be simply because the levels did not change much over the short period post-RBT, or it could be that the data on enforcement from these states are too unreliable to have much predictive power. If further research is to be conducted profitably in this field, it is essential that the quality of police enforcement data be improved.

Effects of Other Legal Countermeasures

In every case, the impact of RBT exceeded in magnitude the impact of de facto RBT or RID, although in a few instances RBT was not as statistically significant as de facto RBT. In several analyses the impact of RBT was substantially greater than the de facto program. It is concluded that RBT is a more effective method of enforcement than de facto RBT, even though the transition from one to the other was not marked by the kind of intensive publicity used in New South Wales, and despite the fact that the levels and methods of enforcement in some areas still reflect pre-RBT practices.

The results obtained for the impact of the .05 law in New South Wales and Queensland are of the same order of magnitude as the estimates for de facto RBT.

The impact of de facto RBT and the .05 law are summarised in Table S.3, which reproduces Table 7.4 in Chapter 7.

Table S.3. Summary of the Impact of the .05 Law and De Facto RBT

State/ City	Counter-measure	Type of accident	Percentage drop in accidents	Accidents prevented per year	Total accidents prevented
NSW	0.05	All serious	7%	605	7291
		Fatal	8%	75	908
		SVNT	11%	296	3568
WA	De facto RBT	All serious	9%	217	508
Perth	De facto RBT	All serious	8%	118	277
		Fatal	23%	27	64
		SVNT	17%	68	159
Qld	0.05	All serious	14%	599	6042
		Fatal	18%	91	921
	RID campaign	All serious	12%	483	1128
		Fatal	15%	78	182

Note: SVNT is single-vehicle night-time accidents

Recommendations

1. All states should increase highly visible stationary RBT to a level equivalent to one test per licence holder per year. This could be accomplished in a cost effective manner by using general duties police and highway patrol vehicles, and possibly also booze buses, and by utilising the management techniques embodied in the random roadwatch program.

2. A cost-benefit analysis should be conducted comparing the merits of the Victorian booze bus strategy with the New South Wales strategy of relying on general duties and traffic police operating from standard police vehicles.

3. Police in all states as a matter of urgency should improve the accuracy and comprehensiveness of their enforcement data, so that detailed analyses can be conducted on daily data broken down by mode of enforcement, location of testing, and time of day.

4. The methods used in this study should be applied to each of the time series augmented by an additional five years of data. This would be particularly important for Queensland and Western Australia for which in the present study it was not possible to include the Introduction and Enforcement components of the model. In this way the long-term impacts of RBT in each state, especially in the light of recent variations in enforcement levels, could be better understood.

CHAPTER 1. INTRODUCTION

Police spend a considerable amount of time engaged in traffic duties. In fact, according to a recent report by the Queensland Criminal Justice Commission (1996), management of traffic, traffic law enforcement, and responding to accidents, are amongst the most frequently performed activities, greatly exceeding the time spent in criminal investigations. Even if the time spent by general duties police in routine traffic work is excluded, calls for service involving traffic matters are exceeded in frequency only by calls related to "disturbances" and calls to do with general property offences.

Given the amount of time police devote to traffic-related activities, and given the central place accorded to traffic law enforcement in reducing accidents by both police and the community, it is important that the effectiveness of police traffic work be evaluated. Of course it is important that other aspects of police work, such as preventing crime, be evaluated as well, but one major advantage of studying road accidents is that it is usually possible, with more scientific certainty than in the case of crime, to establish definite links between what police do and what happens on the roads. One reason for this is that statistics on accidents, particularly serious accidents, are relatively accurate and are collected on a routine, daily basis. Another reason is that the causal factors involved in serious accidents are better understood than for most categories of non-traffic crime, and so police programs targeting specific risk factors (such as alcohol) can be (relatively) easily assessed for their effects on accident categories known to be strongly influenced by these risk factors. Knowledge of risk factors also means that variables extraneous to those of central interest, such as economic indices and measures of vehicle usage, can be taken into account when assessing the impact of police work.

A further, important advantage of evaluation in the traffic accident field is that police programs have generally been developed in a more scientific fashion than in other areas of police activity, and have certainly been developed with prevention as a much more central focus. In contrast to the situation for crime, it now seems to be generally accepted by the community and by police themselves that their primary goal is to reduce accidents, not simply to ticket or arrest errant or delinquent drivers (although these remain as important operational goals). Major examples of scientifically designed prevention programs include *random roadwatch* (Leggatt, in press), *speed cameras* (Bourne and Cooke, 1993), and *random breath testing* (Homel, 1988).

Random road watch, or (more precisely) the *randomised scheduled management system for police traffic enforcement* was developed in Tasmania in 1984 and has since been introduced in several other Australasian jurisdictions. The method targets all forms of traffic behaviour, and entails deploying police traffic resources in a truly random manner across a high proportion of the road network on an ongoing basis without increasing staffing levels. The aim is to create the impression in the mind of motorists that a patrol vehicle will be located somewhere along any given road on any day, with the exact location being uncertain. A key feature of the program is the ability to link enforcement levels and patterns with accident reductions, so that there is continual performance feedback to management.

Speed cameras have been used most intensively in Victoria, where they have operated since 1986. (Currently about 24 million camera checks are conducted each year in Victoria, compared with about 9 million in New South Wales and none in Queensland.) In 1989 in Victoria the number of cameras was greatly expanded, and improvements in technology allowed the number of officers required for each camera to be reduced from four to one. Cameras are mounted in vehicles or on tripods, and can be moved from site to site easily and quickly where they can take up to one photo per second. Verification operators have been trained to assess up to one photograph per minute, which permits compliance with speed laws by a very large number of motorists to be assessed. Since cameras are unpredictable in their locations, the actual and perceived risks of detection for speeding are greatly increased, although the sheer numbers of drivers detected and fined may indicate that specific deterrence as well as general deterrence is a key mechanism. Moreover, the camera program has been combined with intense media publicity designed to increase moral condemnation of speeding, reinforcing the view that general deterrence is only part of the explanation for how the speed campaign has influenced behaviour.

Random breath testing (RBT) was first implemented in Australia in 1976, when it was introduced in a low-key way into Victoria. It has since been introduced in all Australian states and territories, most recently in Western Australia in October 1988 and Queensland in December 1988. Although the intensity of enforcement has varied considerably between and within jurisdictions over the years, the essential feature of RBT is that motorists passing an arbitrarily selected, highly visible checkpoint are pulled over for a preliminary roadside breath test in a more or less random fashion. Like the speed camera and random road watch programs, RBT is designed to be combined with ongoing media publicity that adds to the visibility of the enforcement and intensifies the general moral condemnation of the target offences (Clarke and Homel, in press).

Although they differ in their precise goals and methods, these three programs have at least four elements in common: they are designed to prevent accidents, with the apprehension of offenders as a secondary objective; they are based on a model of general deterrence (and to some extent specific deterrence) that utilises the *managed uncertainty of the actual risk of detection* as a central feature; they involve intense and ongoing collaboration between police and state government traffic bureaus; and they are based on carefully developed management systems that allocate police resources in some kind of optimum manner and utilise accident data to refine the effectiveness of the program.

These programs are also examples of *problem-oriented policing* applied at an organisation-wide level to the traffic arena (Goldstein, 1990). The essence of problem-oriented policing is that police move from uncoordinated reactions to individual incidents (such as traffic offences or accidents) to identifying and addressing the actual problems (such as road accidents occurring across a jurisdiction). This is accomplished, in part, by analysing some of the causes or risk factors (such as driving after drinking) and then dealing effectively with these factors by whatever legal means are most appropriate. Implicit in the problem-oriented approach is an emphasis on prevention and on effectiveness in dealing with problems, and the relegation of the traditional police reliance on the criminal justice system (detect, arrest, prosecute, punish) to a secondary place.

The present study is about the long-term effectiveness of random breath testing, as judged by time series analyses of statistical data on accidents and police enforcement in four Australian states: New South Wales (RBT introduced December 17, 1982), Queensland (RBT introduced December 1, 1988), Western Australia (RBT introduced October 1, 1988), and Tasmania (RBT introduced January 6, 1983). This report, which focuses on the statistical evidence, is designed to be read in conjunction with a sequel, that explores in more detail police enforcement practices in the various jurisdictions. Issues to do with improved management of RBT in the general context of problem-oriented policing, and its possible links with the other major traffic enforcement programs that rely on general deterrence and on publicity, are also explored in the sequel.

Random Breath Testing: Theory, Practice and Impact

As indicated above, the defining feature of RBT is that any motorist at any time may be required to submit to a preliminary breath test, and there is nothing he or she can do to influence the chances of being tested. In fact there are two major forms of random testing in some states, stationary and mobile. It is unclear whether mobile testing achieves the deterrent impact of stationary testing, although even stationary testing can be performed in such a way that its impact is limited. In stationary testing, checkpoints are staffed by highway patrol or general duties personnel operating from a single vehicle, or special purpose "booze buses" staffed by several officers and equipped with bright lights and breath analysis equipment are used. Whatever vehicle is used, checkpoints are varied from day to day and from week to week, and are not announced publicly in advance - although ideally they are always highly visible.

In most jurisdictions all motorists pulled over at a stationary operation are tested, regardless of the type of vehicle they are driving or their manner of driving; refusal to submit to a breath test is equivalent to failing the test.

However, in Western Australia an explicit distinction is made between stopping a vehicle and testing the driver, with slightly more than half of all stopped drivers being recorded as tested up to the end of 1992 (the period of this study). In other states, especially Queensland, not all drivers stopped are tested, but this is contrary to policy and there are no official records of the percentage of drivers not tested (although surveys in Queensland suggest that in 1989 25% of drivers were not tested, this figure dropping to around 13% in 1993: Watson, Fraine and Mitchell, 1995). No attempt is officially made in stationary RBT to detect symptoms of alcohol use through observation of behaviour, although such processes undoubtedly occur sometimes on an informal basis, especially in Western Australia and Queensland where police exercise a discretion to test. Once a driver is pulled over it seems that no record checks are run on a routine basis (licences used to be checked routinely in New South Wales), and no equipment checks are conducted.

Mobile RBT was introduced in New South Wales in late 1987, and has been permitted in Queensland since RBT legislation was introduced (although figures are kept in terms of individual and team testing, which does not appear to equate exactly to mobile and stationary testing). No formal distinction is made between stationary and mobile testing in Tasmania and Western Australia. Under mobile testing, police are authorised to pull over any motorist at any time, regardless of their manner of driving or whether they have committed an offence or been involved in an accident. Currently about 15% of random tests in New South Wales are conducted through mobile operations, which is about 50% higher than in 1989 (Homel, 1990; NSW Police Service Technical Support Group, 1996). The rate of mobile testing in Queensland is double the New South Wales proportion, at 33.1% since 1991 (Watson, Fraine and Mitchell, 1995), and has also been rising in recent years.

Once a motorist is pulled over, mobile RBT operates in much the same way as stationary RBT. Drivers returning a negative breath test result are not detained and usually drive away after a delay of less than a minute. Drivers who test positive during the preliminary screening (i.e., register over .05 g./100 ml. of blood) are detained for a formal breath analysis for evidentiary purposes, either at a police station or (if a booze bus is being used) at the roadside. The percentage of "positive tests" varies depending on the state and the mode of enforcement, but (as illustration) is of the order of 3% for mobile testing in Queensland and New South Wales, and 0.35% for stationary tests in New South Wales and 1.4% in Queensland (Watson, Fraine and Mitchell, 1995).

Random breath testing is a very pure expression of the theory of general deterrence, described in detail by Homel (1988). An updated model of general deterrence applied to drinking and driving and located in the more general context of the *rational choice perspective* is presented by Homel (1993). The power of the technique lies in its ability to increase the average motorist's perceived likelihood of apprehension for drinking and driving because of the apparent ubiquity and unavoidability of the police checkpoints. Central to its success is its visibility and the certainty of being tested once pulled over, no matter how clever a driver feels he or she is in concealing the effects of their intoxication. Viewed in this light, the weaknesses of mobile testing and of stationary RBT with discretionary testing are apparent.

As an enforcement tool, RBT stands in marked contrast - at least in theory - to the roadblocks or random stopping programs that, prior to 1989, were used in Western Australia and Queensland. ("De facto RBT" through roadblocks began in Western Australia in November 1980 and in intensified form since July 1987, while RID - "Reduce Intoxicated Driving" - began in Queensland in August 1986.) The critical difference is that when the roadblocks were in use, only motorists who were judged by police to have been drinking were asked to take a breath test, and these drivers were fewer than ten percent of those pulled over (Watson, Fraine and Mitchell, 1995). The failure to test all drivers under RBT in these two states can to some extent be understood in the light of the previous enforcement regimes. Despite the obvious shortcomings of roadblocks as a deterrent measure, it is interesting to note that there is some evidence that they did result in a reduction in accidents. For example, Watson, Fraine and Mitchell suggest that RID in Queensland may have been associated with a drop of about 24% in alcohol-related fatalities, compared with a drop of 29% when RBT was introduced. By contrast, Loxley and Smith (1991) could find little evidence on the basis of a survey of 500 drivers that random stopping in Western Australia was an effective deterrent.

Many studies have been conducted on the effectiveness of RBT in reducing accidents, with the general conclusion that RBT does indeed work, primarily by increasing the perceived probability of apprehension and by reinforcing the role of informal (non-legal) sanctions against drinking and driving. This finding is consistent with the limited literature on "sobriety checkpoints" in the United States, which are similar to the roadblock systems used formerly in Western Australia and Queensland, although as Ross (1994) notes in a comprehensive review there are very few evaluations of the checkpoints that are methodologically strong enough to sustain the argument that they achieve major deterrent effects. Neverthless, as noted by Homel (1988; p. 111), it still remains an open question as to whether enforcement blitzes utilising roadblocks could achieve as much, or nearly as much, accident reduction as RBT, especially if combined with intensive publicity.

Studies of RBT and other drink-driving deterrent measures conducted internationally prior to 1987 are reviewed by Homel (1988),who also reports the results of time series and other analyses of Australian accident and survey data that were available at that time. As noted in that book, it is somewhat surprising that so few formal time series analyses of accident data were completed during the 1980s in Australia, given the common use of such techniques with accident data by US researchers (e.g., Ross, 1981/82).

A regression analysis of New South Wales data by Thomson and Mavrolefterou (1984) suggested that economic factors were quite important in influencing accident rates, and that the impact of RBT might be short-lived. An interrupted time series analysis a year later carried out by the Traffic Authority of New South Wales (Arthurson, 1985) claimed a significant reduction in fatalities that was sustained till the end of 1985, although no details of the analyses were provided. A later analysis of weekly accident data by Homel, Carseldine and Kearns (1988) utilising cumulative sum techniques but not incorporating any controls for economic or other factors led to the conclusion that RBT in New South Wales did have a marked impact on accidents, particularly alcohol-related accidents. They estimated a 36% drop in alcohol-related accidents relative to the three years prior to RBT, and suggested from the shapes of the CUSUM graphs that apart from occasional signs of a diminution in effectiveness (especially during 1983, when the slopes of the alcohol-related accident graphs briefly returned to the horizontal) RBT had sustained its impact. These conclusions were supported by data from a series of surveys carried out in New South Wales during the 1980s.

Homel (1994) published a further time series analysis for New South Wales, based on *daily* fatal crash incidents occurring between July 1975 and December 1986. The aim of the study was to evaluate the effects of 14 road safety interventions introduced at different times in the 12-year period. As well as RBT, these included the .05 law introduced in December 1980, a variety of other drink-driving countermeasures, and non-alcohol measures such as the 100 km/h speed limit introduced in July 1979. On the basis that daily accident data follow a Poisson distribution, log-linear methods were used to model the effects of these interventions and also to explore the effects of the day of the week and holidays. The validity of this type of analysis depends critically on residuals not exhibiting evidence of autocorrelation, a condition that was satisfied at all time lags investigated. It was found that RBT immediately reduced fatal crashes by 19.5% overall and by 30% during holiday periods, and that the .05 law reduced fatal crashes by 13% on Saturdays (significant effects were not found for other days of the week).

The most recent time series analysis for New South Wales is a study conducted by Stanislaw (1996) for the Roads and Traffic Authority. This study used regression/analysis of variance techniques to analyse monthly data on persons involved in accidents (rather than crash incidents) between 1976 and 1992. Alcohol-related crash involvement was measured by constructing the ratio of motorists who crash during “drinking hours” to motorists who crash at other times. This involves the ratio of two Poisson variables, the residuals from which in a regression analysis are approximately normally distributed. Variables incorporated in the analysis include other legal interventions (such as the .05 law), the unemployment rate (by age and sex), location (Sydney/other), age and sex, and accident severity. Since the analysis was based on regression techniques and only first order autocorrelations were investigated, it is not clear whether the problem of serial correlation was dealt with adequately in the study.

Consistent with Homel (1994), the only legal interventions that were found to influence the odds of drinking-hour accident involvement were the .05 law and RBT. The odds of drinking-hour accident involvement appeared to have remained "essentially unchanged" since RBT began, which led the author to conclude that the reduction in drink-driving since 1982 cannot be attributed to changes in economic conditions. He also concluded on the basis of the unchanged odds that since the number of random breath tests each year has more than doubled since 1982, drinking drivers are more responsive to publicity campaigns than to actual levels of enforcement. He conjectured that "... it may be possible to scale the level of breath testing back to 1983 levels with no deleterious effects." (p. 2).

A number of other time series analyses have been conducted in recent years. Henstridge (1990) assessed the impact of RBT in Western Australia after one year, using daily accident data. He used log-linear methods similar to Homel (1994), but his analyses were superior in that seasonal effects were modelled using a Fourier representation of the seasonal components; rainfall and temperature data were incorporated as controls; and measures of the intensity of police enforcement were included. Autocorrelations between residuals were also thoroughly investigated and found to be insignificant in magnitude. The conclusions from the study were not strong, since the post-RBT data were very limited. Fatal accidents showed no effect of RBT, but there was a strong suggestion that metropolitan night-time accidents had been reduced, with approximately 0.11 fewer accidents per night.

Time series methods have also been extensively used in Victoria to evaluate the impact of an RBT initiative in the 1989-91 period that involved intensive publicity and the replacement of car-based stationary operations with highly visible "booze buses." Two methods were used: quasi-experimental time series (Drummond, Sullivan & Cavallo, 1992) and multivariate time series (Cameron, Cavallo & Sullivan 1992). In both approaches "treatment groups" in metropolitan and rural Victoria were compared with comparison groups in Sydney and rural Victoria. In the quasi-experimental approach, exponential and Auto Regressive Moving Average (ARIMA) forecasting models were developed for each area to provide the best prediction, taking into account pre-intervention and long-term trends and seasonal effects, of the incidence of crashes that would have occurred if the initiative had not taken place. These predictions were compared with actual crashes post-intervention over a one year period. The multivariate approach was closer to the methods used by Henstridge (1990), since it involved explicitly modelling the effects of some exogenous factors, such as the unemployment rate, and permitted statistical assessment of effects in post-intervention periods longer than 12 months.

The conclusion of both studies was that the RBT initiative reduced fatal crashes in high alcohol times of the week in Melbourne during 1990 by around 19-24% relative to what was expected (Cavallo & Cameron, 1992). Serious casualty crashes in high alcohol times in rural areas around Melbourne were reduced 15% relative to other rural areas where the RBT initiative was expected to have had a minimal effect. The studies differed in their estimates of the impact of the RBT initiative on Melbourne serious casualty crashes at high alcohol times.

A number of methodological problems made it impossible to disentangle the effects of enforcement and publicity in the Victorian analyses. These included measurement difficulties and multicollinearity between enforcement, publicity and seasonal factors. However, in a separate study Cameron and Newstead (1994) assessed the impact of cumulative awareness of advertising using multivariate regression models that included monthly unemployment rates, numbers of random breath tests, an index of alcohol sales, a measure of publicity, seasonal variation, and long-term trends. The research found clear links between levels of publicity supporting the drink-driving and speed enforcement programs and reductions in casualty crashes, holding other factor constant.

Apart from some cumulative sum analyses carried out by the Queensland Department of Transport, the only time series analysis reported for Queensland is by Watson, Fraine and Mitchell (1995). As part of an evaluation of the efficiency and effectiveness of RBT in that state, they used regression discontinuity techniques to estimate the effects of the .05 law (January 1983), the RID program (July 1986), and RBT (December 1988). The analysis involved comparison of the slopes of four regression lines corresponding to the four "time segments" created by these interventions in the period 1979 to 1993. Alcohol- and non-alcohol-related driver/rider fatalities were used as the outcome measures. The authors concluded that all the interventions were associated with significant reductions in fatalities, although there was evidence that the initial impact of RBT was not being sustained.

The Present Study

A number of useful conclusions can be drawn from the Australian time series analyses conducted in the past ten years. Perhaps the most important of these is that RBT initiatives in various states are nearly always associated with reductions in fatalities and serious injuries, no matter which precise methods of analysis are used. However, it is clear that accurate estimates of the magnitude and duration of effects require sophisticated models that control in some way for extraneous factors, either through explicit modelling procedures or through the use of control series or comparison areas. It is also clear that measurement problems are encountered at all levels, and that due to marked seasonal effects and high correlations over time, the separation of the effects of economic factors, enforcement variables, and publicity is very difficult.

In terms of policy relevance, the studies certainly suggest that RBT has been successful and should be continued, although they also suggest that the precurser to RBT in some states - random stopping programs in which only a minority of drivers pulled over were tested - may have been surprisingly successful. It is important to know how the impact of RBT can be enhanced, and in particular whether the levels of police enforcement can be scaled back without deleterious effects, as one recent study surmises. To this end it is critical that estimates of the size and duration of the initial impact of RBT be determined as accurately as possible, together with estimates of the effects of ongoing police enforcement. To withstand challenge, analyses should also control for weather conditions, which are known from Henstridge's (1990) research to have a large impact on accident frequency; for seasonal effects; and for economic variables such as unemployment rates that appear from several studies (e.g., Cavallo & Cameron, 1992) to have a strong bearing on travel frequency and accident numbers.

For reasons stated by Homel (1994) and by Henstridge (1990), accident data should be at the lowest possible level of temporal disaggregation. Change in a time series is not evidence of causality unless the change can be detected in the first post-intervention observation, and so daily data are the ideal (and most natural) unit for analysis. A further major advantage of daily data is that weather conditions and type of day can be controlled.

The present study incorporates and improves on many of the controls referred to in previous studies, especially since it is based on the use of daily accident data. A fundamental feature of the design is a comparison of four states, two of which can be described as *revolutionary* in their approach to RBT, and two of which can be described as *evolutionary*.

New South Wales and Tasmania both introduced RBT at nearly the same time in a "boots and all" fashion (Homel, 1990), in the sense that RBT did not follow a period of "de facto" RBT and was enforced intensively once it was introduced. The major difference between the two states, particularly in the early years, was in the level of publicity surrounding RBT. New South Wales spent millions of dollars on media publicity, while Tasmania spent virtually nothing, relying on press coverage and "word of mouth."

Western Australia and Queensland introduced RBT much later than Tasmania and New South Wales, and in both states RBT represented a development of the earlier de facto programs rather than being an entirely new form of enforcement. In Western Australia, for example, the change from de facto to full RBT was to some extent a change in the nature of police effort, not an increase in effort. In fact hours devoted to enforcement dropped slightly, with police seeing RBT as a mechanism that allowed them to be more efficient at doing the same job. In addition, the "evolutionary" states did not devote the same level of resources for enforcement and publicity as the "revolutionary" states.

The major differences between Queensland and Western Australia lie in the quality of the available data and the greater rural population in Queensland, making it useful to include both states in the study, and to separate metropolitan and rural populations if possible. Apart from the rural factor, similar results would be expected for Queensland and Western Australia, whereas the smaller size of Tasmania and its failure to publicise RBT in a systematic way would lead one to predict a more substantial impact of RBT in New South Wales. These predictions do of course require testing.

There are some further advantages in selecting these four states for intensive analysis. New South Wales has already been the subject of considerable research, but the size and duration of the impact of RBT is still uncertain. Very little work has been conducted in Tasmania, and given the intensity with which RBT has been enforced in that state a rigorous time series analysis is long overdue. Similarly, the relative impacts of de facto RBT and full RBT in Western Australia and Queensland have not been assessed in rigorous time series analyses incorporating appropriate controls. Finally, while Victoria and South Australia could profitably have been included in the study, considerable research has already been conducted in both states (time series analyses in Victoria and random roadside surveys in South Australia - McLean et al., 1984), suggesting that the limited resources available for the study should be devoted to other parts of the country.

In summary, the major research questions addressed by the present study are as follows:

(a) What are the size and duration of the impact of RBT in the "revolutionary" states that introduced RBT "boots and all" (New South Wales and Tasmania) and in the "evolutionary" states that introduced de facto RBT before full RBT (Queensland and Western Australia)?

(b) Did the small state of Tasmania achieve a similar impact as New South Wales with similar approaches to enforcement but markedly different levels of media publicity?

(c) What have been the effects of ongoing RBT enforcement on accidents?

(d) What have been the relative effects of de facto and full RBT in the "evolutionary" states?

CHAPTER 2. METHOD

This chapter reports the methods used for the time series analyses for the four states included in the study: Western Australia, Tasmania, New South Wales and Queensland. Using accident data over as long a time period as possible, the aim of the analyses was to measure the short-term and long-term impacts of RBT and to explore some of the reasons for its apparent success or failure, especially in the light of differences that might emerge between the states.

A particular focus was on the quantification of police enforcement activity devoted to RBT, taking advantage of the natural variation that takes place over time within a jurisdiction, and between jurisdictions. In order to assess validly the accident-reduction effects of higher or lower levels of enforcement, it is essential that as many other influences on accident rates as possible be controlled. These include rainfall, seasonal patterns, type of day (e.g., weekends and public holidays), economic activity, and road usage. Measures related to all these factors were included in the analyses.

Ideally media publicity devoted to RBT or to drinking and driving issues should also be quantified and analysed for its independent impact on accidents, but in order to do this it is important to know precise dates on which advertising appeared and to have some method for measuring the quantity and intensity of the publicity, and the types of media used. Although extensive attempts to collect these types of detailed data were made, the resulting information was generally too poor in quality to permit its inclusion in the time series analyses. It is not possible therefore to draw any conclusions from the present study about the effects of RBT publicity independent of enforcement effects.

Accident Data

RBT was introduced at different times in the four states. New South Wales was first on 17 December 1982 (although it lagged Victoria by six years), then Tasmania soon after on 6 January 1983. It was a few years before the other two states followed suit - Western Australia on 1 October 1988 and Queensland on 1 December 1988.

For each state accident statistics were obtained for as many years as possible prior to the introduction of the legislation. The aim was to attempt to establish a trend in accident numbers and thus better identify the effects of the implementation of RBT. Thus data were used from 1976 for New South Wales, 1977 for Tasmania, and 1980 for Western Australia and Queensland. Since the accident data for Tasmania were obtained in the initial stages of this project, accidents up to the end of 1991 were available for this state. For the other three states data up to the end of 1992 were used. The result is 15 years of data for Tasmania, 17 years for New South Wales and 13 years for each of Western Australia and Queensland.

Accidents, rather than persons involved in accidents, were the focus of analysis. Thus even if two or three people were killed or injured in a single crash, that incident was counted as only one accident. This approach has many technical advantages that are described below in the discussion of statistical methods, especially the fact that daily rather than monthly data can be used, with all the advantages that accrue due to the introduction of controls such as daily rainfall figures. However, the use of accident data does have the disadvantage that the characteristics of accident-involved persons, such as age and sex, do not feature explicitly in the analyses. For a recent analysis of New South Wales data that includes such factors, see Stanislaw (1996).

Fatal accidents or accidents which led to serious injury resulting in the hospitalisation of at least one person involved in the accident, were considered. Such accidents will be referred to as "serious" accidents in this report. Only such accidents were used since hospitalisation was seen as a reasonably accurate cut-off point which would avoid problems of definition of types of accidents over time and would also ensure uniform coverage since all such accidents are reportable by law. In addition, of course, alcohol is implicated more often in serious than in minor accidents, justifying a focus on injury accidents (Evans, 1991).

The accidents targeted by RBT legislation are alcohol-related and ideally numbers of serious alcohol-related accidents should be analysed. Unfortunately information on blood alcohol levels of drivers is often either unreliable or not available, especially for accidents which occurred in the earlier years of the study (see O'Connor and Trembath, 1995 for a detailed analysis of this problem in the Australian context). A solution is to look at the types of accidents that are accurately recorded and are thought to have a high probability of being alcohol-related, such as single-vehicle night-time accidents. However for some states the numbers of such accidents are simply too low for meaningful analysis, and the ability to detect important effects of exogenous factors on accident numbers is greatly diminished.

For these reasons, analyses on different groups of accidents were carried out for each state. All serious accidents were considered, and then wherever possible serious single-vehicle night-time accidents and fatal accidents were distinguished. Fatal accidents are important due to the loss of life involved and the prevalence of alcohol as a causal factor, but they have the major statistical disadvantage that the power of time series analysis is diminished due to the relative rarity of fatalities. Single-vehicle night-time casualty accidents also suffer from the disadvantage of lower statistical power. In New South Wales, some other measures of alcohol-related accidents were also explored to facilitate the interpretation of the impact of RBT in that state.

Full details of accident data accessed and used for each state are set out in Table 2.1.

Enforcement Variables

In addition to testing for effects due to the introduction of RBT, the effects of some alcohol-related legislation or police campaigns were investigated. For example in Western Australia and Queensland a form of de facto RBT was in operation for a period prior to formal RBT, and in New South Wales the legal blood alcohol limit was lowered from 0.08 to 0.05 g/100ml two years prior to the introduction of RBT. Previous time series research by Homel (1994) using New South Wales data suggested that RBT and the .05 law were, out of some 14 countermeasures tested, the road safety initiatives that had the major impact on accidents, and so the present study is focused on variables related to these kinds of measures.

RBT enforcement statistics were also obtained for each of the four states. The data typically comprise numbers of vehicle stopped in RBT operations or the numbers of drivers tested, and may be kept on a daily, weekly or monthly basis. Since this information is obviously only available after the introduction of RBT, for most states separate analyses were carried out on the post-RBT data to determine the effects of levels of enforcement on road accidents.

Full details of RBT enforcement data accessed and used in the analyses are set out in Table 2.2 (overleaf). As can be seen from the table, the amount of information available varied from state to state. Ideally enforcement data would be available on a daily basis, and would be broken down by such factors as time of day, region, and type of RBT (e.g., mobile or stationary), but no state was able to supply this level of information (although Tasmania did record time-related data on a daily basis). This means that only limited inferences can be drawn from most analyses about whether the impact of RBT could be enhanced by, for example, testing more at nights or in country regions.

A further concern is the quality of recorded data. Officers in every state were ready to cite on an informal basis instances where data had been manufactured or exaggerated, and so strenuous efforts were made to check the validity of published tables. The presence of some gaps and apparent errors in most states led to the decision not to attempt the analysis of indicators of enforcement activity that could not be reasonably defended in terms of reliability. In other words, preference was generally given to summary indicators which would be less seriously affected by errors than indicators based on detailed breakdowns of the data.

Table 2.1: Traffic Accident Data Accessed And Used in Analyses

	NEW SOUTH WALES	TASMANIA	QUEENSLAND	WESTERN AUSTRALIA
ACCIDENT DATA ACCESSED	1976-1992 daily accidents Sydney/other Metro/country day/night fatal/serious Single vehicle/other Alcohol related	1977-1991 daily accidents North Tas metro/country South Tas metro/country fatal/serious single vehicle/other night/other	All serious accidents in Qld 1980-1992 All serious accidents Bris./Gold Coast 1986-1992 Single vehicle night time serious accidents in Qld 1986-1992	1980-1992 daily accidents single vehicle/other fatal/serious day/night Metro/country
DATA USED IN MAJOR ANALYSES	NSW fatal and serious accidents 1976-1992 (separately) NSW serious single vehicle night time accidents 1976-1992 NSW daytime vehicle-vehicle 9am - 3pm school day accidents 1976-1992	All serious accidents 1977-1991 for Tasmania excluding the north-west All serious accidents Launceston 1984-1991 All serious accidents Hobart 1988-1991	All serious and fatal accidents in Queensland 1980-1992 (separately) All serious accidents in Brisbane and Gold Coast 1986-1992 Single vehicle night time serious accidents in Qld 1986-1992	Fatal/serious accidents WA (separately) 1980-1992 Fatal/serious accidents Perth (separately) 1980-92 Single vehicle/night time serious accidents WA 1980-1992 Single vehicle night time serious accidents Perth, 1980-1992 and RBT period only (separately)
SOURCE	Roads & Traffic Authority Road Safety Bureau	Department of Roads and Transport	Queensland Transport	Department of Main Roads

NOTE: "Serious" accidents include fatal accidents.

Table 2.2: RBT Police Enforcement Data Accessed And Used

	ENFORCEMENT DATA ACCESSED	VARIABLES USED	COMMENT
NEW SOUTH WALES RBT introduced December 1982	All operational regions Monthly data from 1/83 Regional data from 1/86 General duties from 12/86 Regional / GD /stat / mobile from 11/87 HWP tests / HWP +ve GD tests / GD +ve	Total monthly numbers of all types of tests for all of NSW	Data accessed in hard copy and computer format Assessed as relatively accurate
TASMANIA RBT introduced January 1983	2/3 operational regions North South pre regionalistion Oct 1992 Daily data North 1984-1991 South 1987-1991 Nos tested/nos charged country/metro 8am-4pm 4pm-midnight midnight-8am	Numbers tested Country/metro/ North/South 8am-4pm 4pm-midnight midnight-8am	Data accessed manually, pieces missing No distinction made between stationary & mobile testing
WESTERN AUSTRALIA RBT introduced October 1988	All operational regions October 1988-1992 Weekly data	Total vehicles stopped in W A Total vehicles stopped in Perth Total officer hours in WA and Perth	Data available in hard copy, Doubt about accuracy of testing rates No distinction made between stationary and mobile tests
QUEENSLAND RBT introduced December 1988	All operational regions Monthly data December 1988-1990 Nos tested/nos +ve Jan 1991- June 1992 Nos tested individual and nos tested team / nos +ve Nos locations utilised 10/91-6/92 Special Purpose Vehicle (SPV)	Total numbers of tests in Queensland and in Brisbane	Most data available in hard copy Data inaccurate - Sometimes tests recorded twice, as both individual and team SPV data sometimes recorded twice

Weather Information

Daily surface climate data were obtained from the Bureau of Meteorology, National Climate Centre, Victoria. Of most importance (and one of the motivations for doing the analyses on a daily basis) was rainfall. Minimum and maximum daily temperatures were also included as well as a range of other conditions such as whether fog, a thunderstorm or strong winds had occurred on the day. These data are most meaningful for regions or cities, especially in the geographically large states, and for that reason sometimes weather data for the capital city were used as a surrogate measure for the state. However, a variety of methods of matching weather data to the regions being analysed were used, and details are presented with the results.

In general the information on storms and the like is not particularly usable, giving little information above that provided by rainfall. Note that rainfall is conventionally recorded for the 24 hour period up to 9.00 am on the day. Hence the *next* day's rainfall is frequently more significant than that recorded for the day itself.

Road Usage and Economic Indicators

The variables used are summarised in Table 2.3.

Table 2.3. Road Usage and Economic Indicators Used in the Time Series Analyses

Variable	Available	For	Measurement Units
Petrol sales	monthly	states	Megalitres
Petrol production	monthly	Aust.	Megalitres
Vehicle registrations	annual	states	x 1000 vehicle
Drivers/riders licences	annual	states	x 1000 licences
Unemployment rate	monthly	states	Percentage
GDP figure	quarterly	Aust.	$million, 1984-85 prices
Household disposable income	quarterly	Aust.	$million, 1989-90 prices
Private alcohol expenditure	quarterly	Aust.	$million, 1979-80 prices

The first four variables are indicators of the numbers of kilometres travelled and of the number of vehicles on the road. The last four variables are indicators of economic conditions that could be expected to influence accident rates. In order to convert these data from monthly, quarterly or annual to daily data, linear interpolation was used.

In addition all series, other than the annual data, were seasonally adjusted. The GDP figures were at average 1984-85 prices, household disposable income at average 1989-90 prices and private alcohol expenditure at 1979-80 prices. Thus all variables in dollar terms were at constant prices.

Unfortunately figures for petrol sales are only available from 1978 and thus use of this variable in the analyses implies only using accident statistics from 1978. Therefore if petrol sales were found not to be significant in the Tasmanian and New South Wales analyses (using post-1978 data) they were not retained in the models in order to avoid shortening the series. Other adjustments were made for statistical reasons; for example, when vehicle registrations and drivers/riders licences were highly correlated, only one was used.

Time trends for the four variables available on an Australia-wide basis are set out in Figures 2.1 to 2.4. It is interesting to note that private alcohol expenditure began to trend downwards after about 1982, when RBT was introduced in New South Wales, which suggests that to some extent the trend may have been caused by the sudden and massively publicised introduction of RBT in the most populous state. If this is the case, perhaps it is inappropriate to include alcohol consumption as a control variable, since the real impact of RBT would be under-estimated. That this is a likely outcome is supported by the analyses of Homel (1988) and Homel, Carseldine and Kearns (1988), which suggest that RBT in New South Wales did have an impact on alcohol consumption.

Time Factors

This is a loose term referring to seasonal terms; day of the week; and type of day.

Different numbers of accidents occur at different times of the year and on different days of the week. Accidents occur at a disproportionate rate on Friday and Saturday nights. Furthermore differences may occur between public holidays or long weekends, school holiday periods and other times of the year. The variable for the type of day takes account of differences between different times of the year. The day before a public holiday or long weekend was included in the holiday period since it is likely that many people will travel on these days.

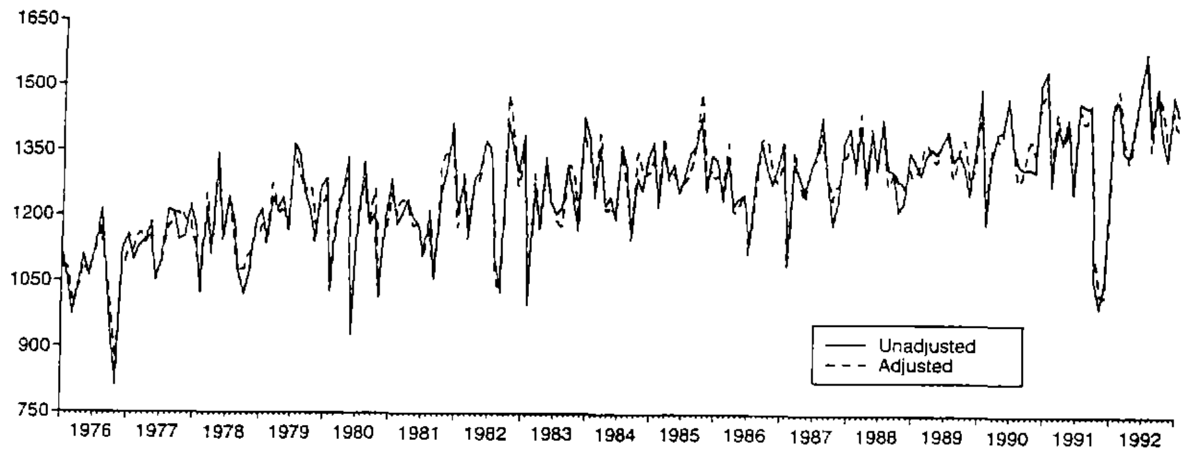

Figure 2.1. Petrol Production in Australia (megalitres)

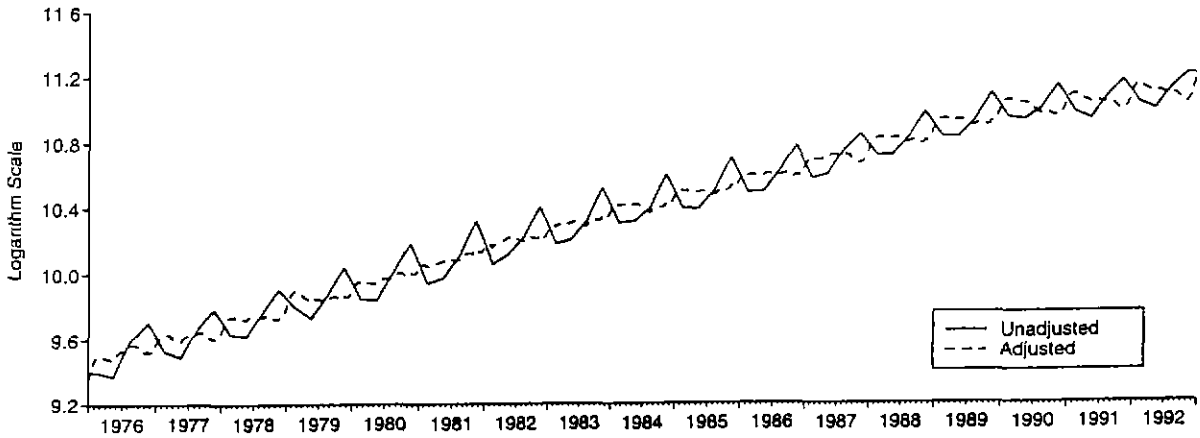

Figure 2.2. Household Disposable Income - Australia ($million, 1989-90 prices)

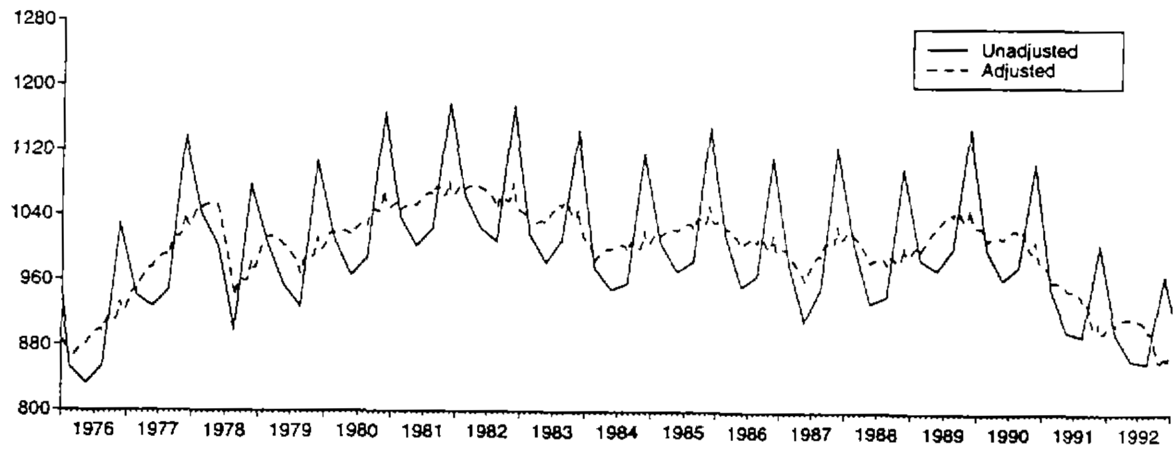

Figure 2.3. Private Alcohol Expenditure in Australia ($million, 1979-80 prices)

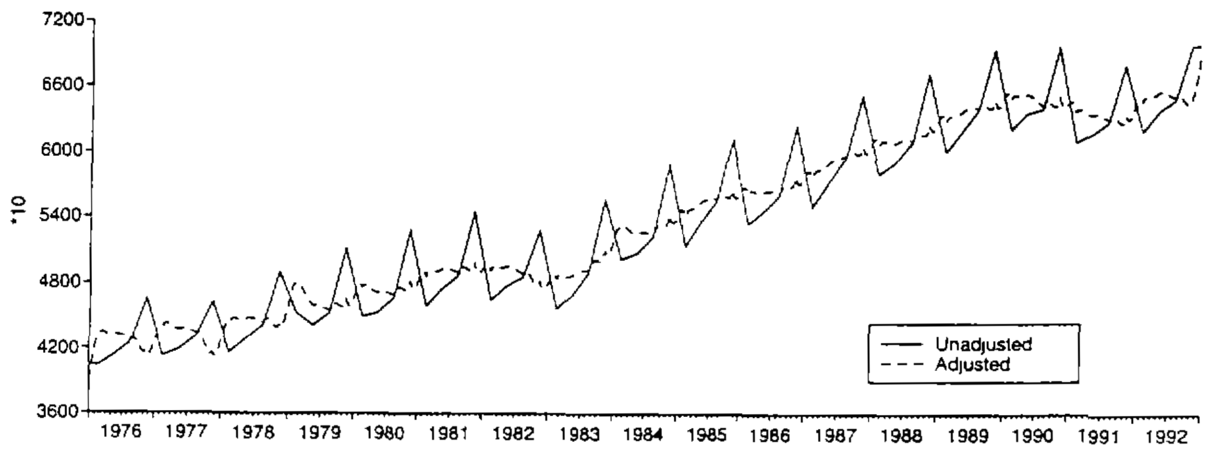

Figure 2.4. Australian Gross Domestic Product ($million, 1984-85 prices)

Publicity Campaigns

Media campaigns targeting drink-driving and in particular RBT are aimed at modifying driver behaviour and reducing accident numbers. In theory the effects of publicity campaigns can be estimated by comparing accident rates in periods where such campaigns were run with periods when there was no publicity. In practice this process is not practical since in most states the tendency is to run media campaigns in periods when high rates of accidents occur, for example at Christmas and Easter.

Ideally two similar states should be compared over the same period during which there is an intensive campaign in one but not in the other, but in practice this never occurs. The outcome is that media campaigns are confounded with seasonal effects, producing an inherently difficult statistical problem. The statistical problems are compounded by the short duration of most campaigns, corresponding to relatively small numbers of accidents and hence low statistical power.

A further complication is that information on media campaigns is often sketchy. A great deal of time and energy was expended in collecting information from each state, with the results as summarised in Table 2.4. It is apparent that in every state data on campaigns were either incomplete, described only in general terms, or were not sufficiently detailed in terms of dates and intensity to warrant inclusion in the analyses. The most complete information was available for New South Wales (summarised in Appendix 1), but even for this state insufficient data were available for useable results. When crude measures for New South Wales were included in some analyses on an experimental basis the results were counter intuitive, with campaigns apparently increasing accident rates. This of course reflects the effects of confounding with seasonal effects and a lack of statistical discrimination due to the inadequacy of the data.

For these reasons data on publicity were not included in the formal time series analyses.

Table 2.4: RBT Publicity Data

	PUBLICITY DATA	DETAILS	PROJECT USE
NEW SOUTH WALES	**1. RTA, NSW and MUARC, VIC Summary document** NSW Road Safety related publicity campaigns 1983 - 1992	1. RBT data includes name of campaign, approx duration, principal medium & other media used, expenditure in principal medium & total cost of campaign, evaluation	1. Data specifying the exact time campaigns were run was not kept, so information not able to be included in the time series analysis. Information used in qualitative analyses. For more details see Appendix 1.
TASMANIA	**1. ABC Television News and Current Affairs,** News items 1975 - 1992 relating to drink/driving issues **2. Transport Tasmania** Road Safety public awareness campaigns 1978-1992 **3. 'The Mercury'** Drink/driving & RBT news items 1974 - 1992	1. No details 2. Drink driving/RBT content, medium and expenditure 3. Accessed description of each article, content, size, page no, picture personality	1. Incomplete, items not individually accessed, unable to distinguish between drink-driving & RBT focused items 2. Not used for data analysis since no date-specific information; RBT & drink-driving not distinguished. Used in qualitative analyses. 3. Used in qualitative analyses; shows increasing levels of attention to drink-driving issues
QUEENSLAND	**1. Queensland Transport** Drink driving publicity campaigns 1986 - 1993	1. Brief report - focus, title, approx. duration, principal medium & other media expenditure	1. Informs qualitative analyses
WESTERN AUSTRALIA	**1. Newspaper articles** from the West Australian, Daily News, Sunday Times between 1986 - 1990 **2. Report.** Daniels, R., Maisey G.(1991/1992) *Road Safety Promotion in Western Australia* , prepared for Western Australia Police Department	1. Newspaper articles, main story drink driving and/or RBT. Assigned ranking according to prominence 2 Brief discussion of 1990/1991 Road Safety Awareness Campaigns includes focus, media, expenditure, approximate duration	1. Newspaper articles not used, incomplete for the time period. 2. Informs qualitative analyses

Statistical Method

Modelling daily accident counts

Daily counts of accidents were analysed in preference to aggregated data such as monthly counts. The following factors are of importance when predicting numbers of accidents:

- weather, particularly rainfall;
- the day of the week;
- the type of day, for example a public holiday; and
- time of the year such as holiday periods.

These factors can easily be taken into account in analyses using daily data. It is also possible to test for lag periods of different lengths for the effects of explanatory variables, in particular enforcement statistics. None of the above can be managed effectively by analysing monthly accident statistics. Moreover, road accident data are naturally in the form of counts. Provided that accident numbers are analysed (not numbers of fatalities, injured persons or vehicles) each unit being counted is in some sense independent, so a Poisson distribution model is appropriate (McCleary and Hay, 1980). In addition, since the rates of accidents are being modelled, a multiplicative structure is appropriate, which means that factors affect the rates by proportionally increasing or decreasing them.

These two features of the data suggest the use of log-linear models - a special case of generalised linear models (Nelder & Wedderburn, 1971). These have been popularised through the computer package GLIM which provides an interactive system for fitting the models by generalising standard regression procedures. For the current problem there is the additional time series aspect. Generalised linear models do not extend naturally to include auto-regression effects common with time series. They do provide a set of standardised residuals which can be used to check for the presence of autocorrelation but to include such correlation in a theoretical model is not practical.

The approach taken here was to use explanatory variables such as the weather and seasonal trends to remove autocorrelation from the residuals. The model fitting was done in a custom modification version of the time series package TSA-32 which implements algorithms identical to those in GLIM (Henstridge, 1994). The use of TSA-32 meant that it was possible to monitor the time series aspects. In particular, residual autocorrelations were reviewed for every fitted model.

The precise means of modelling the effect of RBT was only derived after some investigation of alternatives. Ideally the method would be to have a time series model with an autoregressive filter for the RBT input. This would allow for the magnitude and duration of the RBT effect to be estimated directly. However when using daily data this method is numerically unstable since the parameter for the autoregressive process would be very close to one, the boundary of what is allowable. In addition standard time series modelling software for fitting autoregressive transfer function models is not designed for Poisson variables.

Modelling the effect of RBT

Three separate components of the possible effect of RBT were identified for modelling purposes. These are useful from both the interpretive viewpoint and the data analysis methods.

- **RBT Introduction**. The publicity associated with the legislation for and introduction of RBT in a state can be expected to have an effect which is different in nature and magnitude from the ongoing effect. In addition the initial police enforcement procedures may take some time to settle down to a routine. Hence it is necessary to include a short-lived effect in the model.

  The most appropriate model for this component is an exponential decaying impulse function given by $b \exp(-t/\tau)$, where the parameter τ is an estimate of the duration of the initial impact and the parameter b is an estimate of the magnitude. While the value of b can be estimated through standard regression procedures, the estimation of τ is more difficult, potentially involving non-linear methods. The approach taken here was to choose the value of τ which minimised the deviance of the overall model. Note that τ is the time required for the initial effect to reduce to $1/e = 0.368$ of its original level b. Perhaps a more readily interpreted measure is the time taken to reduce to 5% of its original level. This is $3.0\ \tau$ (since $\ln(0.05) = -3.0$).

  The statistical estimation of this component is dependent upon having a period immediately following the introduction of RBT which is free of other major changes which may have an impact upon crash rates. For example, the introduction of .05 legislation in Western Australia after the introduction of RBT limited the ablility of the statistical analysis to distinguish between short term and on-going effects of RBT.

- **RBT Program - not enforcement related**. Once RBT is operating there might be an effect which does not directly relate to the level of enforcement but rather to the very existence of RBT. It would be a product of community awareness and of attitudes to the legislation, perhaps reinforced by regular publicity. This effect is expected to remain essentially constant once the RBT legislation has been introduced.

The mathematical approach to this component is to represent it as a step function $a\,I_t$ where

I_t = 0 prior to the introduction of RBT and
= 1 thereafter.

The parameter a measures the magnitude of this effect.

- **RBT Program - enforcement related**. The effect of RBT may also have a component which is directly affected by the level and nature of the enforcement process. As the level of enforcement changes, there might be a detectable change in the effect of RBT on crash statistics. This effect is potentially complex since there may well be time delays between enforcement and effect as well as cumulative effects over time. Furthermore the measures of enforcement used in each state are potentially very different, ranging from police officer hours through to numbers of drivers tested.

In the mathematical model the enforcement effect was defined as $c\ \mathrm{ar}(\gamma)\ E_t$, where E_t is a measure of the enforcement on day t and $\mathrm{ar}(\gamma)$ represents an autoregressive filter which smooths the effect and cumulates it over a period of time. The parameter γ, the autoregressive coefficient, measures the duration of impact of enforcement, while c measures the magnitude. The filter was of the form $Y_t = E_t + (1 - 1/\gamma)\ E_{t-1}$.

This model is equivalent to saying that the effect of enforcement is not restricted to the day or the week in which enforcement is carried out but is maintained with an exponential decay with a time constant γ. Putting this in more behavioural terms, γ can be used to estimate the period of time over which exposure to a specific RBT operation on a given day has an ongoing detectable impact on accidents, even if *all* RBT enforcement ceased when the operation concluded. The time constant γ was estimated empirically for each set of series.

Estimation of the ongoing effects of enforcement was done in the following manner. Firstly models were fitted to the data which included terms corresponding to levels of enforcement (such as number of drivers tested). Different lag times were utilised and an optimum time identified where applicable. Secondly a deviance analysis was carried out to determine the overall importance of the enforcement levels. Such an analysis implies comparing the deviance obtained from the model which incudes the enforcement terms with the deviance for the model which does not. This difference in deviances can be assumed to have a chi-squared distribution with degrees of freedom equal to the difference in degrees of freedom for the two models. Thus there is a means of testing whether enforcement levels have a significant effect on accident numbers.

The combination of these three components, together with a fourth component D representing the base number of accidents in the absence of RBT, can be represented as

$$\ln(\text{expected } A_t) = a\, I_t + b \exp(-t/\tau) + c\, \text{ar}(\gamma)\, E_t + D$$

where A_t is the number of accidents on day t. The model predicts the logarithm of the expected number of accidents, not the actual number of accidents. The term D takes into account seasonal, trend, road usage and economic factors.

The modelling process, excluding the enforcement-related component, is represented in Figure 2.5.

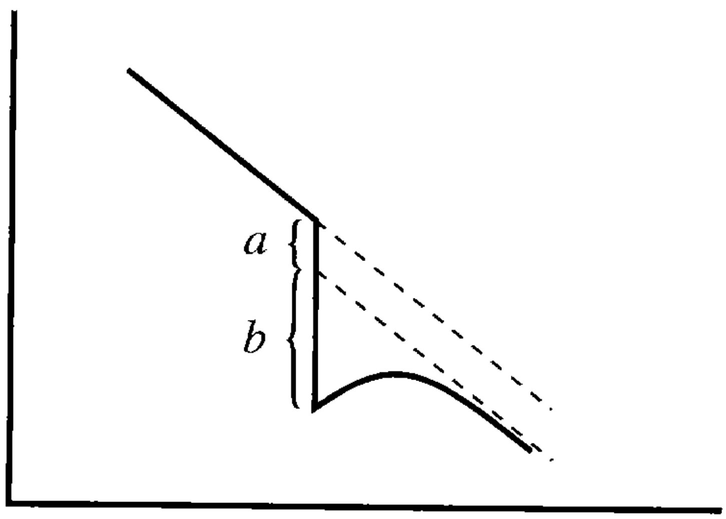

Figure 2.5. Modelling the RBT Introduction and Program Effects (Not Enforcement-Related)

- The initial impact of RBT is estimated by the sum of the coefficients in the model for the step function (a) and the exponential term (b). This corresponds to the value $a+b$ in the figure. The initial percentage reduction in accidents estimated from the model is given by 100*(1 - exp(a+b)).

- The dotted line represents the estimated numbers of accidents that would have occurred had RBT not been introduced - the *D* component. The curved line represents the curve fitted to the observed numbers of accidents under the model including RBT.

- The ongoing effect of RBT is measured by the value of *a*. (In addition but not represented in Figure 2.5 is the effect of the levels of enforcement on accident numbers (E_t). This effect is given by the coefficient in the model corresponding to the enforcement variable, namely *c*.)

- The area under the higher dotted line and above the curve represents the estimated savings in accident numbers due to the introduction and continued existence of RBT. These are calculated from the initial impact, the duration of the transient effect, and from the ongoing program effect. These estimated savings do not include savings related to the effects of the ongoing enforcement of RBT. The area between the dotted lines represents the savings due to the program effect alone.

- Fitted or predicted values from the model were used to estimate the number of accidents prevented by a specific countermeasure. For example, to estimate savings due to the .05 law (which was fitted in all models as a simple step function), fitted values from the model including the .05 term were determined for all days after the introduction of the law. These were summed, and then subtracted from the sum of fitted values for the model excluding the .05 term. The difference is the estimated accidents prevented. This can also be expressed as a proportion of the number of accidents that are predicted with the .05 term omitted, to produce an estimate of the percentage reduction in accidents. The same general approach can be used for other countermeasures such as RBT (which in some models was represented by three terms with three degrees of freedom), and to estimate accidents prevented in specific time periods, such as one year.

Despite the conceptual neatness of the decomposition of the impact of RBT into three components, it is important that the interpretation of the individual components not be pushed too far. All components are related to each other in complex ways, and in an actual analysis it may be hard to disentangle their effects. This will be particularly the case when both enforcement and program effects remain in the model. These are highly correlated over time, and in most cases should be interpreted jointly.

There is the additional problem that there is considerable error in the measurement of enforcement levels, which means that the coefficient *c* will tend to be under-estimated, and the coefficient *a* over-estimated (biased upwards). Thus in some analyses a positive program effect may appear, perhaps in combination with a smaller than expected enforcement effect. These problems are hard to avoid when poor quality data must be utilised.

Modelling the effects of other variables

All the explanatory variables were included in the models initially and then some were excluded until a suitable model was obtained. "Suitable" refers to a model thought to contain sufficient, but no more than necessary, explanatory variables to control for factors other than RBT that may influence accident numbers. Some of the variables are interchangeable in that they are thought to represent the same underlying factor. For example, numbers of licensed drivers and numbers of registered vehicles are highly correlated and thus only one is necessary in the model.

The effect of lowering the legal blood alcohol limit may be of a short-term or long-term nature (Homel, 1994). The difficulty in deciding how to model the effect is compounded by the fact that in the most populace state (New South Wales) the .05 law was introduced only two years before RBT, and it is not really possible to separate the ongoing effects of the lower limit from the effects of RBT. The simple approach was adopted of modelling the lowering of the legal blood alcohol as a step function, with the effect of RBT being calculated in addition to this factor. Campaigns such as de facto RBT in Western Australia and the RID campaign in Queensland were modelled in the same way but with the modification that their effects ceased after the introduction of RBT.

More precisely, the following indicator variables were used in Western Australia and Queensland:

Variable	*Indicator*	*Time period*
.05	0	pre .05
	1	post .05
RID or defacto RBT	0	pre RID/defacto RBT
	1	RID/defacto RBT, pre RBT
	0	post RBT

The correlation between the explanatory variables complicates matters enormously. It is due in the main to the fact that most of the economic indicators and road usage variables display long term trends. Thus it is extremely difficult to distinguish between the effect of the variable on accident numbers in reality and an apparent effect due to the variable as well as accident numbers changing slowly over time. A term estimating a linear trend over time is included in the models, but this is also difficult to separate out from the other effects. It is important therefore to interpret the coefficient of any variable which contains long-term trends in conjunction with other such variables. For example it is possible to obtain a positive coefficient for the linear time trend even though there may be a clear decrease in accident numbers over the years. However in such an instance the overall trend predicted by the model, using *all* the variables, would be negative.

In the modelling process a coefficient and standard error are estimated for each term included in the model. The importance of an individual explanatory variable is estimated by the significance of its coefficient. A large coefficient is indicated by a large t statistic value corresponding to a small p-value. Thus if the p-value is smaller than 0.05 the variable is significant at a 5% level of significance. For these models individual variables may not be significant, due to correlation between the explanatory variables, even though individually they may be significant predictors of accident numbers. As noted, certain variables are also retained in the models to control for any effect they may have. Therefore if any effects associated with RBT are found to be present, such effects are likely to be causally related.

Details regarding the variables included in the models are as follows:

- Six seasonal terms were included, representing a third order Fourier series model.

- The effects of days of the week were estimated in relation to a specific day which changed from analysis to analysis. If, for example, the relevant day is Tuesday then the coefficient for Saturday will often be significantly large indicating that significantly more accidents occur on Saturdays than on Tuesdays.

- Similarly the factor for the type of day was calculated with reference to days within the school terms.

- The road usage and economic indicator variables were all seasonally adjusted prior to their inclusion in the models and the variables in dollar terms are at constant prices.

- In some instances it was not possible to incorporate weather information for each specific area of a state. However the most relevant information was used.

The statistical significance testing procedure as implemented in the present study is naturally conservative, since it reflects only the component of the RBT effect that cannot be ascribed to any other causes. The control variables, such as economic indicators and time trends, are essentially monotonic over time, as is the introduction of RBT. This leads to a substantial correlation between the estimates of the coefficients of control variables and the coefficients of RBT variables. Moreover, as noted earlier, the inclusion of alcohol consumption as a control makes the estimation of

RBT effects especially conservative, since RBT may have achieved some of its impact through reductions in alcohol consumption.

This conservative approach is more likely to underestimate the long-term effect of RBT than the short-term effect. This reflects the reality that as time passes after the introduction of RBT the number of other road safety measures and exogenous influences on accidents increases, making it more difficult to be certain about the real causes of a sustained lowering of accident rates. The only way to overcome this problem would be to observe the effect of discontinuing RBT, an event that one would surmise is unlikely to occur.

Control series

The purpose of including economic and other factors in the analyses is to obtain a more accurate (although conservative) estimate of the "true" impact of RBT. Another way of establishing that RBT is causally related to observed declines in accidents is to analyse its impact on accidents that can reasonably be regarded as not being caused by alcohol. Such accidents constitute a "control series," and the prediction is that RBT would not be statistically significant in a model fitted to such a series.

In New South Wales it was convenient to develop a control series using vehicle-to-vehicle serious accidents occurring during school hours (9 am to 3 pm on school days). This is a suitable control since roadside surveys indicate that alcohol is infrequently present in the blood of drivers at such times (although drivers involved in serious accidents, even at such times, are more likely to be impaired) (McLean, Holubowicz & Sandow, 1980). For a variety of practical reasons, it was not possible in the other states to develop a suitable control series: either accident numbers were too few, or the detail required to isolate the series was not available in the data (see Table 2.5 for a summary).

Models used for each state

Whilst every attempt was made to use a consistent set of models across all series for all states, it was not always possible or appropriate to do so. There were several reasons for this:

- The data were not available in a consistent format for all states, particularly with respect to enforcement.

- The incorporation of too many related variables in a regression can lead to substantial problems of interpretation of estimated coefficients due to multicollinearity. Frequently this is avoided by presenting only models where all non-significant variables have been excluded. To adopt this practice in the present study would have led to even greater differences between models for each series, so a middle course was adopted where changes to models were made only where necessary to maintain statistical stability.

- The ability of statistical methods to distinguish between and measure the various components of the RBT effect is critically dependent upon the data. For example, if the level of enforcement over the period of RBT does not change significantly then it is not possible to estimate the enforcement-related component. This will lead to all the RBT Program Effect being classified as not being enforcement related while in practice part of it may be. In addition the Poisson nature of the crash data means that more detail can be reliably extracted for states where there are more crashes. Hence the most detailed analysis was obtained for New South Wales where the crash numbers were high due to the size of the state. Fortunately New South Wales also exhibited the most variation in enforcement levels, allowing a reliable estimate of the ongoing enforcement component of the model to be derived.

- It was not possible (for the reasons stated above) to include a control time series for Tasmania, Western Australia and Queensland.

Some of the key differences between the models employed for each state are summarised in Table 2.5.

Table 2.5. Key Features of the Models Fitted for Each State

State	*RBT Introduction (short-term effect)*	*RBT Program - Enforcement related*	*Control Series*
New South Wales	Fitted	Fitted using numbers of drivers tested. Autoregressive smoothing model with time decay period of 200 days estimated from data.	Vehicle to vehicle serious accidents, 9 am to 3 pm, school days
Tasmania	Fitted	Fitted only for separate Hobart and Launceston models, using number stopped with three week lag.	No control series, numbers too low for analysis
Western Australia	Not fitted - time series too short post-RBT, and the Introduction was affected by defacto RBT which preceded it.	Fitted only for single vehicle night time accidents in Perth post RBT, since country enforcement data were unreliable. Defacto RBT enforcement data not available/not comparable.	No control series, numbers too low for analysis
Queensland	Not fitted - time series too short post-RBT, and the Introduction was affected by defacto RBT (RID) which preceded it.	Not fitted - data inaccurate.	No control series, time of day and type of accident not available for period

CHAPTER 3. NEW SOUTH WALES

The size of the population in New South Wales leads to higher accident numbers than occur in any of the other states considered in this study. Thus it is possible to analyse groupings of accidents rather than simply considering all serious accidents, as is necessary for example in the case of Tasmania. All serious, fatal and serious single-vehicle night-time accidents which occurred between January 1976 and December 1992 were analysed. These data are displayed in Figures 3.1, 3.2 and 3.3.

As a control, accidents involving two vehicles between the hours of 9 am and 3 pm on school days were analysed. These data, which are displayed in Figure 3.4, acted as a rough surrogate for non-alcohol-related accidents, and ought not to be affected much by alcohol countermeasures such as RBT.

Poisson time series analyses, as described in Chapter 2, were used to fit models to the data. RBT legislation was introduced into New South Wales on 17th December 1982. This date was used to define the Introduction and Program Effects.

Numbers of drivers tested was used as the measure of the level of enforcement at a particular time. These data are available as numbers of tests carried out in stationary and in mobile operations by traffic police and by general duties police on a monthly basis for all of New South Wales. For the analyses, the monthly figures were converted to daily data by linear interpolation. Mobile RBT came into use in August 1987 although the records begin from October 1987. It would appear as though general duties police commenced RBT operations from the end of 1986.

Plots of the monthly data are given in Figure 3.5 for total numbers of drivers tested, while Figure 3.6 contains the breakdown by type of police involved and mobile/stationary. The large increase in enforcement levels from the end of 1987 is matched by a definite decrease in accident numbers from around the same time, as is clear from a comparison of Figure 3.5 with Figures 3.1 to 3.3 for the three groups of accidents being considered. On the other hand Figure 3.4, which shows the control accident series, also exhibits a strong downward trend from 1987, suggesting that the decline in serious accidents in this period could be due largely to factors other than RBT enforcement.

Previous analyses of accidents in New South Wales indicated that the lowering of the blood alcohol limit from 0.08 g/100 ml to 0.05 g/100 ml on 15th December 1980 appeared to have a negative impact on accident numbers (Homel 1994). The effect of lowering the blood alcohol limit was controlled by including an appropriate step function in the model.

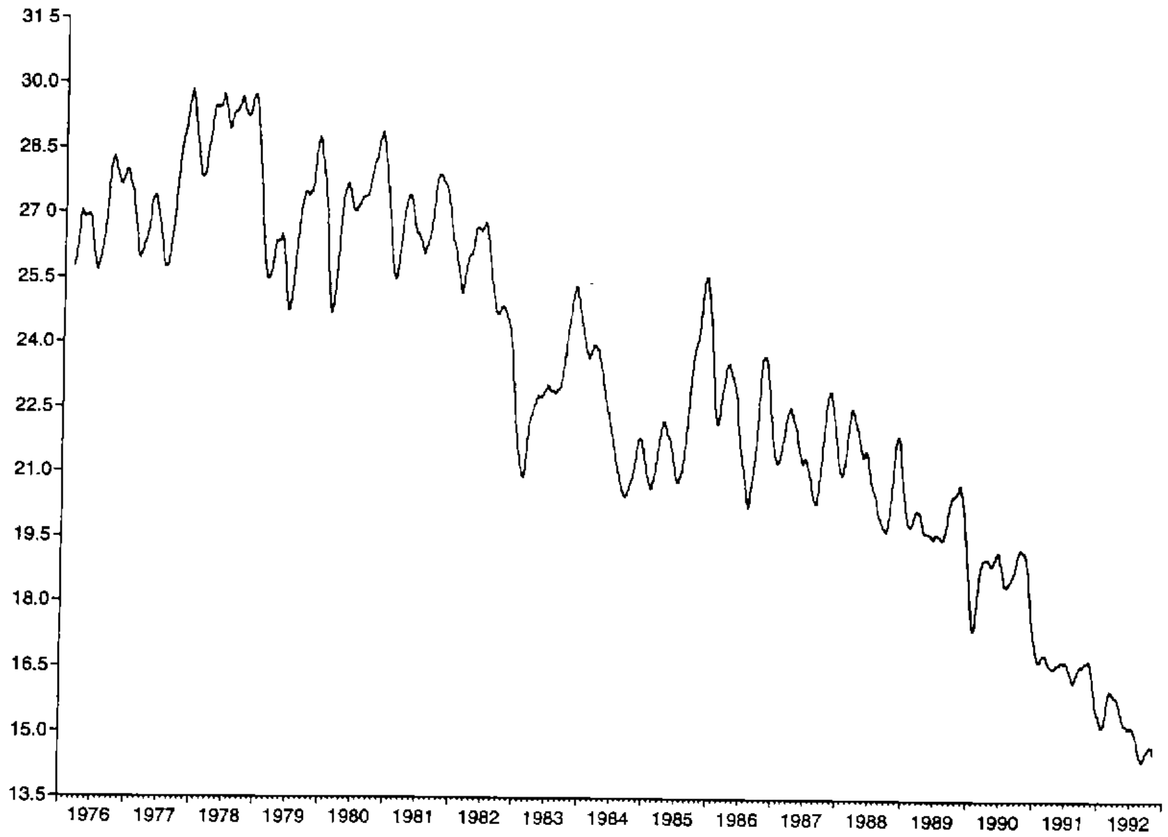

Figure 3.1. Serious (Including Fatal) Accidents in New South Wales, 1976-1992) (Daily Figures)

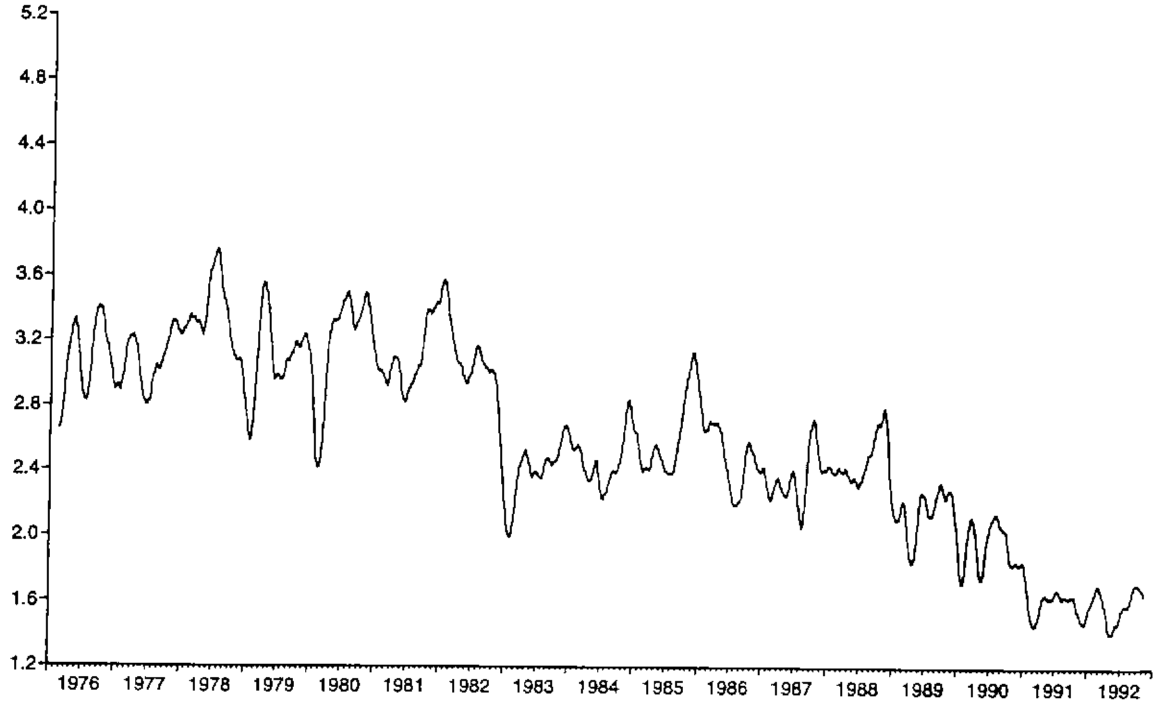

Figure 3.2. Fatal Accidents in New South Wales (1976-1992) (Daily Figures)

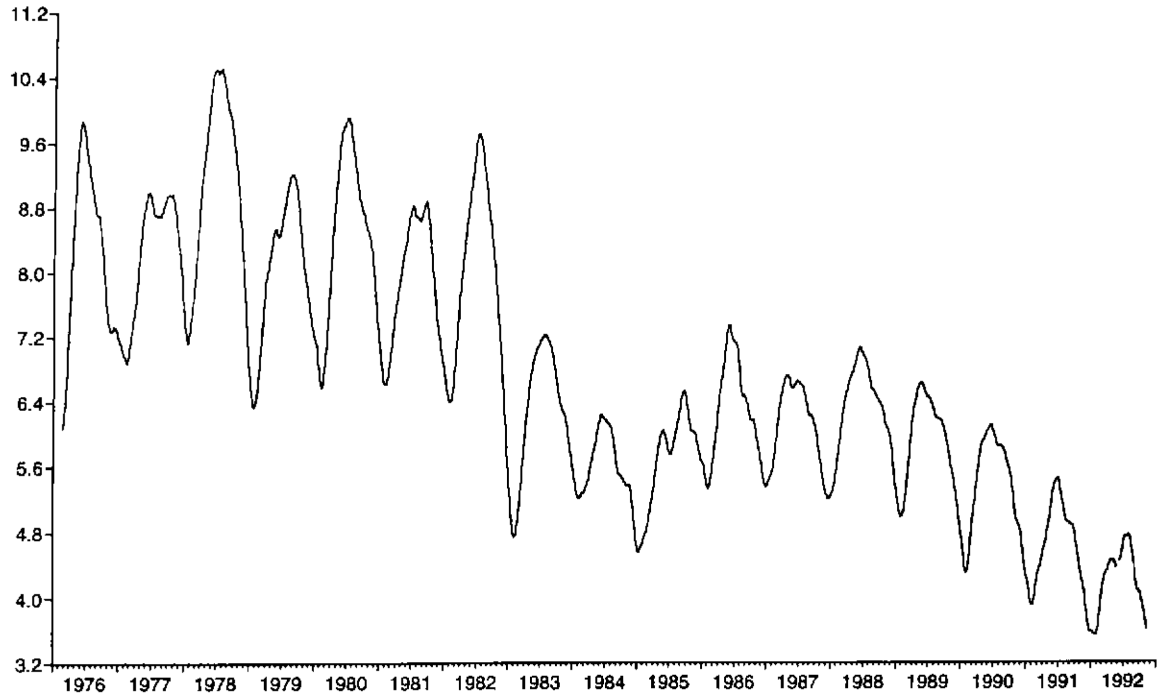

Figure 3.3 Single-Vehicle Night-Time Accidents in New South Wales (1976-1992) (Daily Figures)

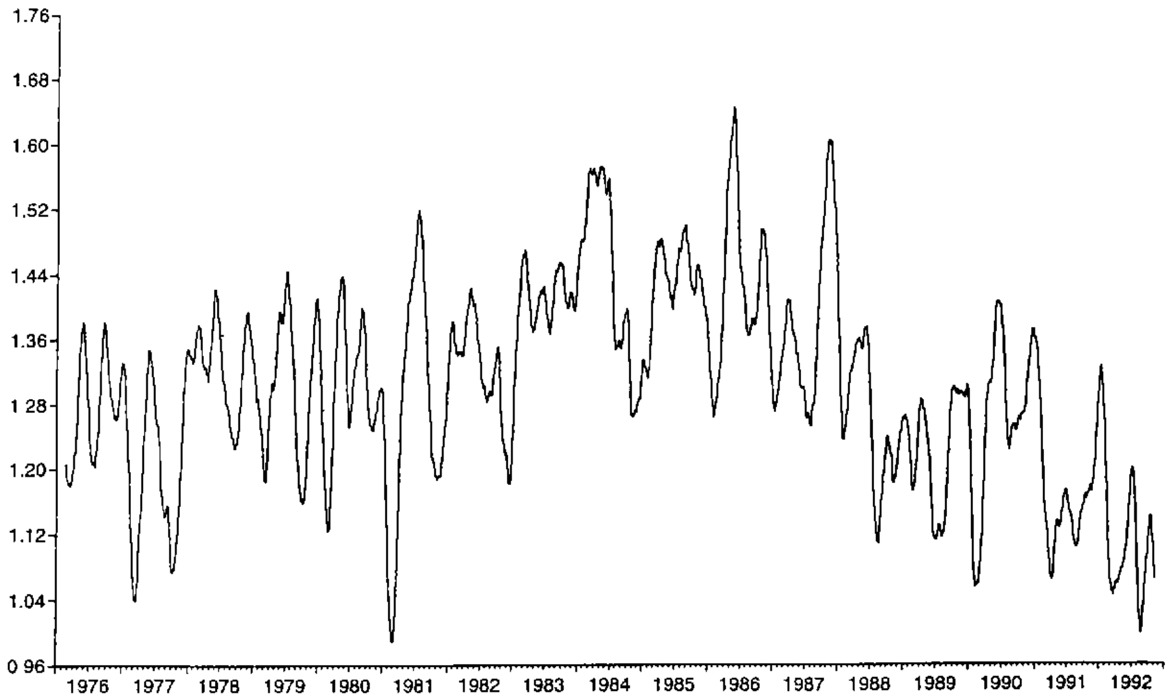

Figure 3.4. Vehicle-to-Vehicle Serious Accidents Occurring Between 9am and 3pm on Schooldays (1976-1992) (Daily Figures)

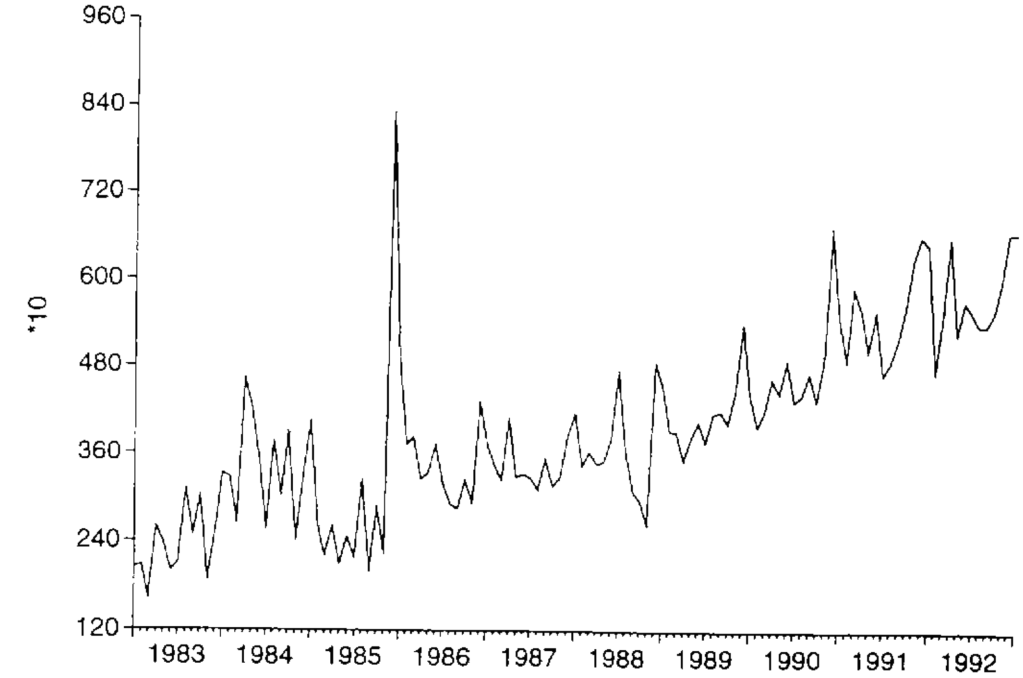

Figure 3.5. Total Drivers Tested in New South Wales (1983-1992) (Daily Figures)

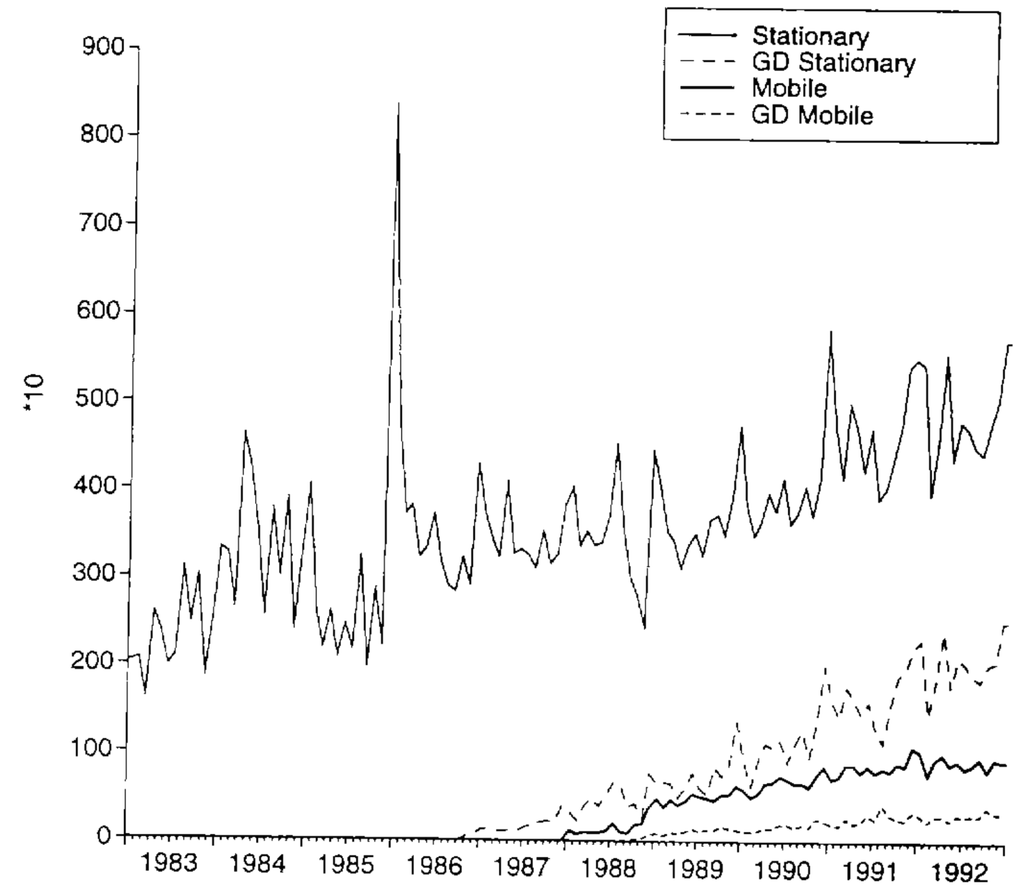

Figure 3.6. Drivers Tested in New South Wales, Broken Down by Type of Enforcement (1983-1992) (Daily Figures)
(*Note*: GD = general duties police)

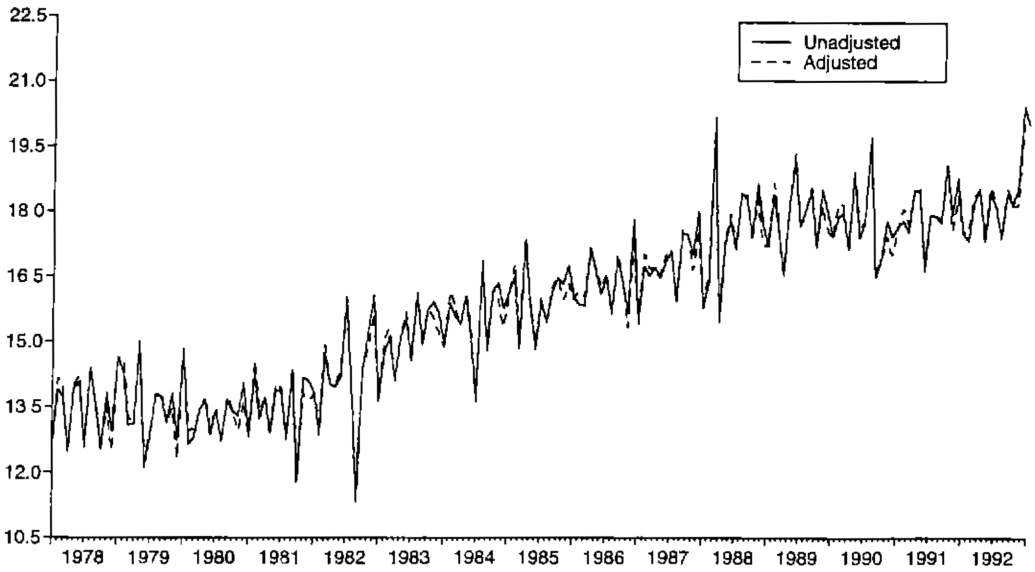

Figure 3.7. Petrol Sales in New South Wales (Megalitres)

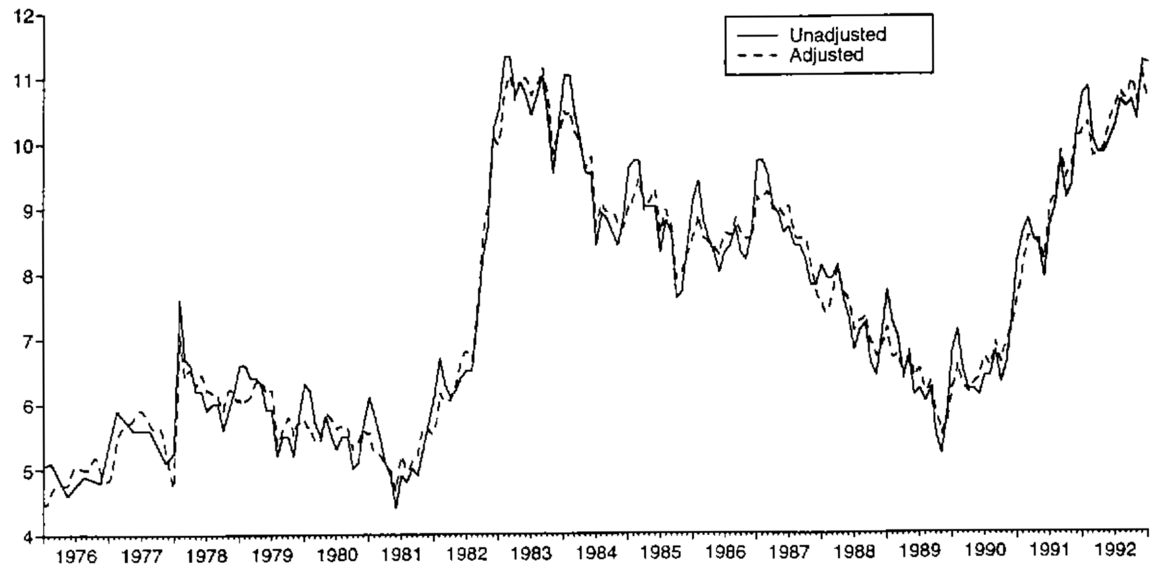

Figure 3.8. Unemployment Rate in New South Wales (%)

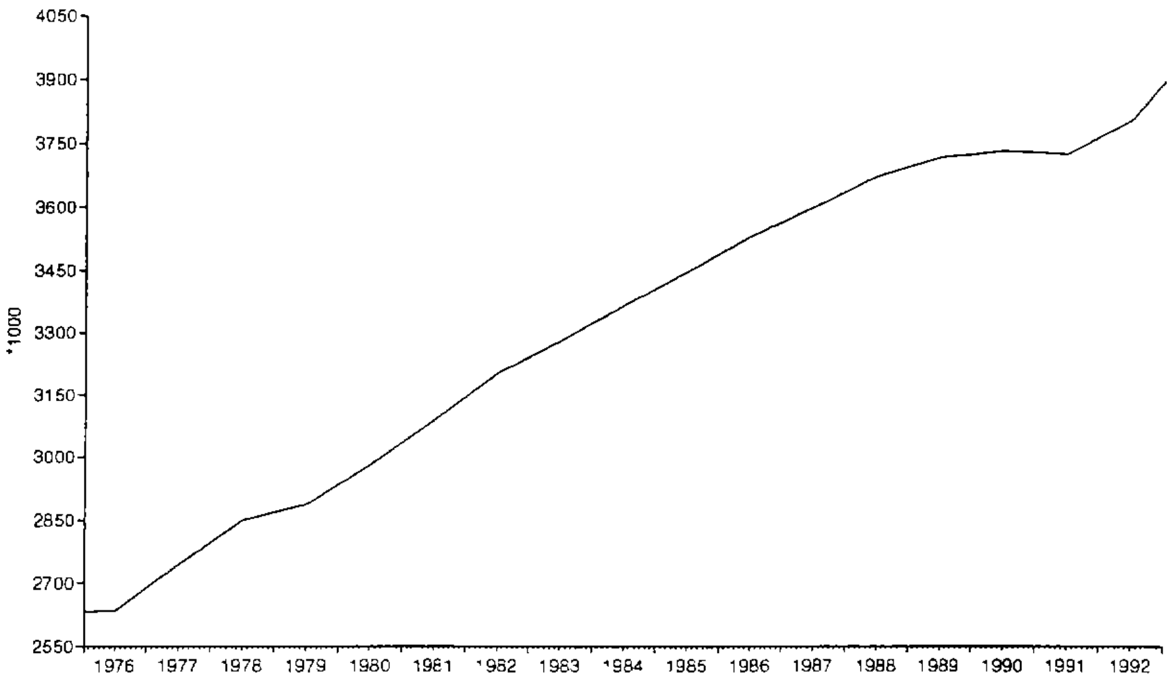

Figure 3.9. Drivers Licences in New South Wales (x 1000 Licences)

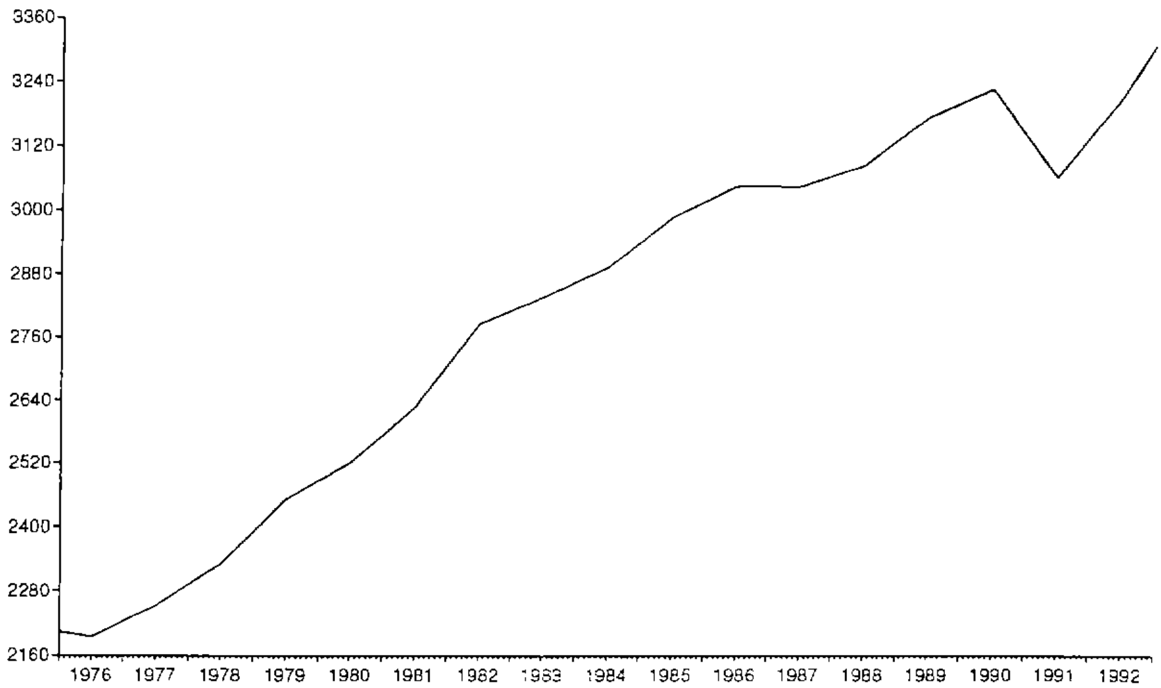

Figure 3.10. Vehicle Registrations in New South Wales (x 1000 registrations)

The control variables described above were also taken into account. The four control variables listed in Table 2.3 that were available at the state level are depicted in Figures 3.7 to 3.10.

Analyses

The results of the analyses of the effect of RBT are presented in Tables 3.1, 3.3 and 3.4, corresponding to all serious, fatal and single-vehicle night-time accidents which occurred in New South Wales. The overall significance of RBT is obtained by performing an analysis of deviance test which reveals whether the inclusion of the terms relating to RBT (i.e., the Introduction and the enforcement and non-enforcement-related Program effects) contribute significantly to the model. The initial effect of RBT is obtained from the sum of the coefficients of the first two RBT terms given in the model (the Introduction and non-enforcement-related Program effects). The period that the Introduction effect is sustained is estimated during the modelling process. The significance of the enforcement term reflects the importance of ongoing enforcement in reducing accident numbers. The average period of awareness of RBT due to enforcement levels at a specific time is also estimated during the modelling process and is reported when appropriate.

In general RBT was found to have resulted in a significant initial drop in accident numbers. Estimation of the length of the period that the effect was sustained was extremely difficult. In most instances there was a definite short-term effect and some evidence of a longer term effect. The strong relationship between enforcement levels and accident numbers which is evident from a comparison of the relevant Figures, is shown to be significant when all other factors have been taken into account. Thus there is a definite decrease in accident numbers when RBT enforcement is at high levels. The interpretation of the results for each of the three types of accident are given below.

All serious accidents

The overall effect of RBT is significant as identified by the result of the analysis of deviance test given at the bottom of Table 3.1. The initial (first day) impact of the introduction of RBT translates into an estimated drop of 19.3% in accident numbers. Some of this initial impact started to decay as the Introduction effect declined, although the analysis suggests that the Introduction effect did not reduce to 5% of its initial value until 15 months after RBT was implemented (i.e. mid-March 1984).

However, at the same time the Introduction effect was decaying throughout the first year (1983), an enforcement effect was beginning to be felt, although this was not sufficient to counteract completely the decay in the initial impact. The analysis suggests that the average period that the effect of an RBT operation is sustained (in New South Wales) is about 200 days or 6.5 months. This period corresponds to a statistically optimum lag associated with the enforcement term, and can be interpreted as the duration of the deterrent impact of exposure to an RBT operation. In other words, one could interpret the estimated parameter as a measure of the time over which a given RBT operation has a measurable impact on driving behaviour. Of course independent measures of the psychological impact of exposure to RBT would be required to confirm this interpretation.

Table 3.1. All Serious Accidents in NSW

Variable		Coefficient	S.E.	t Statistic	p-value
Constant Term		1.5175			
Seasonal Terms	Sin	-0.0068	0.0067	-1.02	0.3100
	Cos	0.0061	0.0044	1.36	0.1723
	Sin2	-0.0254	0.0050	-5.07	0.0000
	Cos2	-0.0198	0.0044	-4.46	0.0000
	Sin3	-0.0244	0.0048	-5.08	0.0000
	Cos3	-0.0078	0.0049	-1.59	0.1116
Day of Week	Friday	0.2110	0.0111	19.06	0.0000
	Saturday	0.2878	0.0109	26.41	0.0000
	Sunday	0.1142	0.0113	10.08	0.0000
	Monday	-0.1381	0.0121	-11.43	0.0000
	Tuesday	-0.1589	0.0121	-13.09	0.0000
	Wednesday	-0.0982	0.0120	-8.21	0.0000
Type of Day	School Holidays	-0.0657	0.0126	-5.21	0.0000
	School Terms	-0.0919	0.0115	-7.96	0.0000
Road Usage	Petrol Production	2.61E-05	4.24E-05	0.61	0.5390
	Driver's Licences	0.0007	0.0001	4.56	0.0000
Economic Indicators	GDP	-2.24E-05	5.01E-06	-4.48	0.0000
	Alcohol Expenditure	0.0002	0.0001	1.98	0.0481
	Disposable Income	0.0896	0.1463	0.61	0.5403
	Unemployment	-0.0248	0.0050	-4.97	0.0000
Weather	Rainfall	0.0900	0.0069	13.11	0.0000
Time		-0.0368	0.0188	-1.96	0.0505
0.05		-0.0751	0.0160	-4.70	0.0000
Legislation					
RBT	Program (non-enforcement)	0.1422	0.0489	2.91	0.0036
	Introduction (15 months)	-0.3526	0.0735	-4.80	0.0000
	Program (enforcement-related) (200 days)	-3.03E-07	8.71E-08	-3.48	0.0005
Deviance	8145.32				
d.f.	6178				

Analysis of deviance for RBT effect $G^2 = 35.0$ d.f. = 3 (p = 0.00)

Whatever the precise interpretation of the duration of impact of enforcement, the model suggests that by mid-1983 the cumulative effects of over six months of enforcement were beginning to be felt. The average number of tests conducted in 1983 was 2326 per day, which is associated with an approximate 13% reduction in serious accidents compared with a level of no enforcement. Unfortunately, this statistic cannot be applied directly to the 1983 data, since the non-enforcement related Program effect has also to be taken into account (as well as the decaying Introduction effect). Since from Table 3.1 the non-enforcement Program component has a *positive* coefficient, the overall impact of RBT in mid-1983 was less than indicated from the enforcement component alone. Calculations indicate that at this time the reduction in serious accidents was around 9%, less than half the initial reduction, and that by the end of 1983 it was even less, at under 3%. The overall reduction for 1983 was estimated at about 5% (Table 3.2 below).

What these calculations suggest is that by the end of 1983 RBT was in danger of completely losing its effectiveness. What saved it was the steady increase in the numbers of tests conducted each year since 1983 (see Figure 3.5), and (by implication) the associated publicity (summarised in Table 2.4 and Appendix 1). By 1992, ten years after the introduction of RBT, the average number of tests conducted each day had risen to 5742, and this level was sufficient to deliver an 18% reduction in serious accidents - about the same reduction that was achieved in the first few days of RBT.

The effects of increases in enforcement levels are shown in Figure 3.11. In this diagram, increases in testing levels from 100 to 6000 per day are plotted against percentage reductions in serious accidents predicted from the model. It is important to emphasise that the effects of *changes* in testing levels are plotted, not the effects of fixed levels of enforcement, and that the maximum change in daily testing levels observed in the data was about 6000 (due to the blitz at the end of 1985). The diagram therefore only involves limited extrapolation beyond the range of the observed data.

Because a log-linear model was the basis of the analysis, the relationship in Figure 3.11 is not quite linear. For example, an increase in daily testing levels of 1000 corresponds to a reduction of 5.9% in serious accidents, but an increase of 3000 corresponds not to a 17.7% but to a 16.6% reduction. The greater the increase in testing levels, the more the reduction in accidents falls below what would be predicted from a straight line relationship.

The direct relationship between increases in testing levels and reductions in serious accidents has important policy implications. It is obvious that not all serious accidents are alcohol-related and also that because of the slowly diminishing returns even alcohol-related accidents cannot be eliminated entirely just by increasing testing levels (even if such a policy were practical). Nevertheless, the model suggests that even modest increases in the number of tests conducted each year could result in worthwhile reductions in accidents. For example, a 10%

increase on current testing levels (which are around 6300 per day) is predicted to produce a reduction of about 3.5% in serious accidents.

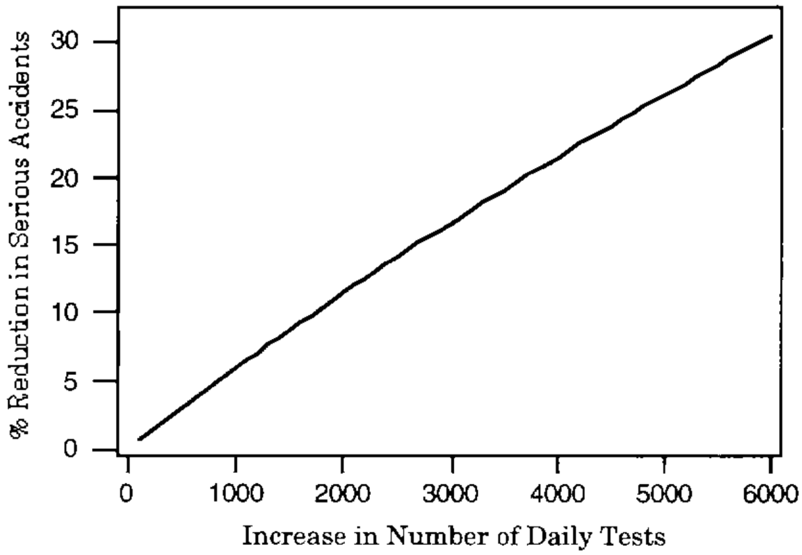

Figure 3.11. Relationship Between Increases in Daily Levels of Random Breath Testing and Reductions in Serious Accidents

Because the number of random tests has increased each year since 1983, and because many other variables in the model change annually or more often, a reasonably accurate way of reporting accident savings is on an annual basis. These savings are the approximate numbers of serious accidents prevented by RBT each year, as predicted by the model. They were estimated using the method described in Chapter 2, and are shown in Table 3.2.

It can be seen from the table that the estimated impact of RBT on serious accidents was a minimum in 1985, when testing was at relatively low levels, but has generally increased each year since then. The intense blitz at the end of 1985 may have contributed to the slightly better result in 1985 than in 1986. As previously noted, the return in the 1990s to accident reductions comparable with the initial impact of RBT appears to be due entirely to the increase in the numbers of tests in recent years.

Table 3.2. Estimated Numbers of Serious Accidents Prevented by RBT, 1982-1992

Year	% Reduction	Estimated Accidents Prevented	Cumulative Accidents Prevented
1982 (from Dec. 17)	18%	70	70
1983	5%	452	522
1984	4%	342	864
1985	3%	292	1156
1986	7%	588	1744
1987	6%	529	2273
1988	7%	597	2869
1989	9%	713	3582
1990	12%	884	4466
1991	15%	1090	5556
1992	18%	1186	6742

Fatal accidents

The introduction of RBT is estimated to have resulted in an initial 48.0% drop in fatal accidents in New South Wales. RBT is found to have a significant effect with a chi-squared value of 20.7 on 2 degrees of freedom (Table 3.3). However some of this is the short-term Introduction effect of 4.5 months (135 days) duration, with the long-term effect reducing to 15% (the non-enforcement-related Program effect). It is not possible to show that ongoing enforcement levels had an influence on fatal accident numbers, due primarily to a lack of power in the statistical tests for the low numbers of fatal accidents.

The fact that the enforcement component was not significant greatly simplifies the interpretation of the model and the estimation of the numbers of accidents prevented. The Introduction effect is estimated to have corresponded to the prevention of 54 fatal accidents in the first few months, with the Program component corresponding approximately to an additional 144 fatal accidents prevented each year. More exact figures are in Table 3.4.

Table 3.3. Fatal Accidents in New South Wales

Variable		Coefficient	S.E.	t Statistic	p-value
Constant Term		-3.4182			
Seasonal Terms	Sin	-0.0352	0.0163	-2.16	0.0305
	Cos	-0.0017	0.0118	-0.15	0.8835
	Sin2	-0.0272	0.0130	-2.10	0.0360
	Cos2	-0.0280	0.0118	-2.38	0.0174
	Sin3	-0.0315	0.0127	-2.49	0.0127
	Cos3	-0.0169	0.0130	-1.30	0.1924
Day of Week	Friday	0.2411	0.0290	8.30	0.0000
	Saturday	0.3110	0.0286	10.86	0.0000
	Sunday	0.1261	0.0298	4.23	0.0000
	Monday	-0.1801	0.0322	-5.59	0.0000
	Tuesday	-0.2628	0.0330	-7.97	0.0000
	Wednesday	-0.1691	0.0322	-5.25	0.0000
Type of Day	School Holidays	-0.1031	0.0330	-3.12	0.0018
	School Terms	-0.1480	0.0301	-4.92	0.0000
Road Usage	Petrol Production	0.0001	0.0001	0.92	0.3583
	Driver's Licences	0.0018	0.0003	5.49	0.0000
Economic Indicators	GDP	-2.22E-06	1.28E-05	-0.17	0.8621
	Alcohol Expenditure	0.0004	0.0003	1.39	0.1657
	Disposable Income	-0.0607	0.3619	-0.17	0.8667
	Unemployment	-0.0130	0.0132	-0.98	0.3256
Weather	Rainfall	0.0690	0.0182	3.80	0.0001
Time		-0.1485	0.0347	-4.28	0.0000
0.05 Legislation		-0.0841	0.0417	-2.02	0.0439
RBT	Program (non-enforcement)	-0.1647	0.0560	-2.94	0.0033
	Introduction (4.5 months)	-0.4888	0.2064	-2.37	0.0179
Deviance	6439.88				
d.f.	6179				

Analysis of deviance for RBT effect $G^2 = 20.66$ d.f. = 2 (p = 0.00)

Table 3.4. Estimated Numbers of Fatal Accidents Prevented by RBT, 1982-1992

Year	% Reduction	Estimated Accidents Prevented	Cumulative Accidents Prevented
1982 (from Dec. 17)	42%	20	20
1983	17%	183	204
1984	15%	162	366
1985	15%	164	529
1986	15%	162	692
1987	15%	157	849
1988	15%	156	1005
1989	15%	148	1152
1990	15%	129	1281
1991	15%	104	1386
1992	15%	101	1487

Single-vehicle night-time accidents

These accidents are considered to be the most likely to be alcohol-related and thus are expected to be the most affected by RBT. This is confirmed by the large deviance of 57.73 with 3 degrees of freedom, which is highly significant and larger than the values for all serious or for fatal accidents (Table 3.5).

Both the Introduction and Enforcement components were highly significant, with the duration of the impact of both components being much longer than for all serious crashes. It was estimated that the Introduction effect took over 10 years (3690 days) to decline to 5% of its initial magnitude, which is about the length of the time series post-RBT. In other words, the impact of the Introduction of RBT was still discernible at the end of 1992. The enforcement component was estimated to have a cumulative impact of up to 18 months (550 days). These are very substantial periods of time over which the presumed deterrent effects of RBT on single-vehicle night-time accidents are discernible, but the long durations are consistent with the assumption that RBT would have a greater impact on accidents that are more directly alcohol-related.

Table 3.5. Single-Vehicle Night-Time Accidents in New South Wales

Variable		Coefficient	S.E.	t Statistic	p-value
Constant Term		-1.5729			
Seasonal Terms	Sin	-0.0274	0.0113	-2.42	0.0156
	Cos	-0.1613	0.0078	-20.61	0.0000
	Sin2	-0.0282	0.0088	-3.21	0.0014
	Cos2	-0.0318	0.0078	-4.08	0.0000
	Sin3	-0.0185	0.0084	-2.20	0.0277
	Cos3	-0.0045	0.0085	-0.53	0.5992
Day of Week	Friday	0.3234	0.0197	16.42	0.0000
	Saturday	0.5879	0.0187	31.38	0.0000
	Sunday	0.3567	0.0196	18.22	0.0000
	Monday	-0.3071	0.0231	-13.31	0.0000
	Tuesday	-0.3366	0.0233	-14.45	0.0000
	Wednesday	-0.1849	0.0223	-8.28	0.0000
Type of Day	School Holidays	-0.1126	0.0219	-5.14	0.0000
	School Terms	-0.1295	0.0196	-6.60	0.0000
Road Usage	Petrol Production	5.15E-05	7.38E-05	0.70	0.4856
	Driver's Licences	0.0011	0.0003	4.17	0.0000
Economic Indicators	GDP	-4.91E-05	9.59E-06	-5.12	0.0000
	Alcohol Expenditure	0.0002	0.0002	0.87	0.3819
	Disposable Income	0.2863	0.2768	1.03	0.3010
	Unemployment	-0.0288	0.0098	-2.33	0.0196
Weather	Rainfall	0.1346	0.0123	10.98	0.0000
Time		-0.0492	0.0296	-1.66	0.0963
0.05 Legislation		-0.1270	0.0301	-4.21	0.0000
RBT	Program (non-enforcement)	0.9197	0.2400	3.83	0.0001
	Introduction (10.1 years)	-1.2220	0.2573	-4.75	0.0000
	Program (enforcement-related) (18 months)	-3.89E-07	9.63E-08	-4.04	0.0001
Deviance	7259.25				
d.f.	6178				

Analysis of deviance for RBT effect $G^2 = 57.73$ d.f. = 3 (p = 0.00)

The initial (first day) impact was 26%, which is sizeable but less than the initial impact on fatal accidents (48%). The reason for the lower estimated initial impact is the large *positive* coefficient for the non-enforcement Program component (similar to the situation for all serious accidents, but larger in magnitude). This large positive coefficient has a "dampening effect" on the sizes of the estimates of reductions in single-vehicle night-time accidents, particularly some years after the introduction of RBT when the initial impact had waned substantially.

As a result of the opposing effects of the Introduction and enforcement-related components, the initial impact was more or less sustained for two years, because enforcement levels had a cumulative effect over such a long time period (18 months). For the full year 1983 the estimated accident reduction was 23%, about the same as at the beginning of the year, and six months later it was even higher as the full effects of 18 months of enforcement, and the increase in testing levels in late 1983 and 1984, began to be felt. However, after that time the enforcement component failed to keep pace with the decaying Introduction component, and there was a decline for some years in the numbers of single-vehicle night-time accidents prevented by RBT before an enforcement-led upswing in the 1990s that restored the percentage accident reductions of the early 1980s. Details are in Table 3.6.

Table 3.6. Estimated Numbers of Single-Vehicle Night-Time Accidents Prevented by RBT, 1982-1992

Year	% Reduction	Estimated Accidents Prevented	Cumulative Accidents Prevented
1982 (from Dec. 17)	26%	29	29
1983	23%	657	686
1984	22%	579	1265
1985	15%	392	1657
1986	14%	360	2017
1987	8%	200	2217
1988	4%	106	2323
1989	3%	75	2399
1990	7%	143	2542
1991	15%	295	2837
1992	22%	409	3246

The results in Table 3.6 highlight the importance of the direct relationship between enforcement levels and accident reductions, as was the case for all serious accidents. In fact the relationship was much stronger than for all serious accidents, due mainly to the longer period over which enforcement had an effect (50 days). An increase of 1000 tests each day was estimated to reduce single-vehicle night-time accidents by a very large 19.3%., while an increase of 3000 corresponded to a reduction of 47.4% (not 3 x 19.3% due to the non-linearity of the relationship). These are very large accident reductions which may or may not be achieved in practice should existing testing levels be raised. What the analysis does confirm, on the basis of the historical data, is that in the past large reductions in alcohol-related accidents have been achieved by increases (over time) in the daily testing rates of the magnitudes given in the above examples.

The control series of accidents

Table 3.7 contains the results of the analysis of vehicle-to-vehicle accidents occurring between the hours of 9 am and 3 pm on schooldays. The deviance for RBT (the three components) was 9.24 with 3 d.f., which is statistically significant (p = .026), although much less strongly than for the other three accident series (and none of the components individually was significant). The estimated period over which the Introduction component had a measurable impact was a very long 30 years, with the impact of enforcement being measurable for 200 days (the same period as for serious accidents).

The regression coefficients showed quite a different pattern from the other accident series, with the result that the estimated impact of RBT was an initial *increase* of 18% in "control" accidents, followed by a gradual decline until the mid-1980s whereupon accident *reductions* were estimated. By 1992, RBT is estimated to have produced an 18% reduction in control series accidents, the same size effect as in 1983, but in the opposite direction.

It is very difficult to know what to make of these results. A literal interpretation of the model would suggest that there was an initial displacement from alcohol- to non-alcohol-related accidents, but that in the long-term RBT had a beneficial impact on both categories. This interpretation might be plausible if one accepts that RBT when it reaches a point of sufficient enforcement intensity begins to have an effect on risk factors that affect non-alcohol- as well as alcohol-related accidents. An alternative assumption, that the control series includes sufficient numbers of alcohol-related accidents to show effects of RBT, is harder to accept, given the initial increase in control series accidents followed by an eventual decline.

In order to clarify the impact of RBT on alcohol- and non-alcohol-related accidents, some supplementary analyses were carried out. These involved examining single and multiple vehicle accidents occurring at day-time and night-time in Sydney and in rural areas. These analyses confirmed that RBT had its largest impact, both in terms of statistical significance and the size of initial impact, on single vehicle accidents occurring at night. There was an initial 24% reduction in night-time single vehicle accidents in Sydney, and 29% in country areas. As with the control series, there were initial increases of 11% and 21% in multiple vehicle day-time accidents in Sydney and country areas respectively.

It seems from these analyses that part of the initial impact of RBT could have been an increase in multiple vehicle day-time accidents, although the reasons for such a displacement are not clear. In addition, RBT

Table 3.7. Control series: Vehicle-to-Vehicle Accidents Occurring Between 9 am and 3 pm on Schooldays

Variable		Coefficient	S.E.	t Statistic	p-value
Constant Term		0.2327			
Seasonal Terms	Sin	0.0076	0.0242	0.32	0.7523
	Cos	0.0039	0.0191	0.20	0.8402
	Sin2	-0.0284	0.0177	-1.60	0.1098
	Cos2	0.0279	0.0189	1.48	0.1396
	Sin3	9.28E-05	0.0175	5.29E-3	0.9958
	Cos3	0.0215	0.0183	1.18	0.2392
Day of Week	Friday	-0.0281	0.0292	-0.96	0.3360
	Saturday	-0.0528	0.0299	-1.76	0.0778
	Sunday	-0.0061	0.0315	-0.19	0.8455
	Monday	0.0000	0.0000		
	Tuesday	0.0000	0.0000		
	Wednesday	0.1290	0.0352	3.67	0.0002
Type of Day	School Holidays	0.0000	0.0000		
	School Terms	0.0000	0.0000		
Road Usage	Petrol Production	2.13E-06	0.0002	0.01	0.9891
	Driver's Licences	0.0005	0.0005	1.11	0.2667
Economic Indicators	GDP	4.87E-06	2.07E-05	0.24	0.8139
	Alcohol Expenditure	0.0003	0.0005	0.55	0.5796
	Disposable Income	-0.1304	0.5648	-0.23	0.8175
	Unemployment	-0.0056	0.0202	-0.28	0.7803
Weather	Rainfall	0.1196	0.0255	4.69	0.0000
Time		-0.0217	0.0599	-0.36	0.7174
0.05 Legislation		-0.0590	0.0680	-0.87	0.3857
RBT	Introduction (30 years)	0.9245	0.4952	1.87	0.0620
	Program (non-enforcement)	-0.7550	0.4923	-1.53	0.1252
	Program (enforcement-related) (200 days)	1.81E-07	2.99E-07	0.90	0.3667
Deviance	3652.52				
d.f.	3366				

Analysis of deviance for RBT effect $G^2 = 9.24$ d.f. = 3 (p = 0.026)

when it became more intensively enforced in the late 1980s and 1990s might have contributed to reductions in non-alcohol- as well as alcohol-related accidents, although again the reasons for such an effect are not clear.

What is clear is that the main impact of RBT was on accidents that are generally regarded as being heavily alcohol-related, namely night-time single vehicle accidents. The statistical significance of RBT for the control series was not high, suggesting that not too much effort should be put into interpreting the model. It is noteworthy that the .05 legislation had no effect in this model, consistent with the assumption that the control series included mainly non-alcohol-related accidents.

The effects of other factors

The lowering of the blood alcohol limit in December 1980 had a significant negative effect on accident numbers. The reduction was 7% for all serious accidents, 8% for fatal accidents, and 11% for single-vehicle night-time accidents. The period that the effect was sustained was not estimated and would be difficult to ascertain given the introduction of RBT two years later. Homel (1994) discusses the relative deterrent importance of the .05 law and RBT.

An estimated total of 7291 serious accidents, 908 fatal accidents, and 3568 single-vehicle night-time accidents were prevented by the .05 legislation up till the end of 1992. These correspond to mean annual savings of 605 serious accidents, 75 fatal accidents, and 296 single-vehicle night-time accidents.

As expected the occurrence of rain contributed significantly to accident numbers. Seasonal trends were evident especially in the case of single-vehicle night-time accidents. However fatal accidents were less affected by the time of the year than other accidents. Most accidents occurred over weekends, peaking on Saturday nights. Another expected result was that there were significantly more accidents on public holidays than at other times of the year.

The interpretation of the individual economic/road usage variables is problematic since they all contain trends over time and this influences the estimation of their coefficients. In particular for New South Wales the coefficients for GDP and the non-enforcement Program component for RBT were found to be correlated. To exclude the GDP figure from the analyses would falsely inflate the RBT effect. Thus GDP was retained in the models and the effect of RBT is underestimated to some extent.

Unemployment rates are thought to be a measure of the influence of economic conditions on accident numbers. These analyses reinforce that belief, indicating that significantly fewer accidents occur in periods of relatively high unemployment. For each group of accidents the contribution to the model of petrol sales was evaluated. Since it was not of importance after the effect of the other variables had been taken into account and to include it would have reduced the size of the data set, it was excluded from the models. Numbers of drivers's licences and numbers of vehicle registrations are highly correlated and it is unnecessary to include both in the models. Thus driver's licences were used. Both variables were found to have a positive influence on accident numbers.

Summary

The population of New South Wales makes possible analyses that are more detailed than for other states. Accidents can be subdivided into categories that permit a better understanding of the impact of RBT while retaining sufficient statistical power for models to be meaningful. In addition, New South Wales has the advantage that enforcement levels are relatively reliably recorded and have varied over the years, with a substantial increase since late 1987, permitting an analysis of the effects of enforcement as a component of the impact of RBT additional to the Introduction and non-enforcement-related Program effects.

The main conclusion from the analyses presented in this chapter is that RBT in New South Wales had an instantaneous, substantial, and permanent effect on accidents, although the permanent effect was achieved only through the sustained increases in overall enforcement levels since late 1987. If enforcement levels had not increased when they did (through the involvement of general duties police), it is almost certain that RBT would have ceased to be effective by the mid to late 1980s.

The model for all serious accidents suggests that an increase of 1000 in the daily testing rate corresponds roughly to a decline of 6% in accidents (within the range of the observed data, which is 2000 to 6000 with a spike at 8400). The relationship for single-vehicle night-time accidents is stronger, with an increase of 1000 tests each day corresponding to a 19% reduction in accidents. However, from the models the relationship between changes in daily testing rates and accident reductions is not linear, so that there is an element of "diminishing returns" as daily enforcement levels increase. This is particularly the case with single-vehicle night-time accidents.

The analyses also suggest that RBT has a "residual deterrent effect" that is of great importance. This effect has been measured in two ways: as the duration of the Introduction component, and as the period over which a specific RBT operation has a statistically discernible impact on accidents. The estimation of the parameters associated with these effects is difficult, and the estimates are subject to statistical error, but taken together they indicate that the initial intensive RBT campaign in December 1982 had an effect on the whole population of motorists that was still measurable at the end of the study period ten years later, and that this effect was periodically boosted for individual motorists by exposure to RBT operations whose presence was remembered and acted upon up to 18 months later.

Consistent with the nature of RBT as a deterrent to drinking and driving, the greatest initial impact was measured for fatal and for single-vehicle night-time accidents (48% and 26% respectively). This result held for both Sydney and country regions. Single-vehicle night-time accidents also had the longest lag associated with enforcement and the longest duration of the Introduction effect, as would be expected if they are largely alcohol-related. The control series (vehicle-to-vehicle accidents occurring between 9 am and 3 pm on school days) was not expected to show any effect of RBT, but in fact a statistically significant but hard to interpret pattern was found. This pattern could mean that there was an initial increase in non-alcohol-related accidents resulting from RBT, but the fact that the level of statistical significance was much less than for the other accident series, and that the pattern was counter-intuitive, suggests that not too much weight should be put on the result.

The estimated impact of RBT on accidents is summarised in Table 3.8.

Table 3.8. Summary of Impact of RBT in New South Wales on Accidents

Year	% Reduction in serious accidents	Serious accidents prevented	% Reduction in fatal accidents	Fatal accidents prevented	% Reduction in SVNT accidents	SVNT accidents prevented
1982[a]	18%	70	42%	20	26%	29
1983	5%	452	17%	183	23%	657
1984	4%	342	15%	162	22%	579
1985	3%	292	15%	164	15%	392
1986	7%	588	15%	162	14%	360
1987	6%	529	15%	157	8%	200
1988	7%	597	15%	156	4%	106
1989	9%	713	15%	148	3%	75
1990	12%	884	15%	129	7%	143
1991	15%	1090	15%	104	15%	295
1992	18%	1186	15%	101	22%	409
TOTAL		6742		1487		3246

Note: SVNT accidents are single-vehicle night-time accidents.

[a] From December 17, 1982

The .05 law, which was introduced two years before RBT, also had a substantial effect on accidents. For the three series of accidents the reductions associated with .05 were 7%, 8% and 11% respectively, with total accidents prevented being estimated since 1980 at 7291, 908, and 3568 respectively. The step-function nature of the .05 effect (not influenced by levels of enforcement and with no decay component) makes the estimated numbers of accidents prevented comparable with those achieved by RBT.

CHAPTER 4. TASMANIA

Accident numbers for the North-West and the South-West of the state corresponding to the Launceston and Hobart metropolitan areas and including the country areas between these two cities, were utilised in the analyses. The North-Eastern part of Tasmania was not considered since relatively few accidents occur in these areas and driving conditions and thus causes of accidents are different from those in the western portion of the state. Consequently, all results and comments relate to the Hobart and Launceston areas of Tasmania.

There were 7288 serious, 1955 single-vehicle night-time and 890 fatal accidents in this part of Tasmania between 1977 and 1991. This translates to an average of 1.33 serious, 0.357 single-vehicle night-time and 0.162 fatal accidents per day during this period. These low numbers of accidents imply that it is not possible to consider any groups of accidents other than all serious accidents in Tasmania.

Thus when investigating the effect of the introduction of RBT all serious accidents were analysed. The model found to most closely approximate observed trends allowed for an initial drop in accident numbers immediately after the introduction of RBT (the combined non-enforcement Program effect and the Introduction effect) and an exponential function describing the period that the Introduction effect was sustained (Figure 4.1). The control variables described in Chapter 2 were included in the models. Figures 4.4 to 4.7 are plots of some of the variables. The results from the analysis are presented in Table 4.1 and described below.

In order to ascertain the effect of enforcement levels on accident numbers, separate analyses were carried out for the Launceston and Hobart metropolitan areas. Enforcement statistics were not available for the initial stages of RBT enforcement and thus the analyses are restricted to the periods for which such data were available. For Launceston the analysis is for the period 1 January 1984 to the end of 1991 and for Hobart from 1 January 1988 to December 1991. The measures of the level of enforcement of RBT used in the analyses are the numbers of drivers tested during the day, in the evening/night, and late at night. All serious accidents occurring in each of the metropolitan areas were considered. Tables 4.3 and 4.4 contain the results for the Launceston and Hobart analyses respectively and accident numbers are plotted in Figures 4.2 and 4.3.

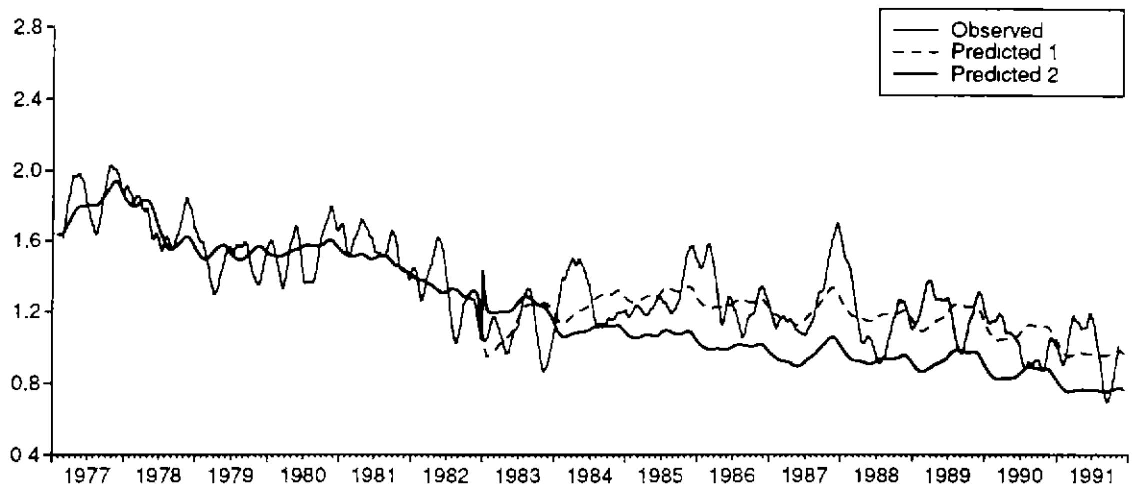

Figure 4.1. Serious and Fatal Accidents in Tasmania (1976-1991) (Daily Figures)

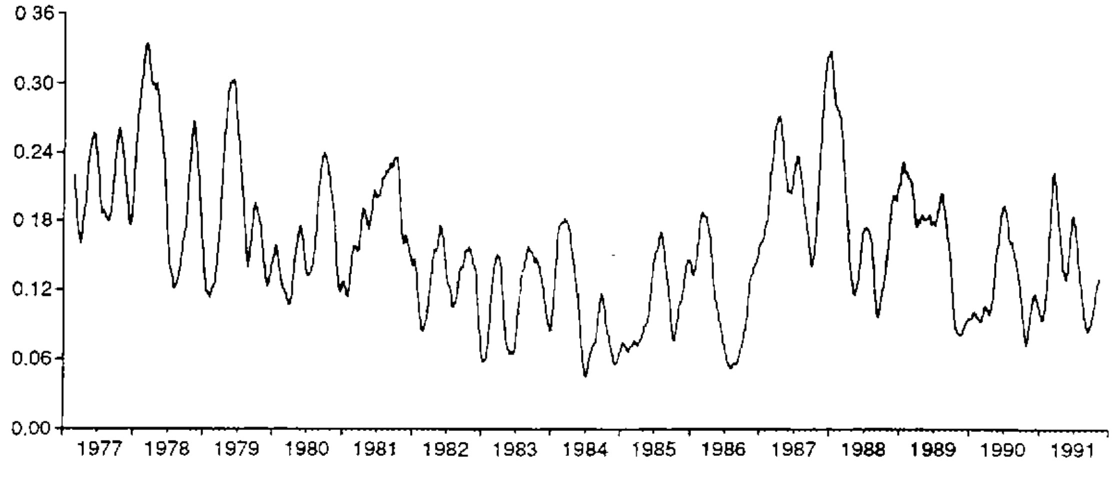

Figure 4.2. Serious and Fatal Accidents in the Launceston Region (1976-1991) (Daily Figures)

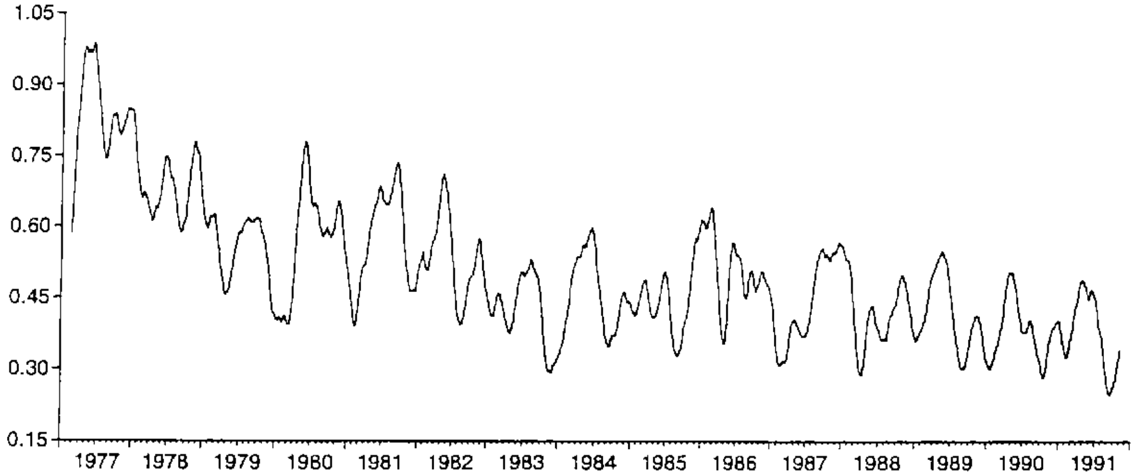

Figure 4.3. Serious and Fatal Accidents in the Hobart Region (1976-1991) (Daily Figures)

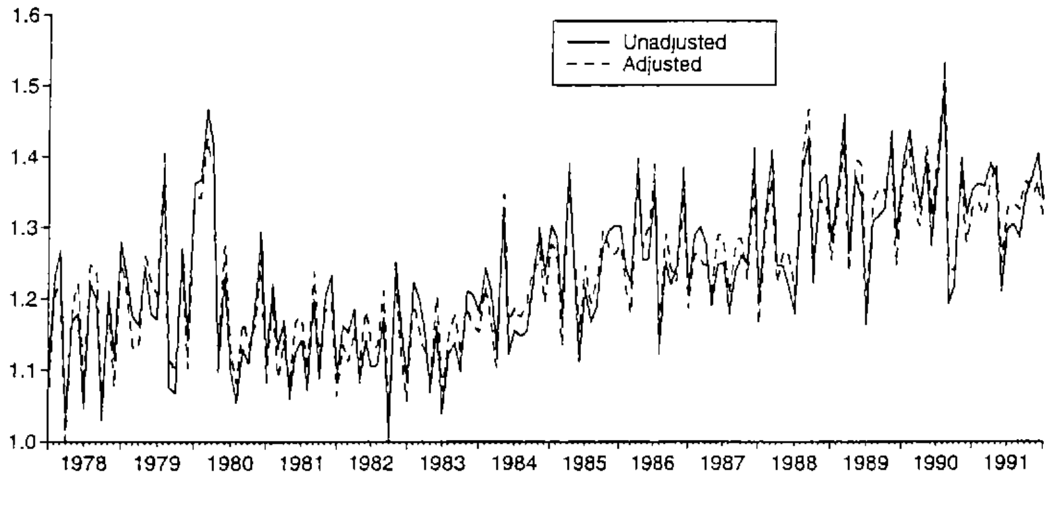

Figure 4.4. Petrol Sales in Tasmania (Megalitres)

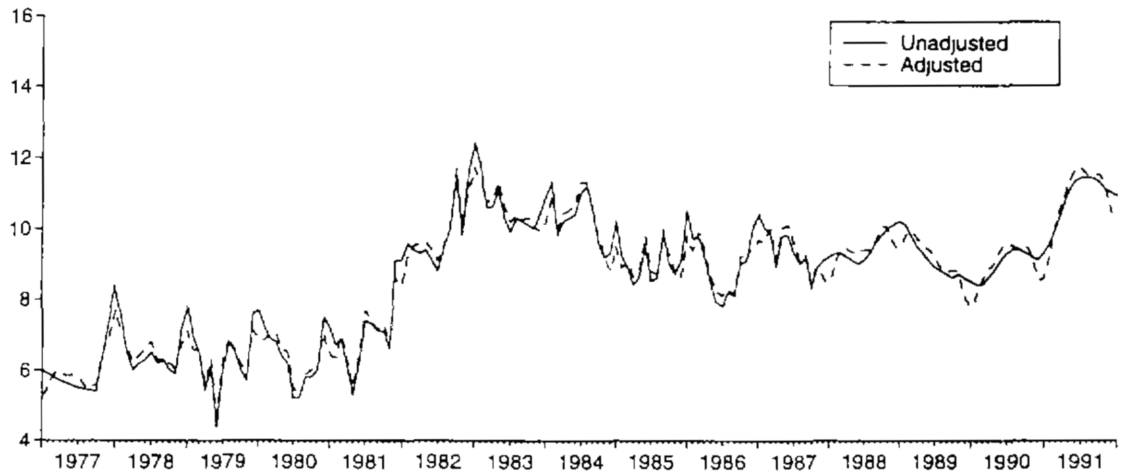

Figure 4.5. Unemployment Rate in Tasmania (%)

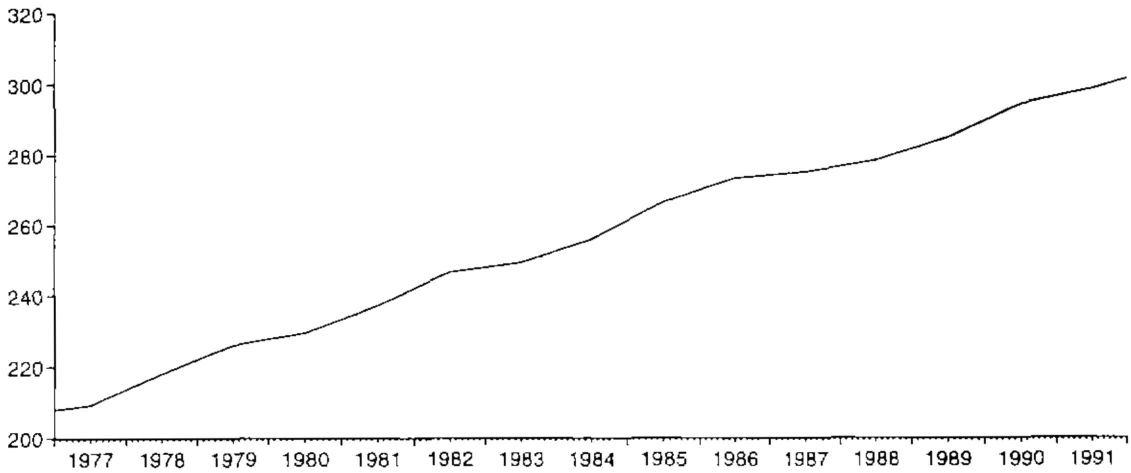

Figure 4.6. Vehicle Registrations in Tasmania (x 1000)

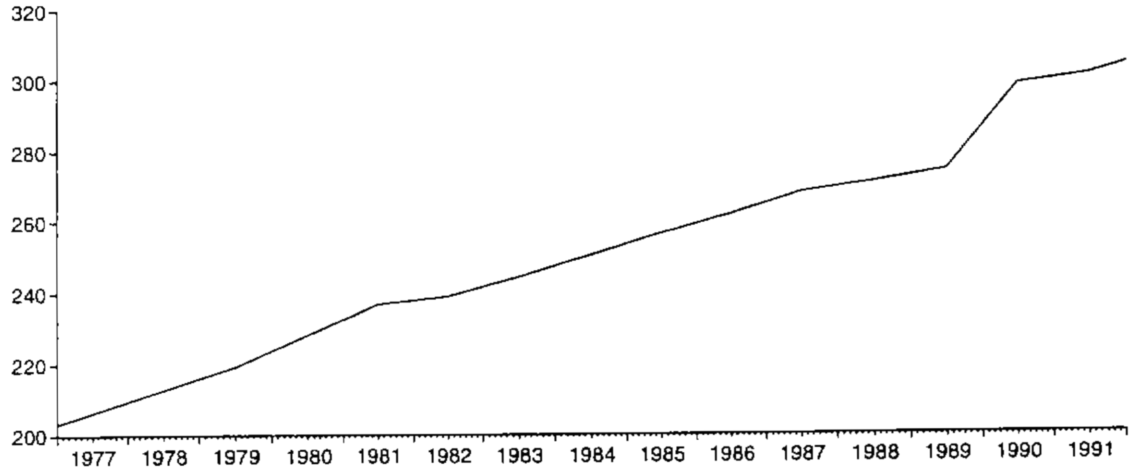

Figure 4.7. Drivers Licences in Tasmania (x 1000)

Table 4.1. All Serious and Fatal Accidents in Hobart and Launceston

Variable		Coefficient	S.E.	t Statistic	*p*-value
Constant Term		10.3153			
Seasonal Terms	Sin	0.0619	0.0260	2.38	0.0172
	Cos	0.0068	0.0329	0.21	0.8359
	Sin2	-0.0171	0.0197	-0.87	0.3841
	Cos2	0.0228	0.0186	1.23	0.2206
	Sin3	0.0311	0.0187	1.66	0.0966
	Cos3	-0.0141	0.0168	-0.84	0.4019
Day of Week	Sunday	-0.2321	0.0394	-5.88	0.0000
	Monday	-0.6040	0.0440	-13.72	0.0000
	Tuesday	-0.6242	0.0444	-14.05	0.0000
	Wednesday	-0.5631	0.0436	-12.91	0.0000
	Thursday	-0.3925	0.0414	-9.48	0.0000
	Friday	-0.2218	0.0393	-5.64	0.0000
Type of Day	School Holidays	-0.1035	0.0397	-2.61	0.0092
	Public Holidays	0.0444	0.0381	1.17	0.2438
Road Usage	Petrol Production	-0.0001	0.0002	-0.29	0.7704
	Vehicle Reg's	-0.0114	0.0068	-1.68	0.0929
Economic Indicators	Alcohol Expenditure	0.0016	0.0005	3.24	0.0012
	Disposable Inc.	-0.8926	0.5377	-1.66	0.0970
	Unemployment	-0.0138	0.0134	-1.03	0.3019
Weather - Hobart	Maximum	-0.0002	0.0005	-0.45	0.6508
	Minimum	0.0003	0.0006	0.51	0.6098
	Rainfall	0.0009	0.0003	2.67	0.0077
	Sunshine	0.0010	0.0005	1.91	0.0557
	Maximum	0.0002	0.0007	0.30	0.7657
Launceston					
	Minimum	-0.0002	0.0005	-0.43	0.6675
	Rainfall	0.0008	0.0003	2.43	0.0151
	Sunshine	0.0004	0.0005	0.73	0.4652
Time		0.1120	0.0643	1.74	0.0817
RBT	Program (non-enforcement)	0.2351	0.0724	3.25	0.0012
	Introduction (12 months)	-0.5116	0.1309	-3.91	0.0001
Deviance	5538.61				
d.f.	5442				

Hobart and Launceston Regions Combined

Effect of RBT

The initial impact of RBT was a significant 24% drop in accident numbers (Table 4.1). This reduction was generated by a large Introduction effect, which dropped to 5% of its initial value after about a year, and a non-enforcement Program effect that (like some of the New South Wales analyses) had a positive coefficient. The combination of a transitory Introduction effect and a positive Program effect means that the reduction in accidents ceased after about three months (95 days). An estimated 36 serious accidents were prevented in this period. Thereafter the model suggests that RBT was associated with *higher* than predicted accident levels.

The effect of RBT as measured by this model can be seen in Figure 4.1. Here the dashed line represents the fitted trend for accidents (serious and fatal) between 1977 and 1991. If the RBT terms (Introduction and non-enforcement Program components) are excluded from the model then the fit represented by the heavy continuous line is obtained. The difference between the dashed and heavy lines represents the effect of RBT. It can be seen that initially accidents reduced to a level below what would have been expected in the absence of RBT. However after a period of less than a year the accident rates returned to the pre-RBT levels and subsequently exceeded pre-RBT levels.

Great care must be taken in interpreting this result. In reality what the model means is that after RBT accident rates ceased to decline in the same way as they had been declining prior to the introduction of RBT. The downward trend in accidents between 1977 and 1982 was not continued at the same pace after 1982. To understand why this happened would require a fuller explanation of the reasons for the decline in accident rates prior to 1982.

In an unpublished analysis of Tasmanian accident trends in the 1970s and 1980s, Leggett (1991) observed that there were steady reductions in alcohol-involved accidents between 1975 and 1981, associated with a marked increase in breath testing and prosecutions over the period, particularly resulting from the convenience provided by the introduction of breath screening devices in 1971. He concludes "... that the introduction and steadily stepped-up use of the breathalyser in the 1970s has much more markedly reduced alcohol involvement in traffic fatalities than the introduction of RBT in the 1980s." (p. 4).

The results of the present analysis are consistent with this conclusion, although it is possible that the impact of RBT would have appeared greater if monthly or daily enforcement data had been available for analysis back to January 1983. This is especially the case since the rate of random breath testing in Tasmania has always been higher than in other states, including New South Wales. Indeed, during the 1980s the ratios of tests per licence holder in Tasmania each year were on average double the New South Wales ratios, and have remained higher in Tasmania into the mid-1990s (Leggett, 1991; see also Chapter 7).

The effects of other factors

As expected the coefficients for the day of the week factor are significant in Table 4.1. They are calculated with reference to Saturdays and since they are all significantly negative, most accidents occur on Saturdays. The coefficients also indicate declining numbers to a low on Tuesdays and then increasing numbers from Tuesdays till the peak occurring on Saturdays.

It appears as though significantly fewer accidents occur in school holiday periods than during school terms, and that increases in private alcohol expenditure lead to increased accident numbers.

Weather data for Hobart and Launceston were included in this analysis. Rainfall is shown to be of importance even though rain in Launceston will not affect numbers of accidents in Hobart and vice versa. Also included was the number of hours of sunshine on the day. This factor is of importance in the Hobart area.

The deviance value of 5538.61 on 5442 degrees of freedom indicates a satisfactory fit for this model.

Effect of Enforcement Level: Separate Analyses for Hobart and Launceston

For Launceston eight years' data and for Hobart only four years' enforcement data were available. Figures 4.8 to 4.11 present plots of the total numbers of drivers tested in different areas, summing across all times of the day. Since the data are daily, a smoothing factor was applied to make the graphs more readable.

It can be seen that levels of enforcement were high at holiday times, but that there was no general trend upward, in contrast to New South Wales. Table 4.2 shows that, as expected, testing levels were much higher in all regions in the evening period (4 pm to midnight), with two to three times as many tests conducted in the Hobart area as in the Launceston area. Testing levels in the country after midnight were particularly low.

The daily counts of numbers of drivers tested at the three times of the day or night were included as explanatory variables in models of serious accidents occurring in Launceston and Hobart. To facilitate the modelling process these daily counts, which are subject to large fluctuations, were filtered using an autoregressive filter. The filtering also compensated to some extent for problems encountered in the data, namely in some instances:

- it was not clear whether a zero signified no RBT operations or a missing value; and

- it appeared as though two days testing may have been noted for one day and a zero for the other.

Lag times for enforcement levels of different lengths, namely one, two, three and four week lags were tested. A period of three weeks was found to be significant. The models for both regions appeared to fit the data adequately.

Numbers of drivers tested in RBT operations in Launceston made a significant difference to accident numbers (Table 4.3). A deviance analysis indicated that the enforcement level terms (for the three times, the four lag periods, and both country and city areas) contributed significantly to the model (the difference in deviances was 53.2024 on 24 (3x4x2) degrees of freedom, which is significant at the 1% level of significance). The important term was the number of drivers tested between 4 pm and midnight. It would appear as if higher numbers of tests during these hours translates to reduced numbers of accidents three weeks later.

Only marginally significant effects were found for the Hobart analysis (Table 4.4). An analysis of deviance yielded a chi-squared value of 3.59 on 24 degrees of freedom. However there are some indications of a negative relationship between numbers of vehicles stopped late at night (after midnight) and accident numbers.

Table 4.2. Average Number of Drivers Tested on a Daily Basis

Area and Time	City		
	Hobart (From 1/1/88)	Launceston (From 1/1/84)	Launceston (From 1/1/88)
Metropolitan			
Daytime	8.33	2.48	4.91
Evening/Night	169.09	82.62	84.23
Late Night	38.02	14.31	14.31
Country			
Daytime	1.84	0.31	0.48
Evening/Night	46.81	16.01	16.01
Late Night	3.83	1.74	1.44
Metro & Country			
Daytime	10.18	2.79	5.39
Evening/Night	216.69	98.65	100.27
Late Night	42.01	16.14	15.75
Total	272.95	117.4	120.95

Note: Daytime = 8 am to 4 pm. Evening/Night = 4 pm to Midnight. Late Night = Midnight to 8 am.

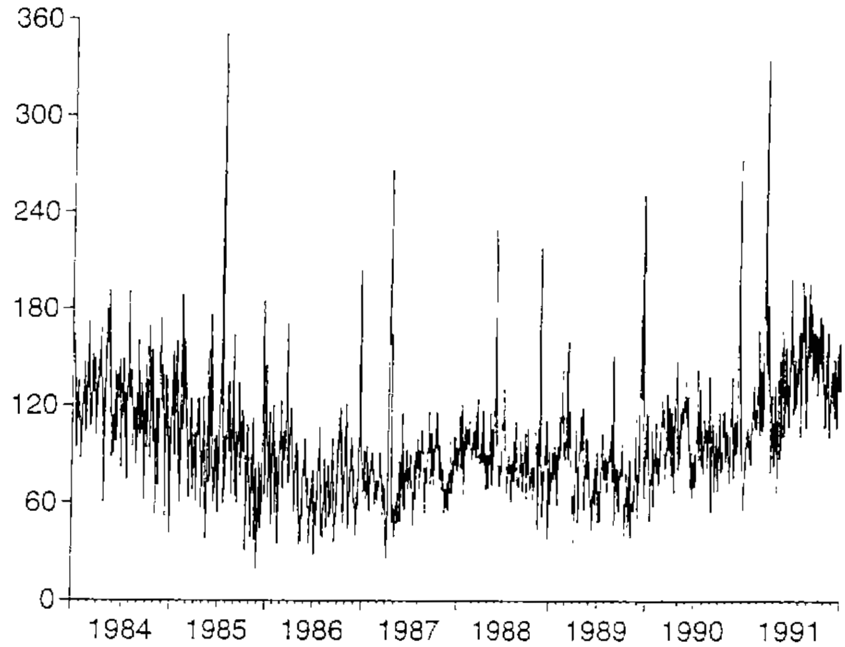

Figure 4.8. Drivers Tested in Metropolitan Launceston (all times of day) (Daily Figures)

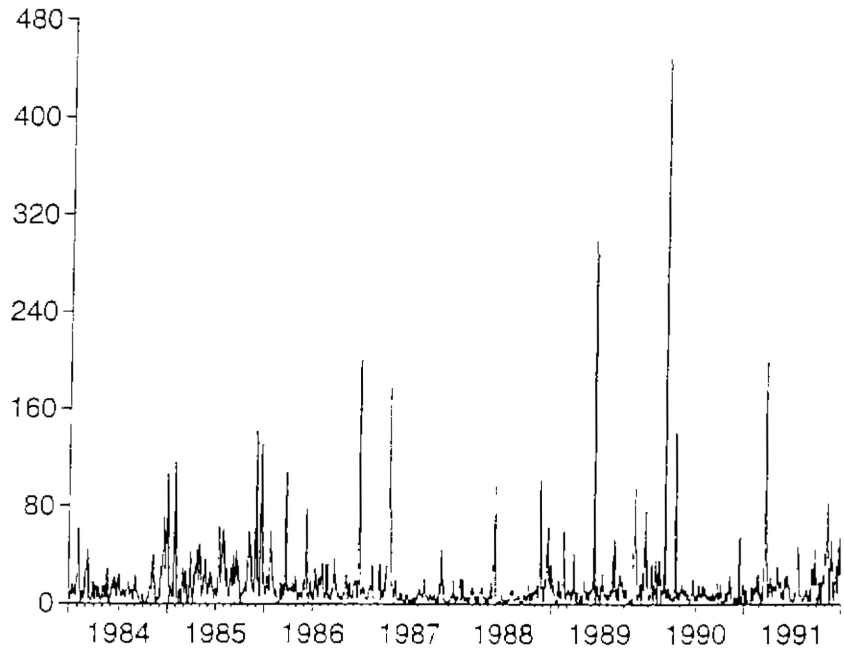

Figure 4.9. Drivers Tested in Country Launceston (all times of day) (Daily Figures)

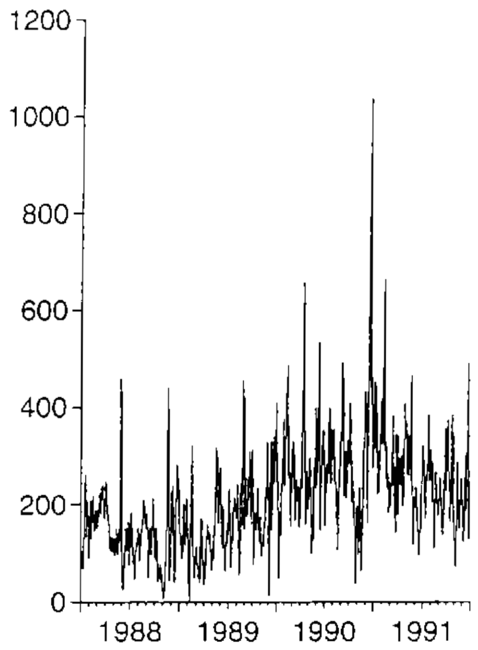

Figure 4.10. Drivers Tested in Metropolitan Hobart (all times of day) (Daily Figures)

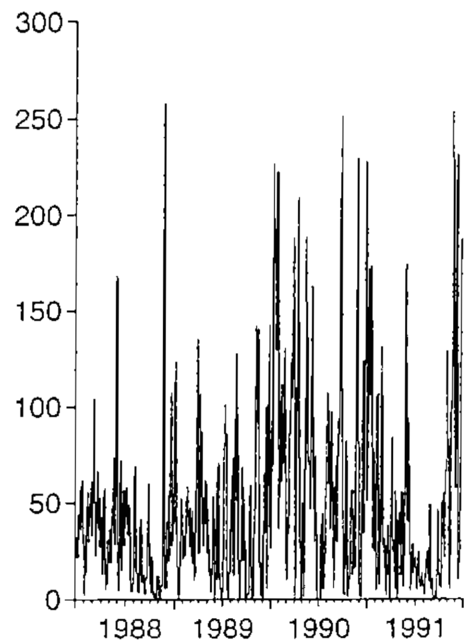

Figure 4.11. Drivers Tested in Country Hobart (all times of day) (Daily Figures)

Table 4.3. Analysis using Enforcement Levels for Launceston City

Variable		Coefficient	S.E.	t Statistic	p-value
Constant Term		96.8258			
Seasonal Terms	Sin	0.5109	0.1800	2.84	0.0046
	Cos	-0.0330	0.1298	-0.25	0.7991
	Sin2	0.1511	0.0936	1.61	0.1066
	Cos2	0.0872	0.0800	1.09	0.2755
	Sin3	-0.0641	0.0885	-0.72	0.4687
	Cos3	-0.0209	0.0716	-0.29	0.7706
Day of Week	Monday	0.0074	0.1952	0.04	0.9697
	Tuesday	-0.1773	0.2056	-0.86	0.3885
	Wednesday	0.1366	0.1904	0.72	0.4733
	Thursday	0.2355	0.1864	1.26	0.2065
	Friday	0.4476	0.1786	2.51	0.0123
	Saturday	0.3174	0.1831	1.73	0.0831
Type of Day	School Holidays	-0.0438	0.1590	-0.28	0.7831
	Public Holidays	-0.2047	0.1769	-1.16	0.2472
Road Usage	Petrol Production	0.0004	0.0009	0.45	0.6502
	Vehicle Reg's	-0.0913	0.0316	-2.89	0.0039
Economic Indicators	Alcohol Expenditure	0.0037	0.0033	1.10	0.2715
	Disposable Income	-7.6973	3.398	-2.27	0.0236
	Unemployment	0.0819	0.0968	0.85	0.3977
Weather	Maximum	0.0013	0.0020	0.66	0.5090
	Minimum	-0.0009	0.0018	-0.50	0.6137
	Rainfall	0.0012	0.0012	1.03	0.3011
	Sunshine	-0.0001	0.0017	-0.04	0.9677
Time		1.3094	0.4509	2.90	0.0037
Drivers Tested (3 Week Lag)	Day	-0.0002	0.0005	-0.36	0.7185
	Evening/Night	-0.0005	0.0001	-4.16	0.0000
	Late Night	0	0.0005	0.02	0.9823
Deviance	2809.83				
d.f.	2868				

Table 4.4. Analysis using Enforcement Levels for Hobart City

Variable		Coefficient	S.E.	t Statistic	*p*-value
Constant Term		-13.0478			
Seasonal Terms	Sin	0.1545	0.2032	0.76	0.4471
	Cos	0.1151	0.1189	0.97	0.3331
	Sin2	-0.0728	0.0863	-0.84	0.3986
	Cos2	0.1360	0.0838	1.62	0.1047
	Sin3	0.0674	0.0845	0.80	0.4255
	Cos3	0.0012	0.0708	0.02	0.9862
Day of Week	Saturday	0.2631	0.1530	1.72	0.0858
	Sunday	-0.1543	0.1695	-0.91	0.3627
	Monday	-0.1354	0.1682	-0.81	0.4209
	Tuesday	-0.2792	0.1741	-1.60	0.1089
	Wednesday	0.0528	0.1603	0.33	0.7422
	Thursday	0.0129	0.1622	0.08	0.9368
Type of Day	School Holidays	-0.3493	0.1546	-2.26	0.0240
	Public Holidays	-0.1894	0.1674	-1.13	0.2579
Road Usage	Petrol Production	-0.0001	0.0007	-0.13	0.8937
	Vehicle Reg's	0.0538	0.0756	0.71	0.4769
Economic Indicators	Alcohol Expenditure	0.0054	0.0035	1.56	0.1194
	Disposable Income	-0.8173	3.9128	-0.21	0.8346
	Unemployment	0.1250	0.1340	0.93	0.3510
Weather	Maximum	-0.0009	0.0015	-0.62	0.5378
	Minimum	0.0006	0.0019	0.33	0.7433
	Rainfall	0.0006	0.0012	0.47	0.6392
	Sunshine	0.0017	0.0016	1.02	0.3094
Time		-0.2908	0.6481	-0.45	0.6537
Drivers Tested (3 Week Lag)	Day	-0.0004	0.0004	-1.11	0.2681
	Evening/Night	0.0001	0.0001	0.89	0.3723
	Late Night	-0.0004	0.0002	-1.99	0.0469
Deviance	1536.76				
d.f.	1407				

Summary

The most marked characteristic of the Tasmanian data is the steep decline in accidents prior to the introduction of RBT in January 1983, followed by a virtual plateau until the late 1980s (Figure 4.1). This pattern, combined with low accident frequencies and a lack of detailed enforcement data back to 1983, make it extremely difficult to determine with any accuracy the impact of RBT.

It is clear that RBT was associated with a marked but temporary decline in serious accidents, corresponding to perhaps 36 accidents prevented over a three months period. Thereafter no impact of RBT can be discerned from the available data, although this is not equivalent to concluding that RBT had no impact. Indeed, the likelihood of some impact is heightened by the high overall levels of testing maintained in Tasmania during the 1980s. Separate analyses for Hobart and Launceston (metropolitan and regional) provide some tentative support for the hypothesis that levels of testing are associated with accident reductions, since in Launceston tests conducted between 4 pm and midnight were associated with lower numbers of accidents.

Leggett (1991) appears to be correct in concluding that the introduction of screening breath devices in the 1970s, and the gradual expansion of breath testing in this period, had a greater impact than RBT on alcohol-related accidents. The relative lack of impact of RBT, if correct, may reflect not a failure of police enforcement (since the evidence is that they enforced the law with great vigour) but a failure to publicise the law adequately through the mass media, as was done in New South Wales. Unfortunately this hypothesis cannot be tested with the available data.

Results for Tasmania are therefore rather inconclusive.

CHAPTER 5. WESTERN AUSTRALIA

Analyses were carried out on numbers of accidents occurring in Western Australia between the beginning of 1980 and the end of 1992. The following six groupings of accidents were analysed:

- All serious accidents in Western Australia
- Fatal accidents in Western Australia
- Single-vehicle night-time serious accidents in Western Australia
- All serious accidents in Perth
- Fatal accidents in Perth; and
- Single-vehicle night-time serious accidents in Perth.

Separate analyses were carried out for Perth for two reasons. First, over the period of the study 58% of all serious accidents in Western Australia occurred in Perth. Secondly, a significant cause of accidents is rainfall, with a higher incidence of accidents on rainy days. Due to the vastness of Western Australia it is only possible to take account of Perth weather conditions. Trends in the above groups of accident numbers are presented in Figures 5.1 to 5.6 after suitable smoothing. Control variables for the state are in Figures 5.7 to 5.10.

It is not appropriate to include an exponential term in the modelling of the effect of the introduction of RBT, since the time series is too short post-RBT. The enforcement statistics for Western Australia consist of numbers of vehicles stopped, numbers of drivers tested as well as other data such as numbers of positive tests, numbers charged and time spent by police on RBT operations. Separate analyses were carried out on the post-RBT data to determine the effect of the various measures of enforcement on accidents, but only the effects of enforcement on single-vehicle night-time accidents in Perth showed any signs of statistical significance.

Consequently, the impact of RBT in Western Australia is assessed chiefly by the inclusion of a step function to represent the non-enforcement Program effect. Although this implicitly implies that the effect of RBT is permanent, this may of course not be the case.

A form of de facto RBT was being practised in Western Australia prior to the introduction of formal RBT. Since this form of testing was replaced by formal RBT its effect is expected to be short-term and thus is only included in the model as having had an effect between June 1986 and October 1988.

There was also a "skipper" campaign which encouraged groups of people going out, for example, for an evening's entertainment, to appoint

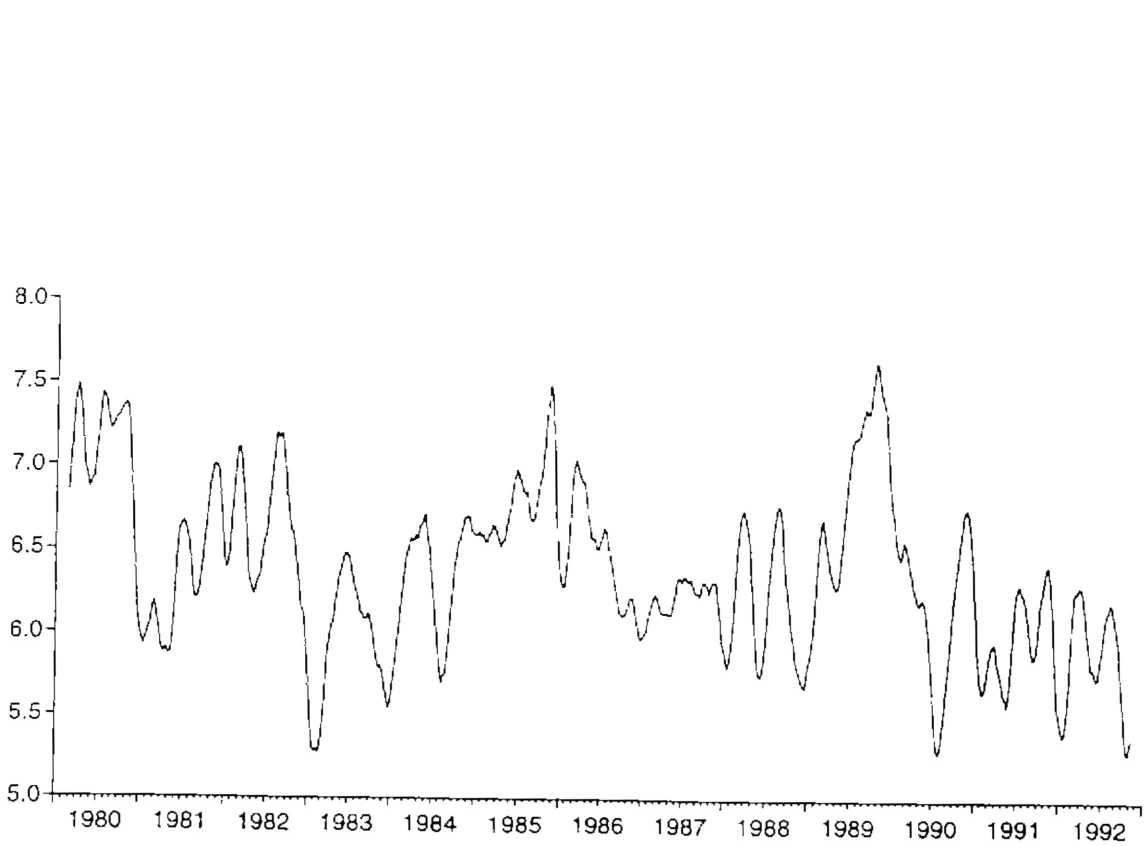

Figure 5.1. Serious and Fatal Accidents in Western Australia (1980-1992) (Daily Figures)

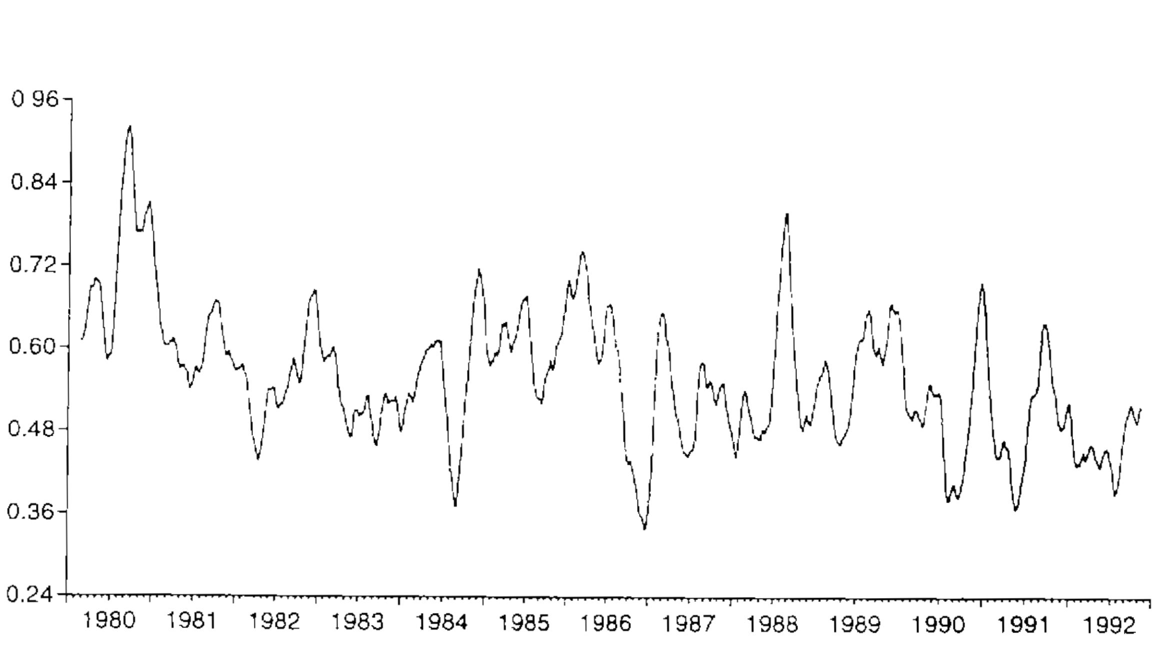

Figure 5.2. Fatal Accidents in Western Australia (1980-1992) (Daily Figures)

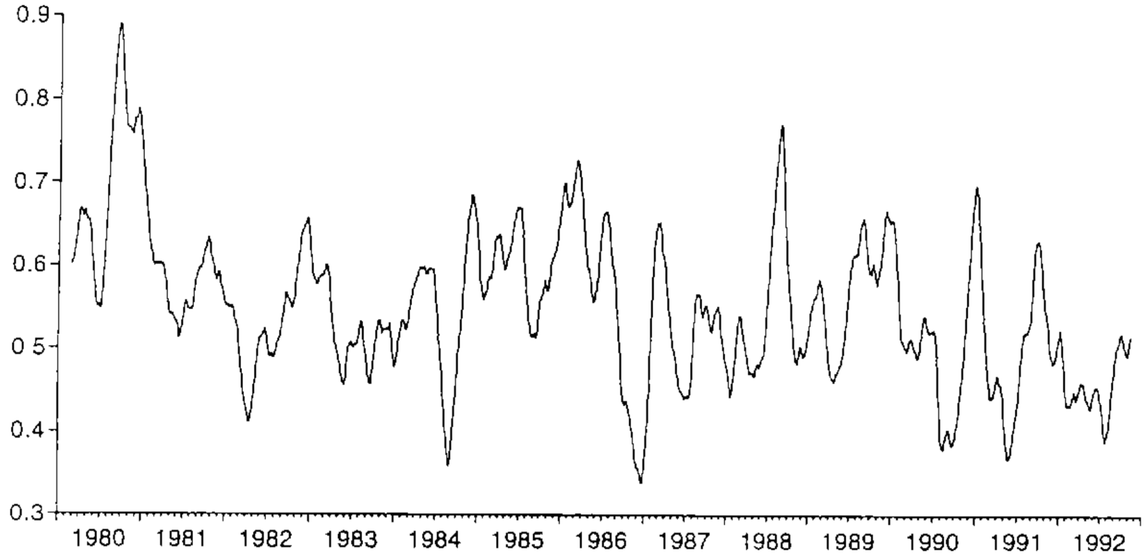

Figure 5.3. Single-Vehicle Night-Time Accidents in Western Australia (1980-1992) (Daily Figures)

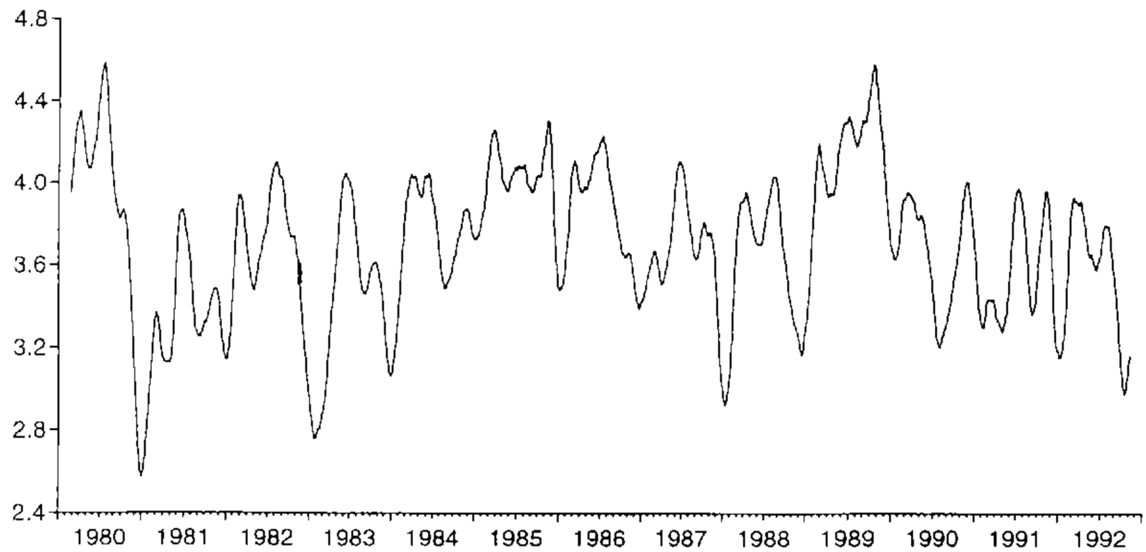

Figure 5.4. Serious and Fatal Accidents in Perth (1980-1992) (Daily Figures)

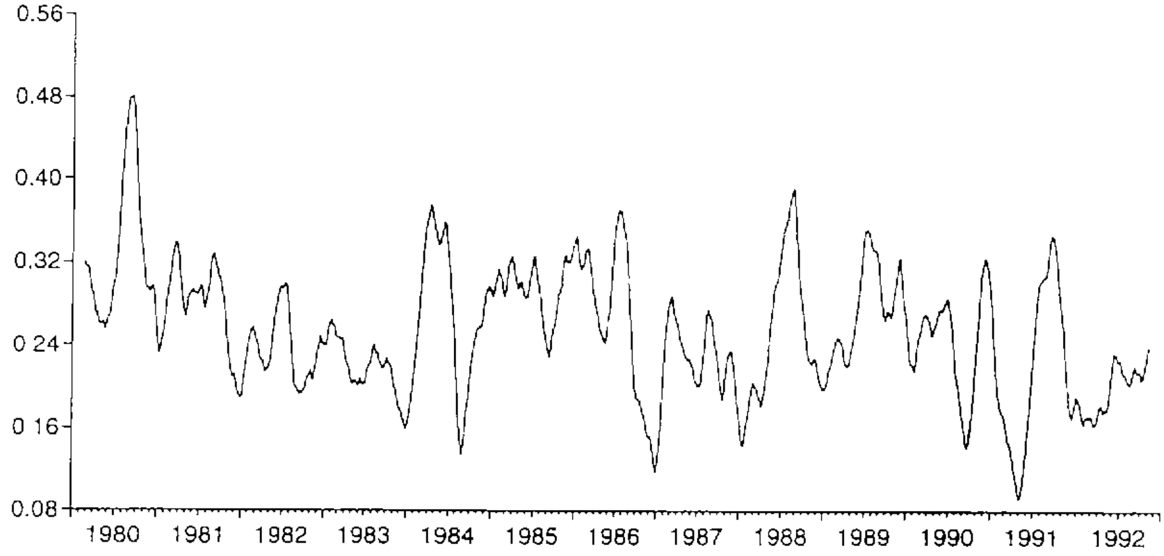

Figure 5.5. Fatal Accidents in Perth (1980-1992) (Daily Figures)

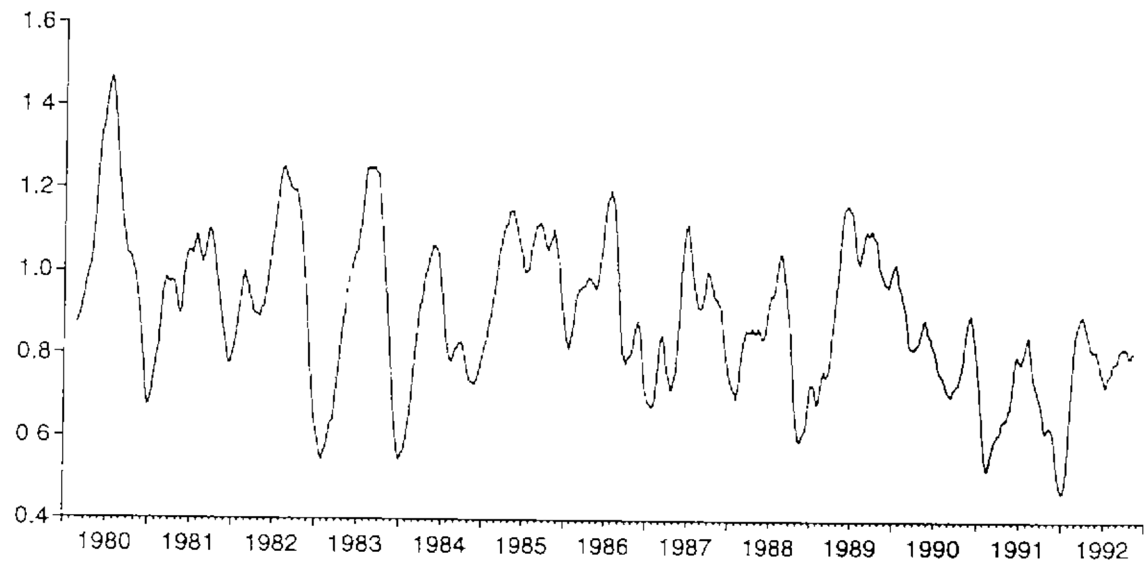

Figure 5.6. Single-Vehicle Night-Time Accidents in Perth (1980-1992) (Daily Figures)

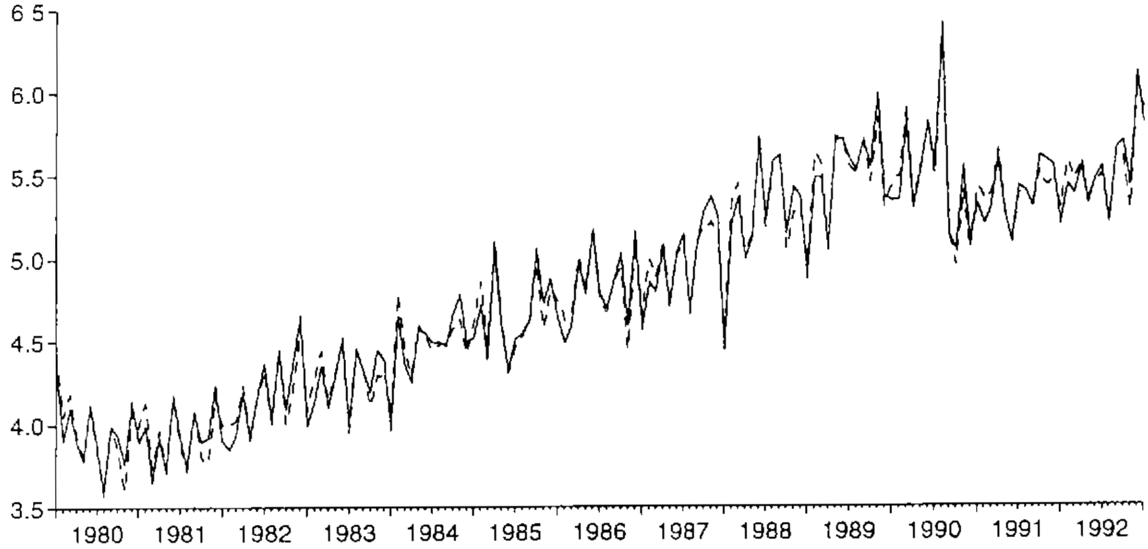

Figure 5.7. Petrol Sales in Western Australia (Megalitres)

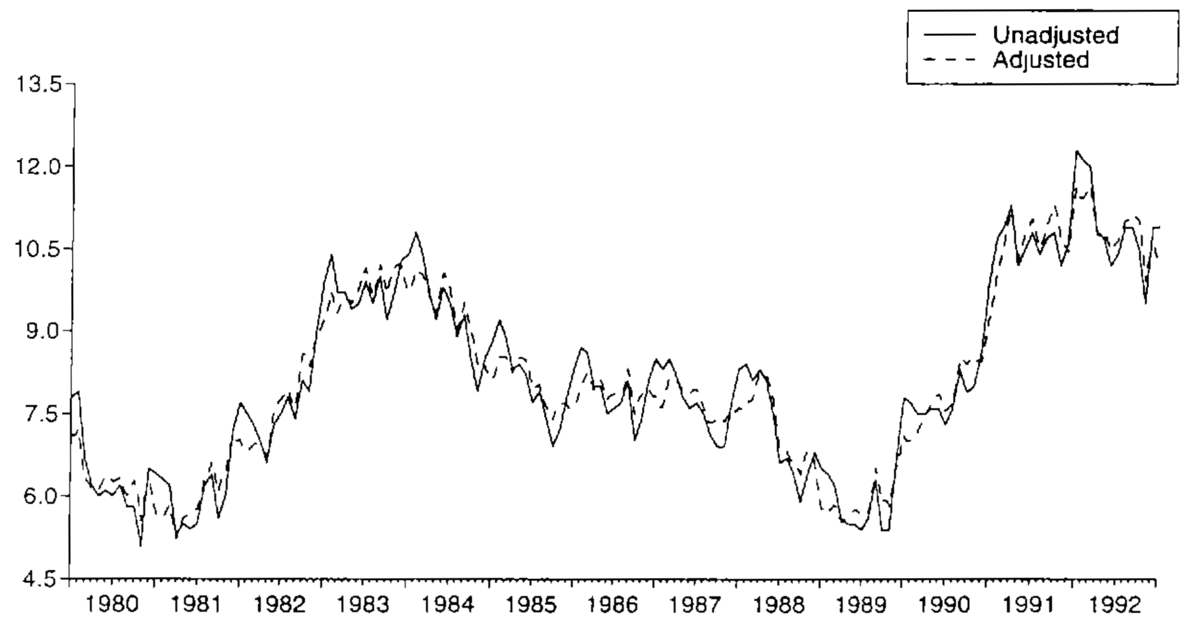

Figure 5.8. Unemployment Rate for Western Australia (%)

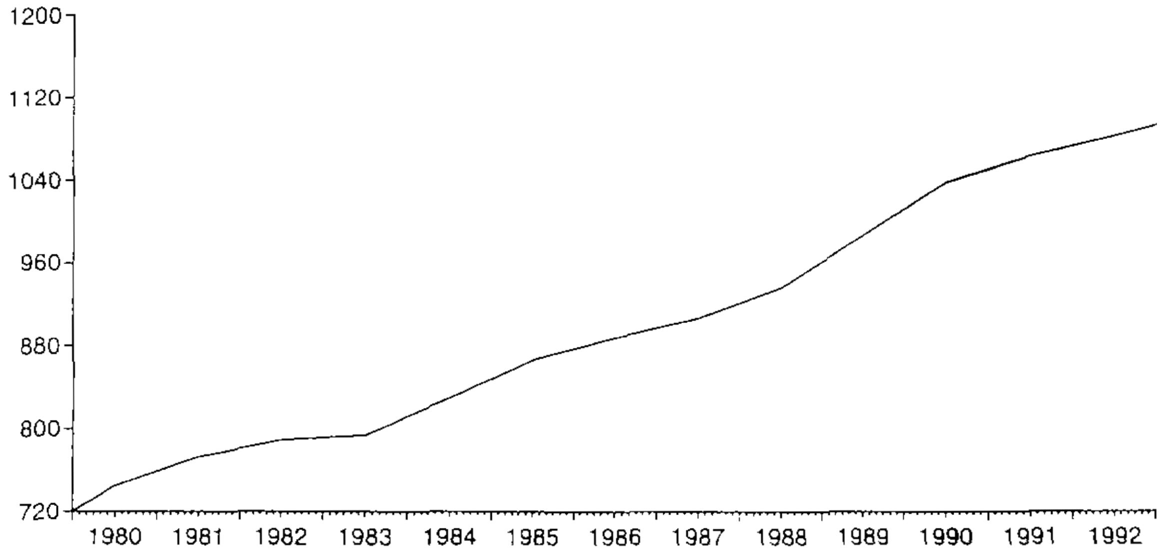

Figure 5.9. Vehicle Registrations in Western Australia (x 1000)

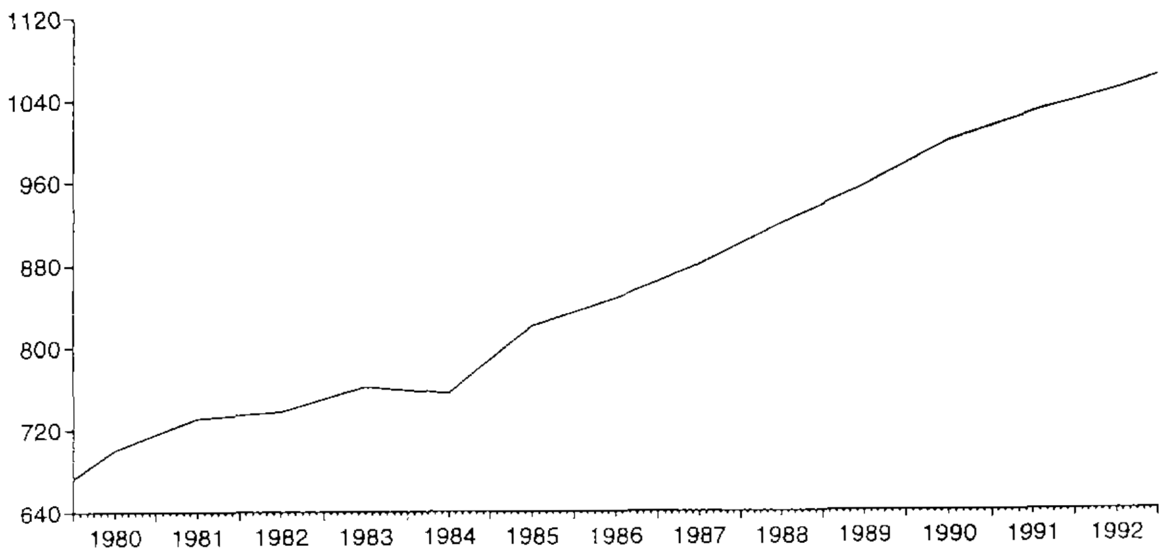

Figure 5.10. Drivers Licences in Western Australia (x 1000)

a skipper or driver who would not consume alcohol and would be responsible for driving the rest of the group home. However, this campaign was not found to have had a significant effect.

Effect of the Introduction of RBT

Relevant details regarding the variables included in the models are as follows:

- The effects of days of the week are estimated in relation to Tuesdays. Thus for example, the coefficient for Saturday will always be large indicating that significantly more accidents occur on Saturdays than on Tuesdays.

- Similarly the factor for the type of day is calculated with reference to days within the school terms.

- Perth weather information was used for all the analyses since it is impossible to incorporate accurate weather information for all parts of the state in the models. Thus, for example, Perth rainfall is used in the models for all accidents in Western Australia in preference to using no rainfall indicator at all.

Details of the models are presented in Tables 5.1 to 5.6. The first three tables concern the analyses of accidents in all of Western Australia and the last three are the Perth analyses.

The introduction of RBT corresponded to a significant lowering of accident numbers on Western Australian roads. This is evident from Tables 5.1 to 5.3 and Table 5.6. All serious accidents in Western Australia are estimated to have been reduced by 13% after the introduction of RBT, corresponding to 334 accidents per year prevented (1443 total). The accidents that are most likely to be alcohol-related, namely single-vehicle night-time accidents, were reduced by 26% for the whole of the state and by 25% for Perth. This corresponded to 212 single-vehicle night-time accidents prevented each year across the state, and 902 during the entire study period. The figures for Perth were 417 single-vehicle night-time accidents in total and 98 per year. Most importantly, an estimated 28% fewer fatal accidents occurred in Western Australia from October 1988 (72 accidents prevented per year, and 280 in total).

It is interesting to note that for all serious accidents and fatal accidents in Perth, RBT was not significant. However, de facto RBT was nearly significant for both these accident series, corresponding to accident reductions of 8% and 23% respectively (277 serious accidents and 64 fatal accidents prevented in total, or 118 and 27 respectively each year). It was also associated with a reduction of 17% in single-vehicle night-time accidents in Perth (159 accidents prevented in all, or 68 each year), and a 9% reduction state-wide for all serious accidents (508 accidents prevented in all, or 217 per year).

This suggests that RBT, especially in Perth, was viewed by both police and public as an extension of de facto testing rather than as a radically new enforcement technique. This is supported by enforcement data presented in Figures 5.11 to 5.16, which suggest that enforcement levels actually dropped during the initial stages of RBT. The "low visibility" of RBT as a distinct program in the early years, combined with low levels of stopping and even lower levels of testing, probably explain its non-significant effects in Perth. The fact that it was more significant across the whole state suggests that in country areas RBT may have been more successful, or it may reflect the greater statistical power available in state-wide analyses.

With regard to the other variables in the models, the effect of rain is evident from the Perth analyses. As expected the terms for day of the week are significant due to the differences in numbers of accidents that occur on different days of the week. Of the economic indicators, unemployment appears to be an important predictor of accident numbers (the relevant indicators for the state are presented in Figures 5.7 to 5.10). The relationship between these two variables is evident from a comparison of Figures 5.1 and 5.8. The coefficient for the linear time trend is not significant for any of the models. However this is due to the fact that many of the variables in the model display long-term trends over time.

Effect of Level of Enforcement

Enforcement statistics are available for Western Australia on a weekly basis. Graphs 5.11 to 5.16 represent these data in terms of daily figures, showing trends in vehicles stopped, the proportion of drivers tested, and police hours spent on RBT each week. The Western Australian data are unique in that vehicles stopped and drivers tested are explicitly distinguished. Over the period of this study, only slightly more than half of all drivers pulled over were recorded as having been tested. Although it is certain that in other states some drivers pulled over are not tested, it is not clear how high the percentage is and the practice is not officially sanctioned. In other states therefore the police enforcement data are for drivers tested.

On average 236 vehicles were stopped per day in Western Australia, of which 152 were in Perth. From the plots of numbers of vehicles stopped and police hours spent on RBT operations, it can be seen that in general, levels of enforcement dropped during the initial stages of RBT. This may be a contributing factor to the increase in overall numbers of accidents during 1988, but prevailing economic conditions at the time are more likely to be of importance. The increase in levels of enforcement in Perth at the beginning of 1991 correspond to a review of policies and in particular policy regarding the enforcement of RBT by the then newly-appointed Assistant Commissioner for Traffic Operations.

The reported average testing rate is 52.6% for all of Western Australia and 54.2% for Perth. However from observations at the time the reported numbers of drivers tested of those stopped is artificially high, and the actual ratio is probably up to 20% less than the given figures. The given ratio appears to have declined in the initial stages of RBT throughout Western Australia, although there was an initial increase in Perth.

Testing levels in Perth in 1992 seemed to be higher than in previous years.

In order to gauge the effect of levels of enforcement on accident numbers, the data on accidents which occurred after the introduction of RBT were analysed. Since different regions of Western Australia will have different levels of enforcement at any given time, only the data for Perth were used. The measures used for levels of enforcement were numbers of vehicles stopped and ratio of drivers tested. Different lag times were used, namely 1 week, 2 weeks, 3 weeks and 4 weeks (corresponding to the variables Stopped(1) to Stopped(4) and Tested(1) to Tested(4) in Table 5.7).

No significant effects were found for all serious and for fatal accidents. There was some evidence that numbers of vehicles stopped in Perth had a significant negative impact on the number of single-vehicle night-time accidents, with a three week lag or delay between enforcement levels and their impact, but the overall deviance for the enforcement terms (10.80 with 8 d.f.) was not significant. The results are presented in Table 5.7.

Table 5.1. All Serious Accidents in Western Australia

Variable		Estimate	S.E.	t Statistic	p-value
Constant term		0.9576			
Seasonal Terms	Sin	-0.0287	0.0144	-1.99	0.0465
	Cos	-0.0053	0.0136	-0.39	0.6948
	Sin2	-0.0125	0.0100	-1.26	0.2087
	Cos2	-0.0213	0.0088	-2.40	0.0162
	Sin3	-0.0312	0.0095	-3.29	0.0010
	Cos3	-0.0265	0.0090	-2.95	0.0032
Day of Week	Wednesday	0.0618	0.0243	2.54	0.0110
	Thursday	0.1363	0.0239	5.71	0.0000
	Friday	0.3816	0.0226	16.86	0.0000
	Saturday	0.3995	0.0227	17.61	0.0000
	Sunday	0.2710	0.0233	11.63	0.0000
	Monday	-0.0054	0.0248	-0.22	0.8275
Type of day	School Holidays	-0.0190	0.0176	-1.08	0.2813
	Public Holidays	-0.0122	0.0249	-0.49	0.6226
Road Usage	Petrol Sales	0.0248	0.0337	0.73	0.4624
	Vehicle Reg's	0.0013	0.0007	1.69	0.0915
Economic Indicators	Alcohol Expenditure	-0.0001	0.0004	-0.25	0.8059
	Disposable Income	0.3627	0.2973	1.22	0.2226
	Unemployment	-0.0259	0.0065	-3.99	0.0001
Weather	Maximum	0.0002	0.0002	1.03	0.3032
	Minimum	-0.0001	0.0002	-0.25	0.7994
	Rainfall	0.0007	0.0001	7.88	0.0000
Time		-0.0634	0.0441	-1.44	0.1502
De facto RBT		-0.0909	0.0300	-3.03	0.0025
RBT		-0.1402	0.0470	-2.98	0.0029

Deviance 5120.18

d.f. 4718

Table 5.2. Fatal Accidents in Western Australia

Variable		Estimate	S.E.	t Statistic	p-value
Constant term		-3.8345			
Seasonal Terms	Sin	-0.0430	0.0400	-1.07	0.2828
	Cos	0.0419	0.0439	0.96	0.3395
	Sin2	0.0165	0.0301	0.55	0.5847
	Cos2	0.0054	0.0286	0.19	0.8511
	Sin3	-0.0319	0.0298	-1.07	0.2838
	Cos3	0.0108	0.0292	0.37	0.7116
Day of Week	Wednesday	0.0700	0.0823	0.85	0.3952
	Thursday	0.1710	0.0804	2.13	0.0335
	Friday	0.4486	0.0758	5.92	0.0000
	Saturday	0.6272	0.0737	8.51	0.0000
	Sunday	0.5057	0.0753	6.71	0.0000
	Monday	-0.0527	0.0851	-0.62	0.5354
Type of day	School Holidays	-0.0196	0.0571	-0.34	0.7311
	Public Holidays	0.0859	0.0761	1.13	0.2592
Road Usage	Petrol Sales	0.2755	0.1071	2.57	0.0101
	Vehicle Reg's	0.0044	0.0024	1.83	0.0674
Economic Indicators	Disposable Income	-0.1610	0.6792	-0.24	0.8127
	Unemployment	-0.0283	0.0193	-1.47	0.1424
Weather	Maximum	0.0001	0.0006	0.09	0.9262
	Minimum	0.0001	0.0007	0.12	0.9019
	Rainfall	0.0005	0.0003	1.60	0.1089
Time		-0.1341	0.1141	-1.18	0.2396
De facto RBT		-0.1344	0.0940	-1.43	0.1530
RBT		-0.3271	0.1501	-2.18	0.0293

Deviance 4704.58

d.f. 4719

Table 5.3. Single-Vehicle Night-Time Accidents in Western Australia

Variable		Estimate	S.E.	t Statistic	p-value
Constant term		-3.4333			
Seasonal Terms	Sin	-0.0396	0.0404	-0.98	0.3271
	Cos	0.0535	0.0441	1.21	0.2255
	Sin2	0.0149	0.0303	0.49	0.6225
	Cos2	0.0034	0.0288	0.12	0.9055
	Sin3	-0.0288	0.0300	-0.96	0.3369
	Cos3	0.0006	0.0294	0.02	0.9829
Day of Week	Wednesday	0.0574	0.0828	0.69	0.4883
	Thursday	0.1631	0.0808	2.02	0.0434
	Friday	0.4375	0.0762	5.74	0.0000
	Saturday	0.6111	0.0741	8.24	0.0000
	Sunday	0.5018	0.0756	6.64	0.0000
	Monday	-0.0610	0.0855	-0.71	0.4758
Type of day	School Holidays	-0.0178	0.0575	-0.31	0.7570
	Public Holidays	0.0899	0.0765	1.17	0.2402
Road Usage	Petrol Sales	0.2740	0.1079	2.54	0.0111
	Vehicle Reg's	0.0038	0.0024	1.60	0.1102
Economic Indicators	Disposable Income	-0.1317	0.6818	-0.19	0.8469
	Unemployment	-0.0262	0.0194	-1.35	0.1767
Weather	Maximum	0.0000	0.0006	-0.05	0.9615
	Minimum	0.0001	0.0007	0.18	0.8572
	Rainfall	0.0005	0.0003	1.73	0.0845
Time		-0.1206	0.1143	-1.05	0.2915
De facto RBT		-0.1257	0.0947	-1.33	0.1844
RBT		-0.3028	0.1509	-2.01	0.0449

Deviance 4695.34
d.f. 4719

Table 5.4. All Serious Accidents in Perth

Variable		Coefficient	S.E.	t Statistic	p-value
Constant term		2.2872			
Seasonal Terms	Sin	0.0102	0.0195	0.52	0.6026
	Cos	-0.0207	0.0179	-1.15	0.2489
	Sin2	-0.0106	0.0132	-0.80	0.4212
	Cos2	-0.0198	0.0117	-1.69	0.0916
	Sin3	-0.0273	0.0125	-2.18	0.0290
	Cos3	-0.0446	0.0118	-3.78	0.0002
Day of Week	Wednesday	0.0415	0.0310	1.34	0.1804
	Thursday	0.1264	0.0304	4.17	0.0000
	Friday	0.3424	0.0290	11.81	0.0000
	Saturday	0.2752	0.0296	9.28	0.0000
	Sunday	0.1090	0.0308	3.54	0.0004
	Monday	-0.0392	0.0319	-1.23	0.2186
Type of day	School Holidays	-0.0690	0.0233	-2.96	0.0031
	Public Holidays	-0.1971	0.0355	-5.56	0.0000
Road Usage	Petrol Sales	0.0653	0.0443	1.47	0.1404
	Drivers Lic's	-0.0013	0.0009	-1.49	0.1353
Economic Indicators	Alcohol Expend.	-0.0004	0.0005	-0.72	0.4699
	Disposable Income	0.2573	0.4132	0.62	0.5334
	Unemployment	-0.0264	0.0087	-3.04	0.0024
Weather	Maximum	-0.0003	0.0002	-1.21	0.2275
	Minimum	0.0002	0.0003	0.57	0.5708
	Rainfall	0.0009	0.0001	8.79	0.0000
Time		0.0148	0.0595	0.25	0.8037
De facto RBT		-0.0836	0.0431	-1.94	0.0524
RBT		-0.0674	0.0669	-1.01	0.3137

Deviance 5131.77

d.f. 4718

Table 5.5. Fatal Accidents in Perth

Variable		Coefficient	S.E.	t Statistic	p-value
Constant term		-2.1358			
Seasonal Terms	Sin	-0.0129	0.0588	-0.22	0.8269
	Cos	-0.0413	0.0647	-0.64	0.5236
	Sin2	0.0721	0.0436	1.65	0.0984
	Cos2	0.0329	0.0423	0.78	0.4368
	Sin3	-0.0325	0.0434	-0.75	0.4533
	Cos3	-0.0320	0.0427	-0.75	0.4533
Day of Week	Wednesday	-0.0969	0.1131	-0.86	0.3914
	Thursday	0.1020	0.1078	0.95	0.3441
	Friday	0.2782	0.1037	2.68	0.0073
	Saturday	0.3453	0.1031	3.35	0.0008
	Sunday	0.1571	0.1074	1.46	0.1435
	Monday	-0.2737	0.1194	-2.29	0.0220
Type of day	School Holidays	-0.1854	0.0863	-2.15	0.0317
	Public Holidays	-0.1193	0.1231	-0.97	0.3322
Road Usage	Petrol Sales	0.2941	0.1557	1.89	0.0589
	Drivers Lic's	0.0008	0.0030	0.27	0.7885
Economic Indicators	Disposable Income	-0.6685	1.0211	-0.65	0.5127
	Unemployment	-0.0583	0.0297	-1.96	0.0496
Weather	Maximum	0.0001	0.0009	0.17	0.8640
	Minimum	-0.0002	0.0010	-0.19	0.8455
	Rainfall	0.0007	0.0004	1.78	0.0754
Time		0.0237	0.1594	0.15	0.8816
De facto RBT		-0.2652	0.1432	-1.85	0.0641
RBT		-0.3449	0.2301	-1.50	0.1340

Deviance 4567.40
d.f. 4719

Table 5.6. Single-Vehicle Night-Time Accidents in Perth

Variable		Estimate	S.E.	t Statistic	p-value
Constant term		-1.0183			
Seasonal Terms	Sin	-0.0705	0.0327	-2.15	0.0313
	Cos	-0.1521	0.0364	-4.17	0.0000
	Sin2	-0.0085	0.0244	-0.35	0.7284
	Cos2	-0.0271	0.0233	-1.17	0.2435
	Sin3	-0.0133	0.0241	-0.55	0.5817
	Cos3	-0.0351	0.0235	-1.49	0.1357
Day of Week	Wednesday	0.2289	0.0753	3.04	0.0024
	Thursday	0.4728	0.0716	6.60	0.0000
	Friday	0.8919	0.0667	13.36	0.0000
	Saturday	1.0352	0.0657	15.75	0.0000
	Sunday	0.9401	0.0666	14.12	0.0000
	Monday	0.0986	0.0778	1.27	0.2053
Type of day	School Holidays	-0.0392	0.0460	-0.85	0.3942
	Public Holidays	0.0322	0.0630	0.51	0.6091
Road Usage	Petrol Sales	0.0651	0.0883	0.74	0.4612
	Drivers Lic's	0.0006	0.0016	0.34	0.7370
Economic Indicators	Disposable Income	0.0535	0.5742	0.09	0.9257
	Unemployment	-0.0478	0.0165	-2.89	0.0038
Weather	Maximum	0.0000	0.0005	-0.05	0.9598
	Minimum	0.0003	0.0006	0.59	0.5537
	Rainfall	0.0005	0.0002	1.99	0.0463
Time		-0.0145	0.0889	-0.16	0.8707
De facto RBT		-0.1906	0.0796	-2.40	0.0166
RBT		-0.2897	0.1289	-2.25	0.0247

Deviance 4951.49
d.f. 4719

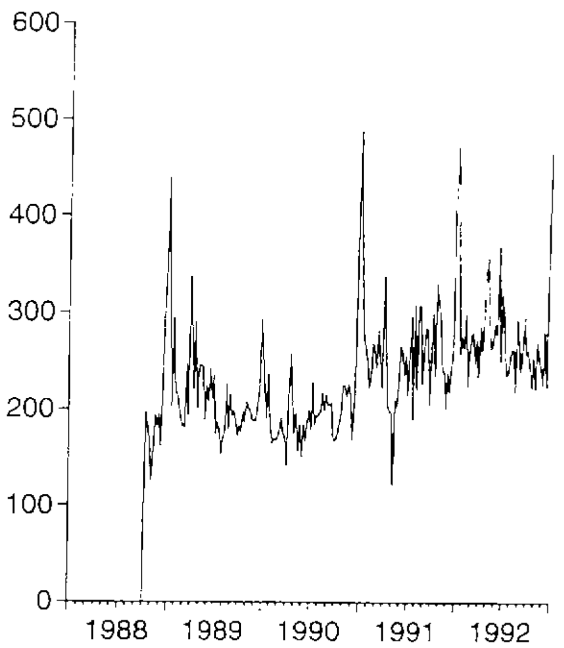

Figure 5.11. Vehicles Stopped in Western Australia Post-RBT (Daily Figures)

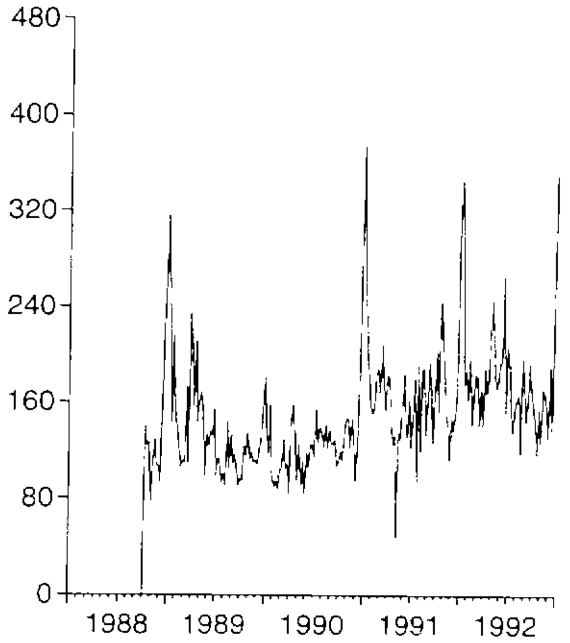

Figure 5.12. Vehicles Stopped in Perth Post-RBT (Daily Figures)

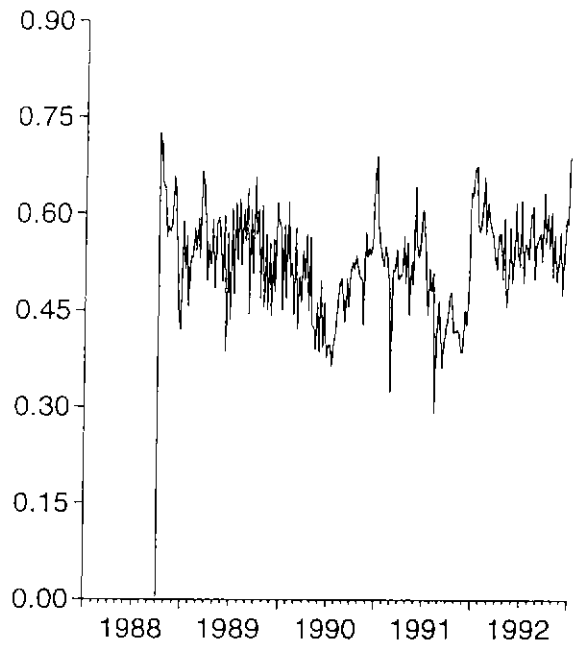

Figure 5.13. Proportion of Drivers Pulled Over Recorded as Tested (Western Australia)

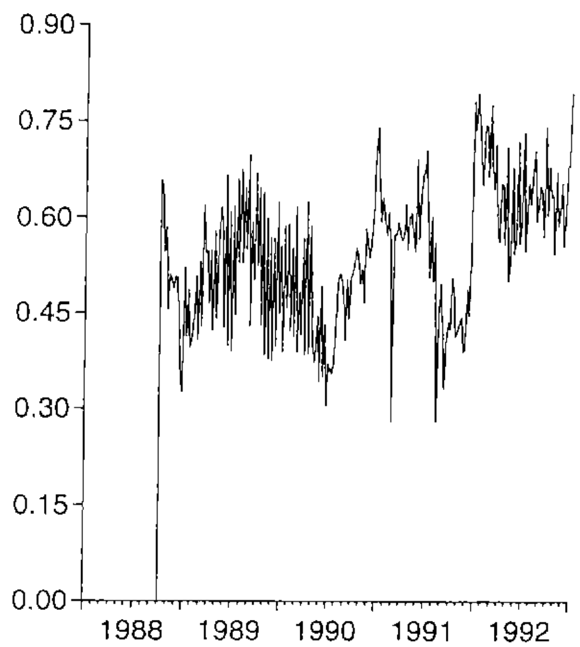

Figure 5.14. Proportion of Drivers Pulled Over Recorded as Tested (Perth)

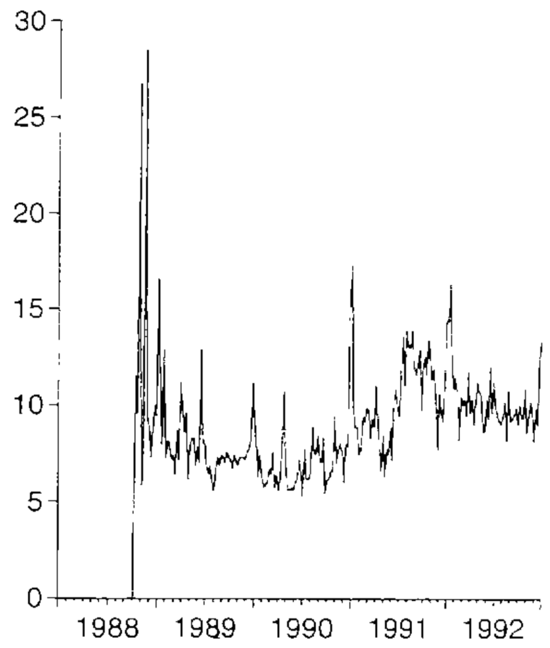

Figure 5.15. Police Hours Each Week Spent on RBT in Western Australia

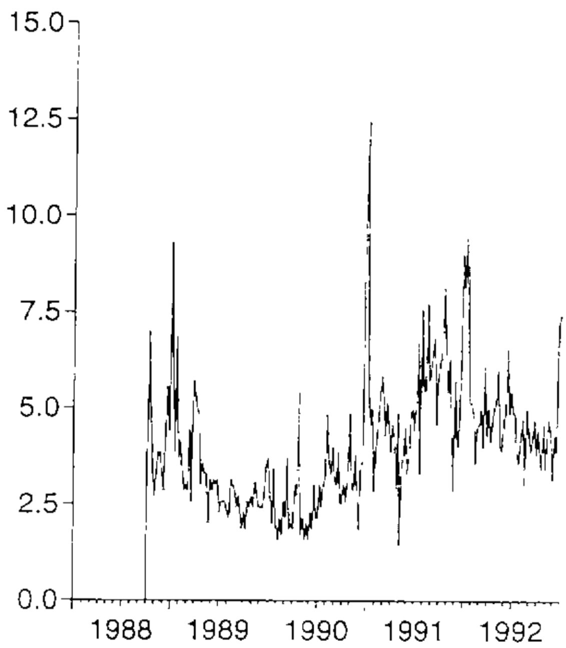

Figure 5.16. Police Hours Each Week Spent on RBT in Perth

Table 5.7. Single-Vehicle Night-Time Accidents in Perth, Incorporating Enforcement Data for the Post-RBT Period.

Variable		Coefficient	S.E.	t Statistic	p-value
Constant term		2.5222			
Seasonal Terms	Sin	-0.0643	0.0710	-0.91	0.3653
	Cos	0.1307	0.1448	0.90	0.3672
	Sin2	0.0822	0.0821	1.00	0.3169
	Cos2	-0.0140	0.0450	-0.31	0.7548
	Sin3	-0.0299	0.0450	-0.67	0.5059
	Cos3	-0.0103	0.0547	-0.19	0.8502
Day of Week	Wednesday	0.0577	0.1374	0.42	0.6744
	Thursday	0.3172	0.1296	2.45	0.0145
	Friday	0.8264	0.1181	7.00	0.0000
	Saturday	0.8795	0.1175	7.48	0.0000
	Sunday	0.7902	0.1191	6.63	0.0000
	Monday	0.0809	0.1364	0.59	0.5533
Type of day	School Holidays	-0.0624	0.0837	-0.75	0.4561
	Public Holidays	0.1651	0.1124	1.47	0.1420
Road Usage	Petrol Sales	0.0825	0.1575	0.52	0.6003
	Vehicle Reg's	0.0000	0.0000	-0.43	0.6683
Economic Indicators	Disposable Income	2.9918	2.7631	1.08	0.2791
	Unemployment	-0.1200	0.0568	-2.11	0.0347
Weather	Maximum	-0.0004	0.0009	-0.39	0.6997
	Minimum	0.0003	0.0011	0.28	0.7758
	Rainfall	0.0003	0.0004	0.81	0.4179
Enforcement level (showing lag in weeks)	Stopped(1)	0.0005	0.0011	0.43	0.6695
	Stopped(2)	-0.0003	0.0014	-0.21	0.8339
	Stopped(3)	-0.0030	0.0014	-2.17	0.0302
	Stopped(4)	0.0013	0.0011	1.10	0.2699
	Tested(1)	0.1678	0.5036	0.33	0.7391
	Tested(2)	0.1351	0.5310	0.25	0.7991
	Tested(3)	-0.2442	0.5325	-0.46	0.6465
	Tested(4)	0.8970	0.5197	1.73	0.0845
Time		0.1092	0.2416	0.45	0.6513

Deviance 1526.21
d.f. 1486

Deviance for enforcement terms = 10.80 with 8 d.f. (p = .21)

Summary

Given the limited time between the introduction of RBT in October 1988 and the end of the study period in 1992, as well as the complications that flow from different stopping and testing rates, it was not possible to fit models that were as sophisticated as for New South Wales or Tasmania. Nevertheless, the analyses suggest that RBT had a substantial impact on most types of accidents in Western Australia.

In cases where an impact of RBT could not be demonstrated (as for all serious and fatal accidents in Perth) de facto RBT, introduced two years prior to RBT, was significant. This suggests that de facto RBT and RBT-proper should be considered together as constituting a single, evolving package of enforcement methods, rather than as two distinct initiatives. This view is supported by the data on enforcement, as well as by direct observation of police activity, which suggest that both police and public viewed RBT as an extension of the roadblock system.

The impacts of RBT and de facto RBT are summarised in Table 5.8. Despite the blurring of the distinction in practice between the two enforcement regimes, it is interesting to note from the table that, except in the two cases where RBT was not significant, its impact was invariably greater than the de facto approach.

Table 5.8. Summary of Impacts of RBT and De Facto RBT in Western Australia

Type of Accident	RBT % Reduction in Accidents	RBT Accidents Prevented Each Year	De Facto RBT % Reduction in Accidents	De Facto RBT Accidents Prevented Each Year
WESTERN AUSTRALIA				
All serious	13%	334	9%	217
Fatals	28%	72	--	--
Single-vehicle night-time	26%	212	--	--
PERTH				
All serious	--	--	8%	118
Fatals	--	--	23%	27
Single-vehicle night-time	25%	98	17%	68

Little can be concluded about the effects of enforcement levels. This is probably due to the short period of time post-RBT, the unreliability of the data (especially the rates of testing), and the absence of large variability in the recorded levels.

CHAPTER 6. QUEENSLAND

The analysis of the effect of RBT in Queensland was problematic since detailed information on accident numbers prior to 1986 was not available. RBT came into force in Queensland on 1 December 1988 and in order to identify long-term trends it is necessary to include in the analyses accident rates for a number of years prior to 1988. Unfortunately the only relevant data available prior to 1986 were all serious and fatal accidents which occurred throughout Queensland. Thus the groups of accidents considered in the analyses were

- All serious accidents in Queensland (January 1980 - December 1992);
- All fatal accidents in Queensland (January 1980 - December 1992);
- Single-vehicle night-time accidents in Queensland (January 1986 - December 1992); and
- All serious accidents in Brisbane (January 1986 - December 1992).

For the purposes of the analyses "Brisbane" includes the Gold Coast area.

The fact that less than three years data were available prior to the introduction of RBT for the last two groups of accidents implies that a statistically accurate benchmark with which to compare post-RBT trends cannot be obtained for these types of accidents.

An average of 4.11 serious accidents occurred in Brisbane and the Gold Coast area during the period 1986 to 1992. These accounted for nearly 43% of all accidents in Queensland. Graphs of the accident numbers after smoothing are given in Figures 6.1 to 6.4. The control data for the state are shown in Figures 6.5 to 6.7. (Data on licenced divers were only available on a financial year basis in the period 1980-1988, and thereafter on a calendar year basis. For this reason registrations rather than licences have been used to indicate trends in the population at risk.)

For Queensland, as for Western Australia, the most appropriate model to fit to the data includes a simple step function testing for the effect of RBT (the non-enforcement Program effect). Although this implies implicitly that any significant effect of RBT is permanent, an inspection of Figures 6.1 to 6.4 indicates that this may not be the case and that the effect may in fact be a short-term one. Analysis of more recent data may clarify this issue.

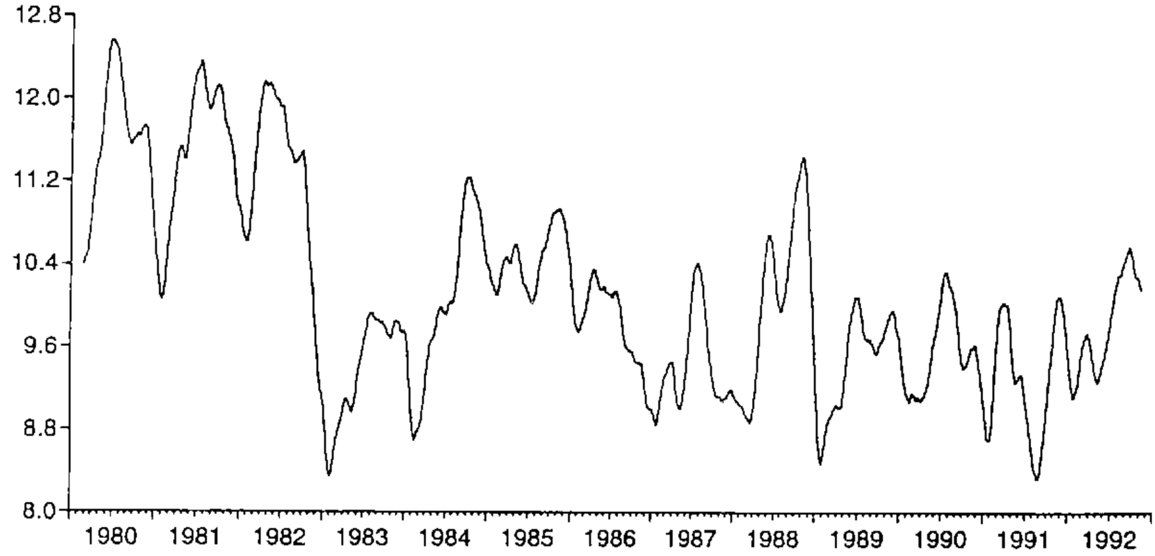

Figure 6.1. Serious and Fatal Accidents in Queensland, 1980-1992 (Daily Figures)

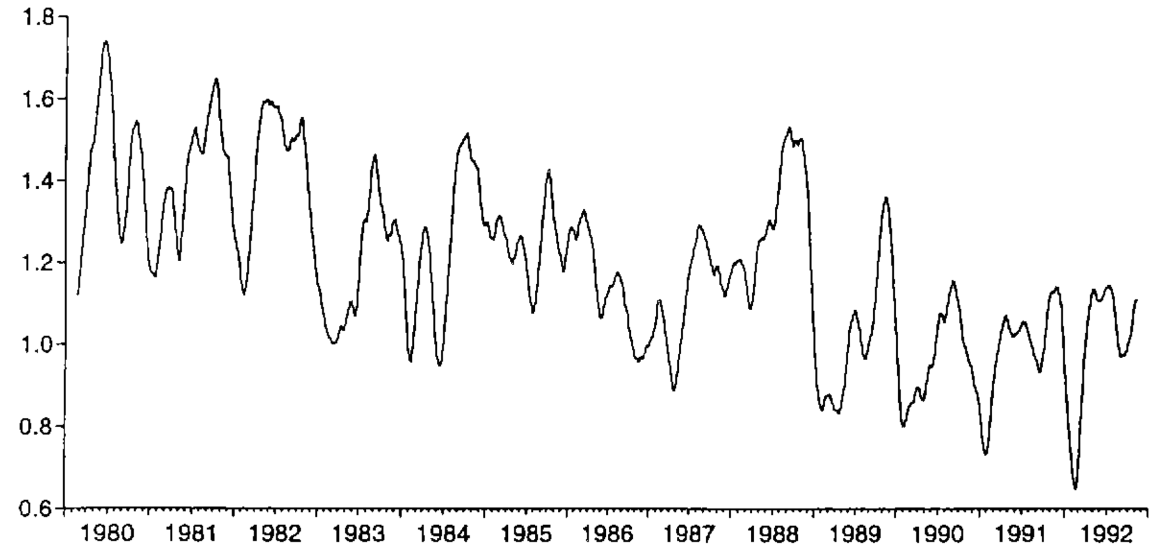

Figure 6.2. Fatal Accidents in Queensland, 1980-1992 (Daily Figures)

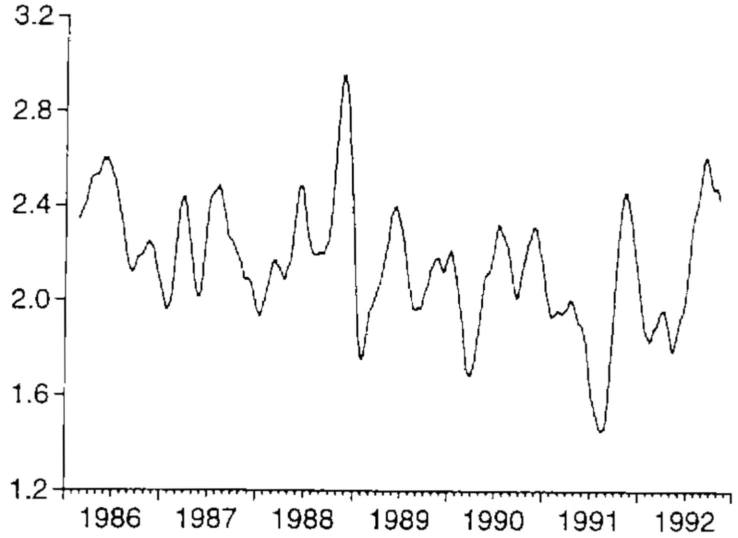

Figure 6.3. Single-Vehicle Night-Time Accidents in Queensland, 1986-1992 (Daily Figures)

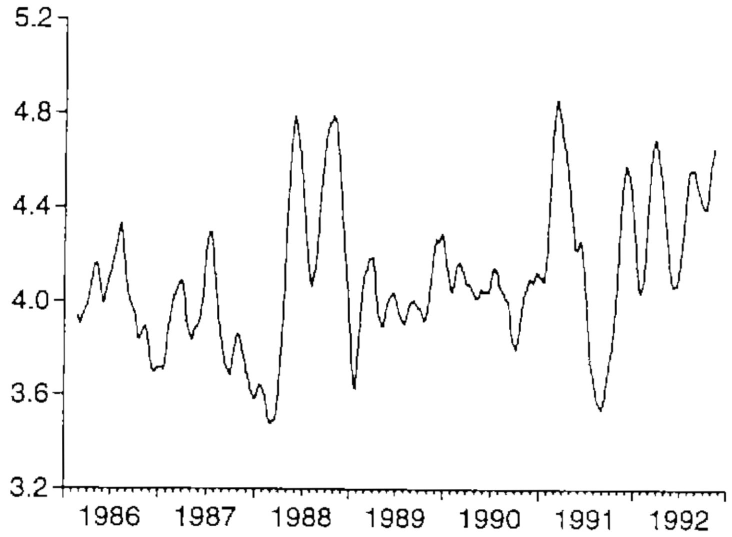

Figure 6.4. Serious and Fatal Accidents in Brisbane, 1986-1992 (Daily Figures)

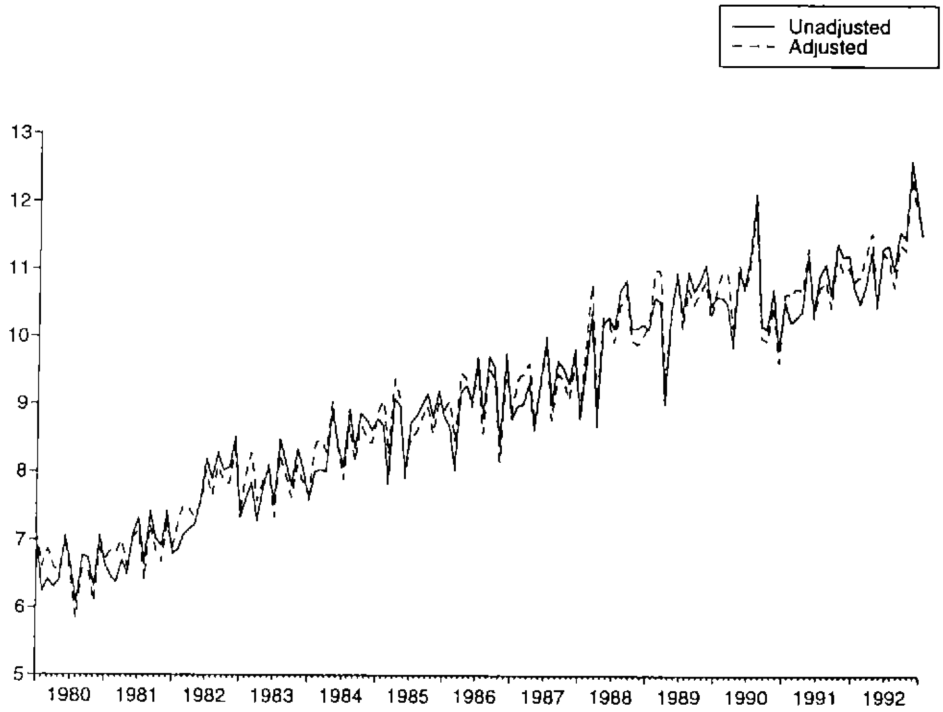

Figure 6.5. Petrol Sales in Queensland (Megalitres)

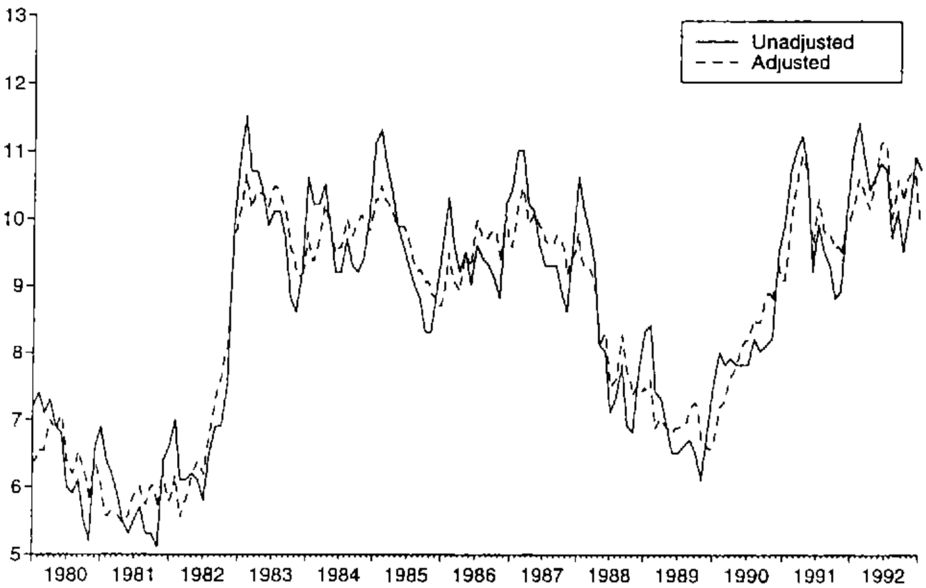

Figure 6.6. Unemployment Rate for Queensland (%)

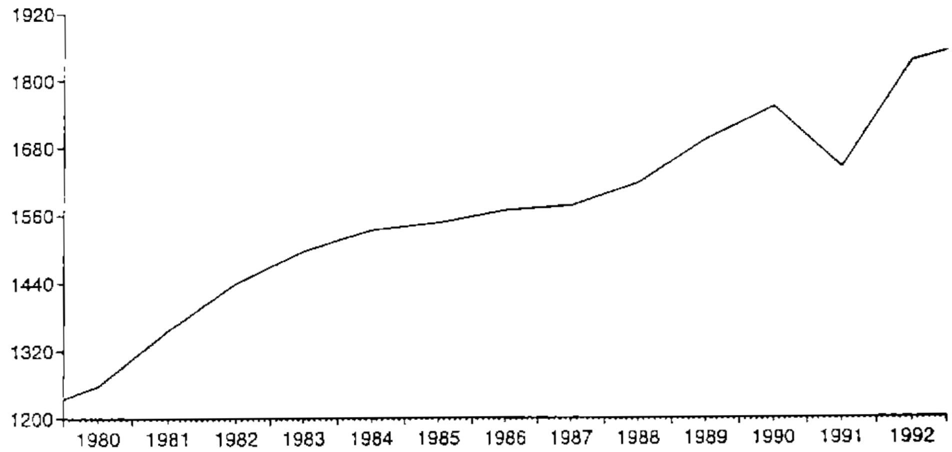

Figure 6.7. Vehicle Registrations in Queensland (x 1000)

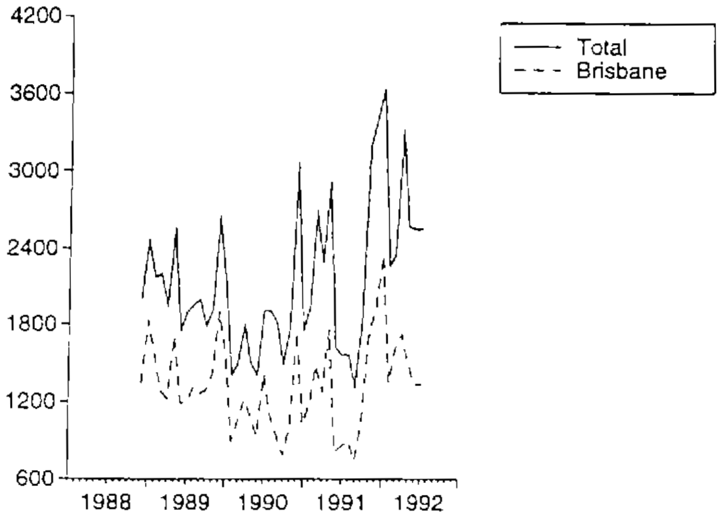

Figure 6.8. Drivers Tested in Queensland and Brisbane, Post-RBT

The lowering of the legal BAC level to 0.05g/100ml on 1 December 1982 is tested in the model using a step function. The Queensland Traffic Police instigated a campaign against drink-driving in August 1986, the "RID" or "Reduce Intoxicated Driving" campaign. This action and the "de facto RBT" action which occurred in Western Australia prior to formal RBT, were similar campaigns. The effect of RID is included in the model as being of short-term duration; that is, from August 1986 until the introduction of RBT in December 1988.

Separate analyses were carried out testing for the effect of levels of enforcement on accident rates for the four groups of accidents. Overall numbers of drivers reported as tested were again used as the indicator of level of enforcement. Trends in numbers of drivers tested in Queensland and in Brisbane are shown in Figure 6.8. Separate totals were available from January 1991 for individual and team operations, which probably correspond roughly to mobile and stationary testing. However these were totalled because this information was only available from 1991 and the distinction between the two types of operation did not appear to be well defined. Lag times of 1, 2, 3 and 4 weeks respectively were allowed for and Tables 6.5 to 6.8 present the results of fitting models containing the four terms relating to these lag times simultaneously.

The Effect of RBT

The results from the analyses are presented in Tables 6.1 to 6.4. RBT had a significant effect on all serious and on fatal accidents in Queensland. There is an estimated initial drop in serious accidents of 18.5% and in fatal accidents of nearly 35%, corresponding to reductions of 789 serious accidents and 194 fatal accidents each year (3217 serious accidents and 789 fatal accidents in all).

RBT was not found to have had an effect on single-vehicle, night-time accidents. It is possible that a small drop in serious accidents in Brisbane occurred but the evidence for this is not conclusive. These results are not unexpected since as mentioned the lack of data for these last two groups of accidents considerably reduces the power of the analyses.

With regard to other factors in respect of drink driving, the lowering of the legal BAC and the RID campaign were found to have had significant negative impacts on fatal accidents and on all serious accidents. There are some indications of a slight drop in single-vehicle night-time accidents during the period of the RID campaign. Specifically, the .05 law resulted in a 14% drop in all serious accidents and a drop of 18% in fatal accidents, corresponding to a total of 6042 serious accidents and 921 fatal accidents prevented (an average of 599 and 91 each year). The equivalent figures for RID were 12% for all serious accidents (1128 accidents prevented in all and 483 per year), and 15% for fatal accidents (182 accidents prevented in all and 78 per year).

Levels of enforcement, as measured by number of drivers tested in RBT operations, did not appear to impact significantly on accident numbers. Fitting models with the four terms for the lag times simultaneously yielded non-significant result for all four groups of accidents except fatal accidents in Queensland, where the deviance was significant (10.95 with 4 d.f., p = .027). In this latter case, however, only one enforcement term was close to significant (a two weeks lag), and the pattern was hard to interpret, so it may probably be dismissed as a false positive (Type I error). Each of the enforcement terms were also included in the models individually, but no effects were shown in any of the instances.

As expected, accidents occur with different frequencies on different days, with the most accidents occurring on Saturdays. In Brisbane and on the Gold Coast the highest numbers of accidents occur on Friday nights.

There appear to be fewer accidents in Brisbane on public holidays relative to days during the school terms. Although the road usage and economic indicator variables are not significant they are of importance and as a group contribute to the model. As discussed previously, since most of these variables contain trends over time there is some correlation between them and so interpretation of individual coefficients is problematic.

Since it was not possible to group accidents into regions or different areas of Queensland, it was necessary to use Brisbane weather information in the analyses of the different types of accidents. An indicator variable was set up which indicated whether rain had occurred in any of eight major centres throughout Queensland, similar to the rainfall indicator variable for New South Wales. However this variable was found to be less effective than including Brisbane rainfall in the models. This control variable was only significant for single-vehicle night-time accidents and serious accidents in Brisbane. It should be noted that the effect of rainfall is controlled to some extent by the inclusion of seasonal terms in the model, and these play a role for all serious accidents and for fatal accidents in Queensland.

Table 6.1. All Serious Accidents in Queensland (1980 - 1992)

Variable		Coefficient	S.E.	t Statistic	p-value
Constant term		2.0213			
Seasonal Terms	Sin	-0.0394	0.0080	-4.96	0.0000
	Cos	-0.0326	0.0071	-4.60	0.0000
	Sin2	-0.0257	0.0071	-3.62	0.0003
	Cos2	-0.0053	0.0072	-0.73	0.4652
	Sin3	-0.0234	0.0072	-3.25	0.0012
	Cos3	-0.0096	0.0073	-1.31	0.1888
Day of Week	Monday	0.0230	0.0200	1.15	0.2509
	Sunday	0.2178	0.0192	11.37	0.0000
	Saturday	0.4141	0.0184	22.52	0.0000
	Friday	0.3849	0.0185	20.83	0.0000
	Thursday	0.1437	0.0194	7.40	0.0000
	Wednesday	0.0743	0.0197	3.76	0.0002
Type of Day	School Holidays	0.0100	0.0139	0.72	0.4702
	Public Holidays	-0.0070	0.0194	-0.36	0.7193
Road Usage	Petrol Sales	0.0154	0.0152	1.02	0.3101
	Vehicle Reg's	8.70E-05	0.0002	0.50	0.6162
Economic Indicators	GDP	1.41E-05	6.35E-06	2.22	0.0266
	Alcohol Expenditure	-0.0006	0.0002	-2.46	0.0139
	Unemployment	-0.0144	0.0088	-1.63	0.1030
Weather	Rainfall	0.0159	0.0106	1.50	0.1326
Time		-0.0151	0.0160	-0.95	0.3442
0.05 Legislation		-0.1561	0.0327	-4.78	0.0000
RID Campaign		-0.1282	0.0255	-5.03	0.0000
RBT		-0.2044	0.0386	-5.29	0.0000
Deviance	5396.58				
d.f.	4719				

Table 6.2. Fatal Accidents in Queensland (1980 - 1992)

Variable		Coefficient	S.E.	t Statistic	p-value
Constant term		-0.5026			
Seasonal Terms	Sin	-0.0967	0.0219	-4.43	0.0000
	Cos	-0.0455	0.0196	-2.32	0.0204
	Sin2	-0.0488	0.0197	-2.48	0.0130
	Cos2	-0.0289	0.0198	-1.45	0.1459
	Sin3	-0.0427	0.0199	-2.15	0.0319
	Cos3	-0.0201	0.0201	-1.00	0.3185
Day of Week	Monday	0.0741	0.0579	1.28	0.2011
	Sunday	0.4435	0.0535	8.28	0.0000
	Saturday	0.6626	0.0514	12.88	0.0000
	Friday	0.5220	0.0527	9.90	0.0000
	Thursday	0.1575	0.0568	2.77	0.0056
	Wednesday	0.1634	0.0567	2.88	0.0040
Type of Day	School Holidays	0.0447	0.0379	1.18	0.2379
	Public Holidays	0.0628	0.0528	1.19	0.2343
Road Usage	Petrol Sales	0.0636	0.0420	1.51	0.1299
	Vehicle Reg's	-0.0002	0.0005	-0.49	0.6237
Economic Indicators	GDP	3.76E-06	1.74E-05	0.22	0.8288
	Alcohol Expenditure	0.0002	0.0006	0.39	0.6961
	Unemployment	-0.0113	0.0242	-0.47	0.6410
Weather	Rainfall	0.0248	0.0291	0.85	0.3945
Time		0.0123	0.0447	0.28	0.7826
0.05 Legislation		-0.2020	0.0890	-2.27	0.0233
RID Campaign		-0.1659	0.0689	-2.41	0.0160
RBT		-0.4282	0.1053	-4.07	0.0000
Deviance	4788.60				
d.f.	4719				

Table 6.3. Single-Vehicle Night-Time Accidents in Queensland (1986 - 1992)

Variable		Coefficient	S.E.	t Statistic	p-value
Constant term		-0.7241			
Seasonal Terms	Sin	-0.0822	0.0278	-2.95	0.0032
	Cos	-0.0094	0.0206	-0.46	0.6484
	Sin2	-0.0595	0.0209	-2.84	0.0045
	Cos2	0.0011	0.0211	0.05	0.9600
	Sin3	-0.0559	0.0215	-2.60	0.0093
	Cos3	-0.0420	0.0212	-1.98	0.0476
Day of Week	Tuesday	-0.1158	0.0629	-1.84	0.0660
	Monday	-0.0829	0.0624	-1.33	0.1840
	Sunday	0.5054	0.0548	9.22	0.0000
	Saturday	0.7654	0.0524	14.60	0.0000
	Friday	0.5251	0.0545	9.63	0.0000
	Thursday	0.0509	0.0603	0.84	0.3984
Type of Day	School Holidays	0.0201	0.0401	0.50	0.6155
	Public Holidays	0.0687	0.0543	1.27	0.2060
Road Usage	Petrol Sales	0.0814	0.0417	1.95	0.0510
	Vehicle Reg's	0.0006	0.0006	1.04	0.2963
Economic Indicators	GDP	1.75E-05	3.41E-05	0.51	0.6082
	Alcohol Expenditure	-0.0012	0.0010	-1.23	0.2197
	Unemployment	-0.0008	0.0251	-0.03	0.9753
Weather	Rainfall	0.0584	0.0307	1.90	0.0574
Time		-0.1062	0.0614	-1.73	0.0837
RID Campaign		-0.1386	0.0793	-1.75	0.0805
RBT		-0.1540	0.1162	-1.32	0.1854
Deviance	2765.96				
d.f.	2528				

Table 6.4. All Serious Accidents in Brisbane (1986 - 1992)

Variable		Coefficient	S.E.	t Statistic	p-value
Constant term		2.5281			
Seasonal Terms	Sin	0.0150	0.0204	0.74	0.4607
	Cos	-0.0036	0.0152	-0.24	0.8122
	Sin2	-0.0145	0.0152	-0.95	0.3402
	Cos2	0.0055	0.0155	0.35	0.7230
	Sin3	-0.0215	0.0156	-1.37	0.1693
	Cos3	-0.0036	0.0155	-0.23	0.8155
Day of Week	Tuesday	-0.0239	0.0393	-0.61	0.5436
	Monday	-0.0524	0.0397	-1.32	0.1872
	Sunday	-0.1299	0.0406	-3.20	0.0014
	Saturday	0.0865	0.0384	2.25	0.0244
	Friday	0.2203	0.0372	5.92	0.0000
	Thursday	0.0588	0.0385	1.53	0.1266
Type of Day	School Holidays	-0.0413	0.0300	-1.38	0.1683
	Public Holidays	-0.0870	0.0421	-2.07	0.0389
Road Usage	Petrol Sales	0.0119	0.0305	0.39	0.6970
	Vehicle Reg's	0.0003	0.0004	0.70	0.4857
Economic Indicators	GDP	-1.63E-05	2.56E-05	-0.64	0.5247
	Alcohol Expenditure	-0.0005	0.0007	-0.66	0.5080
	Unemployment	-0.0312	0.0185	-1.69	0.0912
Weather	Rainfall	0.0671	0.0224	3.00	0.0027
Time		0.0394	0.0454	0.87	0.3846
RID Campaign		-0.0581	0.0604	-0.96	0.3363
RBT		-0.1467	0.0875	-1.68	0.0938
Deviance	2815.01				
d.f.	2528				

Table 6.5. All Serious Accidents in Queensland (December 1988 to mid 1992)

Variable		Coefficient	S.E.	t Statistic	p-value
Constant term		2.2804			
Seasonal Terms	Sin	0.0088	0.0340	0.26	0.7964
	Cos	0.0160	0.0194	0.82	0.4105
	Sin2	-0.0362	0.0165	-2.19	0.0286
	Cos2	0.0112	0.0150	0.75	0.4537
	Sin3	-0.0410	0.0191	-2.15	0.0318
	Cos3	-0.0295	0.0150	-1.96	0.0500
Day of Week	Tuesday	-0.0337	0.0372	-0.91	0.3639
	Monday	-0.0254	0.0372	-0.68	0.4942
	Sunday	0.0257	0.0367	0.70	0.4837
	Saturday	0.1937	0.0353	5.48	0.0000
	Friday	0.2669	0.0347	7.68	0.0000
	Thursday	0.0480	0.0364	1.32	0.1879
Type of Day	School Holidays	0.0179	0.0277	0.65	0.5180
	Public Holidays	-0.0338	0.0369	-0.91	0.3608
Road Usage	Petrol Sales	0.0468	0.0310	1.51	0.1312
	Vehicle Reg's	0.0016	0.0008	2.07	0.0387
Economic Indicators	GDP	-9.38E-05	6.00E-05	-1.56	0.1183
	Alcohol Expenditure	0.0023	0.0013	1.70	0.0890
	Unemployment	0.0408	0.0232	1.76	0.0785
Weather	Rainfall	0.0367	0.0208	1.76	0.0784
Time		0.0134	0.0691	0.19	0.8456
Enforcement level	Tested(1)	-7.11E-05	6.49E-05	-1.09	0.2739
	Tested(2)	8.36E-05	8.56E-05	0.98	0.3290
	Tested(3)	-1.97E-06	8.67E-05	-0.23	0.8204
	Tested(4)	4.71E-06	5.78E-05	0.08	0.9351
Deviance	1423.77				
d.f.	1282				

Deviance for enforcement terms = 4.08 with 4 d.f.

Table 6.6. Fatal Accidents in Queensland (December 1988 to mid 1992)

Variable		Coefficient	S.E.	t Statistic	p-value
Constant term		3.2130			
Seasonal Terms	Sin	-0.0481	0.1017	-0.47	0.6365
	Cos	-0.0525	0.0582	-0.90	0.3675
	Sin2	-0.0928	0.0498	-1.86	0.0627
	Cos2	-0.0145	0.0441	-0.33	0.7417
	Sin3	-0.0625	0.0575	-1.09	0.2772
	Cos3	-0.0566	0.0446	-1.27	0.2045
Day of Week	Tuesday	-0.1502	0.1182	-1.27	0.2042
	Monday	0.0014	0.1138	0.01	0.9900
	Sunday	0.1365	0.1101	1.24	0.2154
	Saturday	0.5111	0.1020	5.01	0.0000
	Friday	0.3782	0.1046	3.61	0.0003
	Thursday	-0.0571	0.1154	-0.50	0.6207
Type of Day	School Holidays	0.1052	0.0813	1.29	0.1958
	Public Holidays	0.0890	0.1067	0.83	0.4040
Road Usage	Petrol Sales	0.0088	0.0912	0.10	0.9234
	Vehicle Reg's	0.0030	0.0023	1.27	0.2028
Economic Indicators	GDP	-0.0002	0.0002	-1.27	0.2060
	Alcohol Expenditure	0.0050	0.0040	1.26	0.2090
	Unemployment	0.0185	0.0696	0.27	0.7905
Weather	Rainfall	0.0333	0.0624	0.53	0.5931
Time		0.1435	0.2080	0.69	0.4904
Enforcement level	Tested(1)	-0.0002	0.0002	-0.80	0.4260
	Tested(2)	0.0005	0.0002	2.02	0.0438
	Tested(3)	-0.0003	0.0002	-1.29	0.1956
	Tested(4)	5.12E-05	0.0002	0.29	0.7697
Deviance	1314.92				
d.f.	1282				

Deviance for enforcement terms = 10.95 with 4 d.f. (p = .027)

Table 6.7. Single-Vehicle Night-Time Accidents in Queensland (December 1988 to mid 1992)

Variable		Coefficient	S.E.	t Statistic	p-value
Constant term		2.5809			
Seasonal Terms	Sin	-0.0049	0.0716	-0.07	0.9458
	Cos	0.0911	0.0405	2.25	0.0248
	Sin2	-0.1241	0.0343	-3.62	0.0003
	Cos2	0.0418	0.0313	1.34	0.1811
	Sin3	-0.0432	0.0399	-1.08	0.2787
	Cos3	-0.0368	0.0314	-1.17	0.2427
Day of Week	Tuesday	-0.2172	0.0882	-2.46	0.0139
	Monday	-0.1531	0.0868	-1.76	0.0780
	Sunday	0.4396	0.0758	5.80	0.0000
	Saturday	0.6539	0.0729	8.97	0.0000
	Friday	0.5004	0.0749	6.69	0.0000
	Thursday	-0.0090	0.0836	-0.11	0.9143
Type of Day	School Holidays	0.0390	0.0579	0.67	0.5006
	Public Holidays	0.0482	0.0739	0.65	0.5143
Road Usage	Petrol Sales	0.1496	0.0654	2.29	0.0223
	Vehicle Reg's	0.0034	0.0017	2.07	0.0389
Economic Indicators	GDP	-0.0002	0.0001	-1.58	0.1138
	Alcohol Expenditure	0.0031	0.0028	1.11	0.2677
	Unemployment	0.0683	0.0475	1.44	0.1506
Weather	Rainfall	0.0758	0.0433	1.75	0.0807
Time		-0.0388	0.1423	-0.27	0.7853
Enforcement level	Tested(1)	-0.0002	0.0001	-1.25	0.2123
	Tested(2)	-1.91E-05	0.0002	-0.11	0.9090
	Tested(3)	0.0002	0.0002	1.08	0.2799
	Tested(4)	-8.65E-05	0.0001	-0.83	0.4089
Deviance	1344.37				
d.f.	1282				

Deviance for enforcement terms = 3.90 with 4 d.f.

Table 6.8. All Accidents in Brisbane (December 1988 to mid 1992)

Variable		Coefficient	S.E.	t Statistic	p-value
Constant term		3.3022			
Seasonal Terms	Sin	0.0921	0.0524	1.76	0.0789
	Cos	0.0571	0.0302	1.89	0.0587
	Sin2	-0.0251	0.0253	-0.99	0.3225
	Cos2	0.0059	0.0232	0.26	0.7979
	Sin3	-0.0450	0.0286	-1.57	0.1158
	Cos3	-0.0086	0.0230	-0.37	0.7099
Day of Week	Tuesday	-0.0221	0.0535	-0.41	0.6795
	Monday	-0.0690	0.0544	-1.27	0.2054
	Sunday	-0.1800	0.0561	-3.21	0.0014
	Saturday	-0.0403	0.0541	-0.75	0.4558
	Friday	0.2102	0.0509	4.13	0.0000
	Thursday	-0.0120	0.0535	-0.22	0.8221
Type of Day	School Holidays	0.0030	0.0425	0.07	0.9442
	Public Holidays	-0.1436	0.0572	-2.51	0.0122
Road Usage	Petrol Sales	0.0224	0.0474	0.47	0.6374
	Vehicle Reg's	0.0016	0.0012	1.35	0.1777
Economic Indicators	GDP	-0.0001	9.03E-06	-1.49	0.1371
	Alcohol Expenditure	0.0031	0.0020	1.55	0.1225
	Unemployment	0.0231	0.0351	0.66	0.5116
Weather	Rainfall	0.0972	0.0311	3.13	0.0018
Time		0.1077	0.1054	1.02	0.3069
Enforcement level	Tested(1)	-0.0002	0.0002	-1.36	0.1750
	Tested(2)	0.0003	0.0002	1.59	0.1117
	Tested(3)	-0.0002	0.0002	-1.05	0.2962
	Tested(4)	0.0001	0.0001	0.73	0.4675
Deviance	1414.13				
d.f.	1282				

Deviance for enforcement terms = 0.71 with 4 d.f.

Summary

As for Tasmania and Western Australia, data limitations prevent the development of a comprehensive picture of the impact of RBT in Queensland. One limitation is the relative shortness of the time series post-RBT, which suggests the need for further analysis with more recent data. However, other limitations inherent in the data, such as the unavailability of "unit record" accident data in the 1980s, and the inaccuracies and ambiguities in the enforcement figures, impose a ceiling on the additional information that can be extracted.

The major finding is that RBT had a substantial impact on all serious accidents and on fatal accidents in Queensland, although it is not possible to determine from the analyses whether this impact was fully sustained until the end of 1992. In addition, both the lowering of the legal BAC to .05 in 1982 and the introduction of the RID campaign (de facto RBT) in 1986, had an impact on all serious and fatal accidents in Queensland, although as in Western Australia their effects were smaller than the effects of RBT.

A lack of statistical power, due to smaller accident frequencies and a shorter data series, contributed to non-significant results for RBT for single-vehicle night-time accidents in Queensland, despite trends in the right direction. Nor, for these statistical reasons as well as poor data quality, could effects of enforcement levels be demonstrated for the whole state or for the Brisbane/Gold Coast region.

The significant effects of RBT, RID, and the .05 law are summarised in Table 6.9.

Table 6.9. Effects of RBT, RID, and the .05 Law in Queensland

Intervention	All Serious Accidents % Reduction	All Serious Accidents Accidents Prevented Each Year	Fatal Accidents % Reduction	Fatal Accidents Accidents Prevented Each Year
RBT	19%	789	35%	194
RID	12%	483	15%	78
.05	14%	599	18%	91

CHAPTER 7. DISCUSSION

The main aim of the present study was to estimate the initial and long-term impacts of random breath testing in two states that had introduced RBT "boots and all" in the early 1980s, and in two states that had adopted a more evolutionary approach by basing enforcement on a form of "de facto RBT" before moving to full RBT in the late 1980s. Specific issues, summarised in the research questions posed at the end of Chapter 1, revolve around the effects of ongoing enforcement, the experience of Tasmania (where there was vigorous enforcement but limited publicity) compared with New South Wales (characterised by both vigorous enforcement and extensive media publicity), and the relative impacts of de facto and full RBT.

In order to address this problem, sophisticated methods of time series analysis were developed, allowing for the control of a range of factors known to influence accident rates. Major factors controlled included seasonal effects, daily weather patterns, indices of economic and road use activity, alcohol consumption, and the day of the week. Many of these controls were possible only because daily accident data were analysed, rather than weekly or monthly figures. An innovative feature of the mathematical model applied when data quality permitted was the decomposition of the overall impact of RBT into three components: an Introduction effect with an exponential decay, a non-enforcement-related Program effect, and an enforcement-related Program effect that allowed for the cumulative or continued impact of exposure to an RBT operation some time in the past. The analytic method used to estimate the lagged effect of enforcement, or the period of time after a given RBT operation over which the apparent effect on accidents could be discerned, has not been used previously in its full form in accident research, so the present study represents a significant methodological advance.

Notwithstanding the subtlety and sophistication of the analytic methods, the analyses are of course only as good as the available data allow. A major difficulty from the point of view of statistical power is the small size of jurisdictions such as Tasmania and the relatively small number of accidents that occur. Similarly, there is a "trade off" between specificity in terms of focusing on alcohol-related accidents and the loss of power consequent on lower accident frequencies. As a result, the outcomes for many data series are not as clearcut as might be desired.

In addition, it must be borne in mind that apart from the problem of power the analyses necessarily yield conservative estimates of the impact of RBT. This is because many of the control variables, especially the economic and road use indicators, have increased monotonically over the years and are therefore highly correlated with the various measures of RBT enforcement. The inclusion of alcohol consumption as a control variable perhaps exacerbates the conservatism inherent in the analyses, since it can be argued plausibly that the declines in alcohol consumption that have been observed over the past decade are partly the result of RBT enforcement and publicity. Generally, as indicated in the discussion of methodology in Chapter 2, the problems entailed in estimating the long-term effects of RBT are greater than in estimating short-term effects, for the obvious reason that the more time elapses the greater the possible influence of a range of factors other than RBT.

The Effects of RBT: An Overview

Initial impact

Having acknowledged both the strengths and weaknesses of the analytical methods and the available data, it is encouraging that there is a consistency in the findings concerning at least the initial impact of RBT in each of the four states. Table 7.1 contains a summary of the estimates of the initial impact of RBT in each state and the duration of the Introduction effects, together with estimates of the numbers of accidents prevented in the first year or so.

Table 7.1. Summary of Size of the Initial Impact of RBT and the Duration of the Introduction Effect for the Four States

State	Type of Accident	Initial Impact	Duration of Introduction Effect[1]	Accidents Prevented in First Year
New South Wales	All serious Fatal Single-vehicle night-time	19% 48% 26%	15 months 4.5 months 10 years	522[2] 204[2] 686[2]
Tasmania[5]	All serious	24%	1 year	36[3]
Western Australia	All serious Fatal Single-vehicle night-time	13% 28% 26%	Ongoing Ongoing Ongoing	334[4] 72[4] 212[4]
Queensland	All serious Fatal	19% 35%	Ongoing Ongoing	789[4] 194[4]

1 Duration of effect until impact reduced to 5% of initial value.

2 For the period December 17, 1982 to January 31, 1983.

3 These savings occurred in the first three months, after which no benefits of RBT could be measured.

4 These are the mean savings per year. Actual annual estimates fluctuate slightly around the mean.

5 Launceston and Hobart regions

Depending on which accident series is examined, the initial impact of RBT ranges from 48% for fatal accidents in New South Wales to 13% for all serious accidents in Western Australia. Only for single-vehicle night-time accidents in Queensland was it not possible to establish a significant effect for RBT, and this almost certainly reflects the combination of relatively low accident frequencies and the shortness of the series. In New South Wales and Western Australia the impact of RBT on single-vehicle night-time accidents was clear, and the Introduction effect appeared to be sustained on a long-term basis, although for Western Australia the permanence of the effect perhaps reflects more the simplified nature of the model at this point than a definite long-term effect. Further analysis of the Western Australian and Queensland data, extending the time series, will be required to resolve the question of duration of impact. Further analysis should also reveal whether all three components of the impact of RBT can be incorporated in the models.

Long-term impact

Table 7.1 summarises the immediate effects of RBT in each state. For Western Australia and Queensland the table also summarises the long-term effects, since the initial impact is also the best estimate of the long-term impact (because only a simple step function was fitted). For Tasmania, no long-term effects of RBT could be detected. This surprising result is discussed further below.

By contrast, for New South Wales the initial impact of RBT is not a good guide to the long-term effects, since the enforcement component was so important and the Introduction component varied so much in its duration depending on which accident series was analysed. It is therefore useful to reproduce the New South Wales summary in Table 3.8 as Table 7.2.

For a combination of reasons the New South Wales results are the most reliable. Enough time has elapsed since RBT was introduced to gain a clear picture of the long-term impact, and sufficient numbers of accidents occur to permit analyses with reasonable statistical power. In addition, the enforcement data are recorded sufficiently regularly and accurately to allow the effects of ongoing enforcement to be estimated. The overall result may be summarised by stating that the impact of RBT was (a) instantaneous; (b) substantial; and (c) permanent, although the magnitude of the effect varied greatly over time. As a consequence of (c), we should also add that (d) the effects were amplified in the long-term through substantial increases in enforcement, an outcome discussed further below.

Results were not as clearcut for serious and fatal accidents as for single-vehicle night-time accidents, at least in terms of the duration of the impact, but this can be explained in terms of the fact that the two former series are not as clearly alcohol-related as the latter (and also by the lower power of the analysis for fatals). The fact that only relatively small and inconsistent effects that were not strongly statistically significant could be discerned for the control series of accidents (vehicle-to-vehicle accidents during school hours) reinforces the conclusion that RBT had a permanent causal impact on alcohol-related accidents. This conclusion is consistent with the supplementary analyses conducted for New South Wales that showed that RBT had the greatest effect on single-vehicle accidents at night in both Sydney and country areas.

Table 7.2. Summary of Long-Term Impact of RBT in New South Wales

Year	% Reduction in serious accidents	Serious accidents prevented	% Reductio n in fatal accidents	Fatal accidents prevented	% Reduction in SVNT accidents	SVNT accidents prevented
1982[1]	18%	70	42%	20	26%	29
1983	5%	452	17%	183	23%	657
1984	4%	342	15%	162	22%	579
1985	3%	292	15%	164	15%	392
1986	7%	588	15%	162	14%	360
1987	6%	529	15%	157	8%	200
1988	7%	597	15%	156	4%	106
1989	9%	713	15%	148	3%	75
1990	12%	884	15%	129	7%	143
1991	15%	1090	15%	104	15%	295
1992	18%	1186	15%	101	22%	409
TOTAL		6742		1487		3246

Note: SVNT accidents are single-vehicle night-time accidents.

[1] From December 17, 1982

The most striking aspect of the long-term results for New South Wales is the way the impact of RBT declined as the Introduction effect wore off. The exact period of this decay depends on whether serious accidents or single-vehicle night-time accidents are considered, but the overall pattern is consistent with the findings of many evaluations of the impact of drink-driving countermeasures (Ross, 1982; Ross et al., 1981/82). What makes RBT in New South Wales different from most other legal interventions is the intensity of the initial enforcement and publicity, and the sustained commitment from police, evidenced by the rise in random tests, particularly after 1987. The crucial role of enforcement is discussed in more detail below.

The decline in effectiveness is not apparent from the fatal accident analysis, because the Introduction effect had a short duration (four months) and because the enforcement component was not significant. This means that the model is close to the models for Western Australia and Queensland, which incorporated a simple step function to represent the effect of RBT. These models almost certainly over-simplify the impact of RBT and possibly overstate its significance in terms of accidents prevented. Nevertheless, it is clear that in these states (and for fatal accidents in New South Wales) RBT did have a sustained effect, although the long-term magnitude of this effect is debatable.

Tasmania

The real enigma in this study is Tasmania. Despite a substantial initial impact, it was not possible to show that RBT had any effect on serious and fatal accidents after about one year. This is contrary to expectation, since as shown in Table 7.3 below RBT was very well enforced, reflecting a high degree of police commitment over many years. However, before concluding that RBT has been a relative failure in that state, it is important to keep in mind the serious statistical limitations of the analysis.

First and most important, the pattern of long-term accident trends in Tasmania poses severe difficulties for interpretation. The steady downturn in accidents that preceded RBT was not sustained into the 1980s, making it extremely difficult to capture statistically the positive impact of *any* traffic safety measure introduced in this period, including RBT. Nevertheless, Leggett (1991) may be correct in concluding that the expansion of breath testing technology in the state in the 1970s had a major impact on alcohol-related accidents, and that the introduction of RBT in 1983 added little to the deterrent effect of these earlier measures. If this argument is correct, however, it is necessary to ask why this phenomenon occurred in Tasmania but not in the other states that also introduced and expanded the use of breath analysis technology in the late 1960s and 1970s.

It must be remembered when discussing the Tasmanian data that the low frequency of accidents makes any meaningful analysis difficult. There were fewer than two fatal and serious accidents per day in the two regions analysed, compared with more than 20 throughout most of the 1970s and 1980s in New South Wales. For this reason, the New South Wales models are generally "richer" and more informative. However if fatal accidents in New South Wales, the most rare category, are analysed, less clearcut results are obtained, despite the fact that the number of fatal accidents in New South Wales was between two and three per day, which was more than fatal and serious accidents combined in Tasmania. A lack of statistical power therefore seems to be an important part of the explanation of the Tasmanian results.

Alternative substantive explanations may be sought either in the lack of formal media publicity in Tasmania or in the levels and patterns of enforcement.

Since, as shown below, overall enforcement levels in Tasmania have been consistently higher in Tasmania than in New South Wales since RBT was introduced, and since there is some evidence for ongoing enforcement effects in the Launceston region, it is difficult to conclude that a failure to enforce RBT is the major explanation for the lack of discernible long-term impact. It is possible of course that there have been deficiencies in the *manner* in which RBT has been enforced, reducing its deterrent effects. These issues are explored in detail in the sequel to this report, but it should be emphasised here that aspects of enforcement were less than optimal in *all* states, and that the strategies and procedures used by police in Tasmania were not obviously less effective than those observed in other jurisdictions.

One is led therefore to consider RBT publicity as the key issue. It is not possible to conclude anything directly about the lack of publicity, but the fact that New South Wales achieved substantial results with intensive enforcement *plus* publicity suggests that publicity is a crucial element in the success of RBT. If correct, this conclusion is not surprising, given that general deterrence is essentially a *communication process* (Homel, 1988).

The effects of enforcement levels

Overall the evidence for the positive benefits of ongoing enforcement levels in states other than New South Wales was not particularly strong. As noted above, some significant results were observed for the Launceston region, but it is not possible to conclude that variations in enforcement levels in Queensland or Western Australia contributed much to reductions in accidents. This could be simply because the levels did not change much over the short period post-RBT, or it could be again that the *manner* of enforcement (perhaps low visibility or predictable sites) was such that the deterrent impact was limited.

An alternative explanation is that the data on enforcement from these states are too unreliable to have much predictive power. It was noted in Chapter 5 that recorded testing rates in Western Australia should be viewed with scepticism, and that true testing rates were probably considerably lower than the official rates over the period of the study. This means that the controversial practice of not testing all drivers pulled over cannot be statistically evaluated for its effects. Similarly, in Queensland it is not possible to be confident that the data on even total testing levels are reliable.

If further research is to be conducted profitably in this field, it is essential that the quality of police enforcement data be improved. With micro computer technology it should be feasible to record the exact time and location of every RBT operation and test, so that detailed analyses can be conducted on the effects of actual daily tests in different regions. There are some intriguing indications from the Tasmanian analyses that tests conducted in the evening before midnight are more important as a deterrent than late night or daytime tests, but unfortunately the low numbers of both accidents and tests after midnight preclude definite conclusions. There is a clear need for data in the larger jurisdictions to be available in the form produced by the Tasmanian police so that these issues can be explored further.

Notwithstanding some possible unreliability in the data, the dramatic effects of the increased levels of enforcement in New South Wales since 1987 that are so clear in the time series analyses for all serious and for single vehicle night-time accidents are probably the most important findings of the present study.

The model for all serious accidents indicated that an increase of 1000 in the daily testing rate corresponded roughly to a decline of 6% in accidents. The relationship for single-vehicle night-time accidents was stronger, with an increase of 1000 tests each day corresponding to a 19% reduction in accidents. However, from the models the relationship between changes in daily testing rates and accident reductions was not linear, so that there is an element of "diminishing returns" as daily enforcement levels increase. This is particularly the case with single-vehicle night-time accidents. This means that care must be taken in making predictions about the effects of increases in testing levels, especially when extrapolating outside the range of the data (about 2000 to 6000 tests per day)

The analyses also indicated that RBT has a "residual deterrent effect" that is of great importance. In previous criminological research it has only been possible to demonstrate residual effects for some types of police blitzes or "crackdowns," whereas the present study demonstrates such effects for ongoing random enforcement. Significantly Sherman (1990), who clarified the concepts of initial and residual deterrence and the decay of deterrent effects, and who also documented these effects for a range of crackdowns for a variety of offences, emphasised the deterrent potential of crackdowns that are *randomised* across time and space. Adopting Australian criminologist Peter Reuter's distinction between the *risk* of getting caught and the *certainty* about what that risk is on any day, randomised enforcement delivers low certainty about whether the risk of apprehension is high or low at any given time and place, thus enhancing the deterrent impact. This of course is the very essence of random breath testing, properly enforced.

The residual deterrent effect of any given RBT operation as estimated from the models persisted for at least six months for all serious accidents, and in the case of single vehicle night-time accidents for about 18 months. These estimates are broadly consistent with the findings of survey research (Homel, 1988; Homel, Carseldine and Kearns, 1988) that suggest that exposure to random breath testing does have an effect for some time after it occurs, although the behavioural impact is subject to decay if not reinforced by further doses. As Homel (1988) put it, deterrence should be seen as:

> ... *a dynamic and unstable situation*, with a constantly changing mix of those deterred through personal exposure to RBT and those 'undeterred' through a successful drink-driving episode or through nonexposure to the operation of RBT. .... RBT is always in the process of losing its effectiveness among drivers who, because they feel under pressure to drink or because they have not seen RBT in operation for some time, take the risk of driving after drinking. [*emphasis in original*]. (pp. 244-245).

The reality of constant decay in the deterrent effect of RBT, and the need to remedy this with continued high levels of visible and unpredictable enforcement, highlights the importance of setting appropriate or optimal levels of testing. The relationships between overall enforcement levels and accidents in New South Wales are apparent from a visual comparison of the graphs of enforcement and accidents (Figures 3.1 to 3.3, and 3.5), and is depicted explicitly (for all serious accidents) in Figure 3.11. The analyses and the graphs together suggest that if there is some "optimum" level of enforcement beyond which accident reduction benefits are not commensurate with the costs of enforcement, it is greater than the approximately 6300 tests per day conducted by New South Wales police in 1995.

To put the question of optimal or desirable enforcement levels in context, it is essential to consider existing levels and historical trends in each state. Table 7.3 shows the total number of tests for each full year RBT has been in operation in each of the four states, and also the number of tests each year as a ratio of licence holders.

As already noted, of the four states Tasmania has consistently had the highest rate of testing. New South Wales rates were steady between 1984 and 1987, after which they began to rise steadily. In 1994 and 1995 Western Australia, which had the lowest rates of actual testing of any state (as opposed to numbers of vehicles stopped), increased its testing rate substantially, due largely to the introduction of two booze buses in Perth and environs.

In contrast to all the other states, the Queensland rate of testing has been dropping since 1992. This appears to be a consequence of the regionalisation of the Queensland Police Service in May 1992 following implementation of one of the major recommendations of the Fitzgerald Commission of Inquiry (Fitzgerald, 1989). Designed to facilitate the introduction of community policing by bringing the police closer to the people, regionalisation appears to have had the unintended consequence of diminishing the organisation's commitment to RBT enforcement. This is probably because there is now no central traffic branch or "traffic task force" that coordinates the regions, and the Assistant Commissioners in charge of regions have not themselves generally given priority to traffic law enforcement.

Table 7.3. Random Breath Tests Each Year of Full RBT Operation in the Four States

	New South Wales		Tasmania		Western Australia		Queensland	
Year	Number of Tests	Tests per Licence Holder	Number of Tests[1]	Tests per Licence Holder	Number of Tests[2]	Tests per Licence Holder	Number of Tests	Tests per Licence Holder
1983	849095	.26	100000	.41				
1984	1240866	.37	158000	.63				
1985	1128850	.33	175000	.69				
1986	1283548	.36	204000	.78				
1987	1256084	.35	160000	.60				
1988	1343528	.37	152000	.55				
1989	1515817	.41	137000	.49	289088	.30	770283	.44
1990	1703946	.46	192000	.68	260955	.26	661841	.37
1991	1996995	.54	186000	.66	319137	.31	793289	.43
1992	2095820	.55	195000	.69	399167	.37	918448	.49
1993	2211746	57	184000	.64	386114	.35	802139	.41
1994	2092798	.53	186000	.64	523267	.47	773059	.38
1995	2307487	.58	194000	.66	737278	.65	697200	.34

[1] From Leggett (1991) for 1983 to 1990, and estimated from financial year data for 1991 to 1995. Data are for the whole of Tasmania.

[2] Number of tests, not number of vehicles stopped.

With the exception of Queensland, the states are now all achieving testing rates well in excess of one test per two licence holders per year. In Tasmania and Western Australia, rates are about two tests for every three licence holders. Given that there is strong evidence that an increase in testing rates in New South Wales would reduce accidents, it is reasonable to recommend that police in all states substantially increase the annual number of tests and evaluate the impact on accidents. Although it would be hazardous to make a prediction concerning the precise level of accident reduction that could be achieved by (say) a 50% increase in testing, one can be confident that *some* worthwhile savings would be achieved.

As a rule of thumb, we might conclude that police in all parts of Australia could conduct up to one random test per licence holder per year and achieve substantial reductions in accidents. There is nothing magical about a level of one test per licence holder per year, but it does constitute a simple target that should be able to be achieved in all states over time with an affordable transfer of resources. Of course this recommendation presupposes that the conditions of enforcement necessary to achieve a deterrent impact are met, an issue explored at some length in the sequel to this report. Chief amongst these conditions are high visibility and apparent ubiquity (Homel, 1988), which have been achieved in New South Wales through a combination of careful choice of sites for stationary testing, signs proclaiming that random testing is in operation, and the increased use of general duties police for RBT.

The use of general duties police in New South Wales, following an earlier practice that highway patrol officers were required to complete one hour of RBT per shift, appears to have been a very important factor in the increase in testing rates in New South Wales. By 1995 nearly half of all tests were conducted by general duties police, a trend that began with the sharp increase in testing towards the end of 1987 (Figure 3.6). What this means in effect is that New South Wales police have “routinised” RBT and incorporated it into the activities of rank and file officers. In contrast to Victoria, the emphasis has been on the use of patrol vehicles rather than on high visibility booze buses. The positive results achieved in Victoria demonstrate that the booze bus strategy can be very successful, but what is not clear is whether that strategy is more cost effective than the patrol car approach, especially in states which are geographically larger and more decentralised than Victoria. A study that carefully compares the costs and benefits of the two approaches should be conducted to address this question.

Overall the New South Wales strategy of constant RBT activity dispersed over a wide area and integrated into routine police work seems more appropriate for states like Western Australia and Queensland than the Victorian booze bus approach, especially in an era when financial constraints are likely to be of over-riding importance, although we are aware that recent increases in testing levels in Western Australia have made heavy use of the booze buses. The challenge for these states is to increase substantially levels of high visibility testing across a geographically wide area within existing or smaller budgets, and to adapt the best aspects of New South Wales practice, with or without the buses. The model of randomised scheduling of enforcement developed by Leggett and his colleagues for the random roadwatch program (Leggett, in press) seems ideally suited as a management tool for accomplishing this.

A key issue to be resolved is the role of mobile testing, which as noted in Chapter 1 has been steadily increasing in popularity in New South Wales (and Queensland) and is presumably part of the price that has been paid for involving general duties police in enforcement. Unfortunately the time series data on mobile testing are confounded with the data on stationary testing, and it is therefore not possible to determine statistically whether mobile testing adds anything to the effectiveness of RBT enforcement. Theoretical considerations would suggest that testing levels should be increased using stationary methods, with mobile testing playing a strictly subsidiary role.

The Impact of Other Legal Factors on Accidents

Where possible, the effects of the lowering of the legal blood alcohol level from .08 to .05 and the effects of de facto RBT using roadblocks were estimated in the time series models. Table 7.4 contains a summary of the findings.

Table 7.4. Summary of the Impact of the .05 Law and De Facto RBT

State/ City	Counter-measure	Type of accident	Percentage drop in accidents	Accidents prevented per year	Total accidents prevented
NSW	0.05	All serious	7%	605	7291
		Fatal	8%	75	908
		SVNT	11%	296	3568
WA	De facto RBT	All serious	9%	217	508
Perth	De facto RBT	All serious	8%	118	277
		Fatal	23%	27	64
		SVNT	17%	68	159
Qld	0.05	All serious	14%	599	6042
		Fatal	18%	91	921
	RID campaign	All serious	12%	483	1128
		Fatal	15%	78	182

Note: SVNT is single-vehicle night-time accidents

In every case, the impact of RBT exceeded in magnitude the impact of de facto RBT or RID, although in a few instances (e.g., fatal accidents in Perth) RBT was not as statistically significant as de facto RBT. In several analyses (e.g., single vehicle night-time accidents and fatal accidents in Western Australia, and serious and fatal accidents in Queensland) the impact of RBT was substantially greater than the de facto program.

Thus it seems clear that RBT is a more effective method of enforcement than de facto RBT, even though the transition from one to the other was not marked by the kind of intensive publicity used in New South Wales, and despite the fact that the levels and methods of enforcement in some areas still reflect pre-RBT practices. Nevertheless, the analyses are consistent with the research of Watson, Fraine and Mitchell (1995) in Queensland, who suggested that RID had had a significant effect on accidents, even though the estimates in the present study are lower (having been corrected for the effects of the control variables) than the raw data indicate.

The results obtained for the impact of the .05 law in New South Wales and Queensland are of the same order of magnitude as the estimates for de facto RBT. As indicated in Chapter 2, it is difficult in the case of New South Wales to separate the effects of .05 and RBT, since only two years separated the initiatives, and many drivers did not become aware of the .05 law until RBT was seriously threatened. Apart from the non-significant effect for single vehicle night-time accidents, the results for Queensland, where .05 preceded RBT by eight years, suggest a subtantial impact of the .05 law.

Conclusion and Recommendations

We may answer the research questions posed at the end of Chapter 1 as follows:

(a) *The size and duration of the impact of RBT.* RBT had an immediate, substantial and permanent impact on accidents in all states except Tasmania, where there was a large initial impact that could not be demonstrated to have persisted beyond a few months. The magnitude of effects varied depending on the state and on the accident series analysed, but the results were most clear for New South Wales, where RBT reduced fatal accidents initially by 48% and by 15% on a permanent basis. However, the permanent impact was achieved only by counteracting an eventual decay in the Introduction effect by increased levels of enforcement in the late 1980s. If enforcement levels had not been increased, RBT in New South Wales would have ceased to have had any effect by the mid to late 1980s.

(b) *The impact of RBT in Tasmania.* Results for Tasmania were equivocal. Although RBT was intensively enforced in that state, a levelling off in the 1980s of the decline in accidents observed during the 1970s, low accident numbers, and low levels of media publicity, mean that a permanent impact could not be demonstrated (apart from Launceston where there was some evidence that ongoing enforcement was associated with a reduction in accidents).

(c) *The effects of enforcement on accidents.* There was a clear relationship between increased enforcement levels in New South Wales from 1987 and reduced accidents. It was estimated that an increase of 1000 tests per day corresponded to a decline of about 6% in serious accidents and 19% in single-vehicle night-time accidents, although the relationships were non-linear with a diminishing impact as the effects of bigger variations in daily enforcement rates were estimated. RBT enforcement was important primarily because residual deterrent effects were achieved, with a given RBT operation having a discernable impact on single-vehicle night-time accidents up to 18 months later. No clear relationships between enforcement levels and accidents could be demonstrated for other states, with the partial exception of Tasmania.

(d) *The effects of de facto versus full RBT.* Although de facto RBT in the "evolutionary states" achieved worthwhile reductions in accidents, in every case RBT was superior in its effectiveness, achieving accident reductions approximately 50% higher than the de facto programs.

The recommendations arising from this statistical study are as follows:

1. All states should increase highly visible stationary RBT to a level equivalent to one test per licence holder per year. This could be accomplished in a cost effective manner by using general duties police and highway patrol vehicles, and possibly also booze buses, and by utilising the management techniques embodied in the random roadwatch program.

2. A cost-benefit analysis should be conducted comparing the merits of the Victorian booze bus strategy with the New South Wales strategy of relying on general duties and traffic police operating from standard police vehicles.

3. Police in all states as a matter of urgency should improve the accuracy and comprehensiveness of their enforcement data, so that detailed analyses can be conducted on daily data broken down by mode of enforcement, location of testing, and time of day.

4. The methods used in this study should be applied to each of the time series augmented by an additional five years of data. This would be particularly important for Queensland and Western Australia for which in the present study it was not possible to include the Introduction and Enforcement components of the model. In this way the long-term impacts of RBT in each state, especially in the light of recent variations in enforcement levels, could be better understood.

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Appendix 1: DRINK DRIVING PUBLICITY IN NSW

Authority Responsible	Theme	Principal Medium	Other Media	Name of Ad	Duration	Expenditure
RTA NSW	Will you be under .05 or under arrest?	TV		How will you go? Nightmare One in 3	Christmas 1982	
RTA NSW	Will you be under .05 or under arrest?	TV	Cinema, radio	One in 3 Human graph Nightmare	Christmas 1983	Dec 83-June 84 $1 500 000
RTA NSW	Will you be under .05 or under arrest?	TV	Radio, press poster, bus taxi backs	Remember how much RBT?/ Nightmare/Drive way/Pub/Disco	Easter 1984	Dec 83-June 84 $1 500 000
RTA NSW	Stay under .05 or get off the road	TV	Radio	Inevitability/ Consequences	Christmas 1984	
RTA NSW	Stay under .05 or get off the road	TV	Radio	Family/ Ruth/Rachel	Easter 1985	
RTA NSW	Stay under .05 or get off the road	TV	Radio	Confessions of a drink/driver	Christmas 1985	
RTA NSW	Stay under .05 or get off the road	TV		Family/ Ruth/Rachel	Easter 1986	
RTA NSW	Stay under .05 or get off the road	TV	Radio, press outdoor	Inevitability	Christmas 1986	Budget 1986-1987 $600 000

Authority Responsible	Theme	Principal Medium	Other Media	Name of Ad	Duration	Expenditure
RTA NSW		Bill-boards		All over Sydney they're all over Sydney/you'll have a lot more fun if you leave the car at home	1987	
RTA NSW		Bus backs		Drink drivers queue here	September '87	
RTA NSW		TV	Radio	Drink drive 3 versions	October '87	
RTA NSW		Print	Radio	200 get life	November '87	Nov '87-June '88 $577,400
RTA NSW		Radio	Print	Family/Ruth Rachel/Mobile No thank you	December '87	Nov '87-June '88 $577,400
RTA NSW		TV		Barbeque Inevitability Mobile RBT	Easter 1988	Nov '87-June '88 $577,400
RTA NSW		TV	Radio, outdoor press	Barbeque	Christmas & Easter '88-'89	1988-89 $665,700
RTA NSW		TV	Radio,outdoor		1989-90	1989-90 $1,500,000

Authority Responsible	Theme	Principal Medium	Other Media	Name of Ad	Duration	Expenditure
RTA NSW		Print		One for the road no thanks	July-Sept 90	1990-91 $1,000,000
RTA NSW		TV		One for the road no thanks	Nov 90-Jun 91	1990-91 $1,000,000
RTA NSW		Print		Blood alcohol	Dec 90-Jan 91	1990-91 $1,000,000
RTA NSW		Print		Blood samples	Dec 90-Jan 91	1990-91 $1,000,000
RTA NSW		TV	Sky TV, press outdoor		1991 - 1992	1991-92 $730,000
RTA NSW		Radio	TV		December '91	$4,500
FORS	Rethink your second drink	TV	Mag supplement press ads, 'Smart Cards'	Rethink	May-Aug 1992	
RTA NSW	Its only a matter of time	TV	Radio, outdoor	Briefing	July - Dec '92	1992-93 $950,000
RTA NSW		TV	Radio, print		Dec '92	
RTA NSW		TV	Radio, print		Dec '92	