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IMPACTS OF CHANGING USED IMPORT VEHICLE VOLUMES ON AUSTRALIAN AND NEW ZEALAND VEHICLE FLEET SAFETY

by

Mike Keall
Laurie Budd
Linda Watson
& Stuart Newstead

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Author(s):

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Abstract:

There are potentially important safety effects of increasing or decreasing sales of used imported vehicles in Australia and New Zealand. Approximately half of the current New Zealand light passenger fleet originated as used vehicles from overseas. Australia currently has a used import program managed under the Commonwealth Government concessional vehicle scheme: used imports currently constitute less than 2% of the total vehicle imports annually. As a proportion of the licensed fleet, concessional vehicles make up a mere 0.2%. This paper uses estimates of the safety of such vehicles in Australia and New Zealand compared to those sold new to predict safety effects of policies around vehicle importation. Compared to business-as-usual, several scenarios were tested to inform policy considerations.

Using New Zealand fleet data 2003-2014 decoded into vehicle clusters and identified according to origin (sold new or imported used), both primary and secondary safety were assessed. For Australia, data on crashed drivers, their injuries and vehicles driven were analysed from Police reported crash data for the years 2008-2012 for Western Australia, South Australia, New South Wales, Queensland and Victoria. This dataset also identified concessional imports. Data from 2012 was used as the baseline crash year in modelling safety effects of scenarios.

For the New Zealand fleet, for any given year of manufacture and market group, there was little difference in the safety of vehicles according to their origin. So merely changing the proportions of used imported vehicles in the fleet of a given age would have little effect on safety per se. If, however, there were other effects from reducing access to used imports, such as increased motorcycle usage, there could be significant reductions in safety. For Australia, expanding the used import program effectively increased the average age of the fleet, with secondary safety deteriorating under the scenarios tested with estimated increases in deaths and serious injuries between 4% with a 100-fold increase in the number of concessional vehicles and 15% if the majority of vehicles were concessional. Analysis showed that it would be possible to theoretically reduce serious road trauma by up to 13% through a used vehicle import program but only if used imports were restricted to only the very safest vehicles available which is unlikely to be achievable.

Key Words:

Road safety, used vehicles, used imports, light passenger fleet, concessional vehicles, primary safety, secondary safety, crash data, safety effects, injury, statistics

Disclaimer

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www.monash.edu.au/muarc

Monash University Accident Research Centre,
Building 70, Clayton Campus, Victoria, 3800, Australia.
Telephone: +61 3 9905 4371, Fax: +61 3 9905 4363

Preface

Project Manager / Team Leader:

A/Prof Stuart Newstead

Research Team:

- Dr Mike Keall
- Linda Watson
- Laurie Budd

Contributorship Statement

- A/Prof Stuart Newstead: Project conception, data analysis, review and management of final version of report
- Dr Mike Keall: Data assembly, analysis design, preparation and statistical analysis of datasets, manuscript preparation
- Linda Watson: Data assembly, analysis design, preparation and statistical analysis of datasets, manuscript preparation
- Laurie Budd: Data assembly, analysis design, preparation and statistical analysis of datasets, manuscript preparation

Ethics Statement

Ethics approval was not required for this project.

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EXECUTIVE SUMMARY

Background

There are potentially important safety effects of increasing or decreasing sales of used imported vehicles in Australia and New Zealand. Approximately half of the current New Zealand light passenger fleet originated as used vehicles from overseas. Australia currently has a used import program managed under the Commonwealth Government concessional vehicle scheme: used imports currently constitute less than 2% of the total vehicle imports annually. As a proportion of the licensed fleet, concessional vehicles make up a mere 0.2%. This paper uses estimates of the safety of such vehicles in Australia and New Zealand compared to those sold new to predict safety effects of policies around vehicle importation. Compared to business-as-usual, several scenarios were tested to inform policy considerations.

Methods

For New Zealand, key scenarios examined included:

- What would happen if used imports became less available, leading to much higher motorcycle usage such as before the used importation programme became established?
- What changes in safety would occur if the age distribution of the vehicle fleet were the same as prior to the used importation programme?

For Australia, key scenarios examined included:

- What effects on safety might occur if used imports were much more common?
- What safety impacts would accompany a fleet with the same age distribution as has occurred in New Zealand, undoubtedly influenced by widespread used vehicle importation?

Using New Zealand fleet data 2003-2014 decoded into vehicle clusters and identified according to origin (sold new or imported used), both primary and secondary safety were assessed.

For Australia, data on crashed drivers, their injuries and vehicles driven were analysed from Police reported crash data for the years 2008-2012 for Western Australia, South Australia, New South Wales, Queensland and Victoria. This dataset also identified concessional imports. Data from 2012 was used as the baseline crash year in modelling safety effects of scenarios.

Results

For the New Zealand fleet, for any given year of manufacture and market group, there was little difference in the safety of vehicles according to their origin. So merely changing the proportions of used imported vehicles in the fleet of a given age would have little effect on

safety per se. If, however, there were other effects from reducing access to used imports, such as increased motorcycle usage, there could be significant reductions in safety.

A comparison of the age distribution of the New Zealand fleet in 1990 was made with the 2014 fleet, showing that the 1990 fleet was on average considerably younger. If the 2014 fleet had the same age structure as the 1990 fleet, estimated savings in fatal and serious injuries due to improved secondary safety of a newer fleet would amount to 7.1% of the current fatal and serious injury rate, or just over 146 fatal and serious casualties. However, if the younger fleet came with a proportionate increase in motorcycle usage, this benefit could be negated. An increase in motorcycle exposure from the current 1% to between 8% and 13% of total travel would double the number of fatal and serious injuries. On this basis, the 7.1% benefit from a newer fleet would be entirely offset with an increase in the total proportion of motorcycle travel of only around 1 percentage point (i.e. increasing the current 1% of total travel which is on motorcycles to be 2%)

For Australia, data on crashed drivers, their injuries and vehicles driven were analysed from Police reported crash data for the years 2008-2012 for Western Australia, South Australia, New South Wales, Queensland and Victoria. This dataset also identified concessional imports. Data from 2012 was used as the baseline crash year in modelling safety effects of scenarios. As expanding the used import program effectively increased the average age of the fleet, secondary safety deteriorated under the scenarios tested with estimated increases in deaths and serious injuries between 4% with a 100-fold increase in the number of concessional vehicles and 15% if the majority of vehicles were concessional. Analysis showed that it would be possible to theoretically reduce serious road trauma by up to 13% through a used vehicle import program but only if used imports were restricted to only the very safest vehicles available which is unlikely to be achievable. This last scenario presumed that regulation or consumer preference could dramatically influence the types of used vehicles imported.

Discussion and conclusions

When considering only the light passenger vehicle fleet, it is likely that used import programs increase the average age of the vehicle fleet hence reducing overall safety unless only the safest used vehicles were allowed to be imported. Analysis has estimated the overall safety penalty to be up to a 15% increase in deaths and serious injuries based on New Zealand experience. However, estimating the overall impact of used vehicle programs on the safety of the vehicle fleet is difficult due to difficulties in quantifying the effects the program might have on more dangerous modes of transport such as motorcycling. Any safety improvement or loss that might be realised through decreasing or increasing used vehicle imports could easily be entirely offset through a resulting change in motorcycle travel exposure. Any change in used vehicle import policy would need to be conscious of these potential flow on effects.

Examination of the real cost of vehicles to New Zealand consumers as a consequence of the used vehicle importation programme (and other market effects) showed that the real cost of purchasing motor vehicles has fallen considerably, approximately halving in the past 30 years. This indicates that the used importation programme should have improved safety considerably

by decreasing the real costs of safer vehicles. However, rather than choosing to improve the quality of the vehicles they drive, New Zealander consumers have preferred to spend their money on other things. Although Australia and New Zealand are different in many substantial ways, not the least being the larger size of the Australian population, it is quite possible that a relatively unconstrained used vehicle importation program in Australia might lead to similar outcomes as seen in New Zealand that have led to generally poorer vehicle secondary safety levels even though the “price” of a given level of safety has fallen considerably.

1. BACKGROUND AND AIMS

Australia currently has a used import program managed under the Commonwealth Government concessional vehicle scheme although the number of used imports annually is relatively small (less than 2% of total vehicle imports). In contrast New Zealand has a large used imported vehicle program, which has been operating for many years and for more than a decade has represented just over half of all licensed passenger vehicles in New Zealand. With the cessation of local vehicle manufacturing in Australia, the potential benefits of increasing access to used imported vehicles in Australia has again surfaced in public debate. In New Zealand, there are concerns that the poorer safety performance of older used imported vehicles might counterbalance more apparent transportation benefits. This project examines current safety effects in New Zealand and estimates potential safety effects of changes to the current volumes of used imported vehicles in both countries.

MUARC has recently completed a project looking at the crash risk and crashworthiness of used import vehicles in Australia relative to vehicles sold new in Australia. This expands previously completed work examining the safety of used imported vehicles in New Zealand. In the current study, the safety effects of changing the proportion, and potentially the mix of used imported vehicles in each country, are to be examined by development and application of a fleet safety model specific to this purpose. Based on estimated risk per vehicle type and importation type for vehicles of different market groups and ages, various scenarios for changing used import vehicles in the fleet are considered compared to a projection of the status quo.

These projections provide a basis for considering various policy options concerning the importation of used vehicles. Compared to business-as-usual, several scenarios were tested:

For New Zealand, key scenarios examined included:

- What would happen if used imports became less available, leading to much higher motorcycle usage such as before the used importation programme became established?
- What changes in safety would occur if the age distribution of the vehicle fleet were the same as prior to the used importation programme?

For Australia, key scenarios examined included:

- What effects on safety might occur if the vehicles currently in the fleet as used imports were much more common?
- What safety impacts would accompany a fleet with the same age distribution as has occurred in New Zealand as a consequence of widespread used vehicle importation?

2. DATA

2.1 Australia

2.1.1 Secondary safety estimates

Crashworthiness (CWR), and total safety ratings (TSR) as estimated by the annual update of the used car safety ratings (Newstead et al, 2015) were attached to vehicles in the crash data so that fleet averages could be estimated by vehicle age and market group. If possible, the TSR or CWR was matched to a specific model; where this was not possible (the model was mis-specified in the data or had insufficient data for secondary safety to be estimated) values estimated at the market group and year of manufacture level were used. If market group could not be determined or a vehicle was manufactured before 1982 average ratings by year of manufacture alone were used. Vehicles with an unknown year of manufacture or a year of manufacture less than 1964 were excluded from the analysis.

One scenario made use of the best rated vehicles within market group and year of manufacture groupings. These models used are listed in the appendix.

2.1.2 Police-reported crash data

All Police reported crash data for the five States of Western Australia, South Australia, New South Wales, Queensland and Victoria were combined and reduced to a set of driver/vehicle cases for the 2014 (crash year up to and including 2012) secondary safety evaluations compiled by MUARC (Newstead et al, 2015). These data also identified which vehicles were concessional imports and were used by MUARC to evaluate their crashworthiness. Data from the crash years 2008 to 2012 was used to establish baseline levels of crashworthiness, total safety ratings and injuries. Data from 2012 was used as a baseline crash year in the modelling process.

2.2 New Zealand

Table 1 **Data analysed: New Zealand licensed vehicles from Motor Vehicle Register snapshots of light 4-wheeled passenger vehicles**

fleet year	n
2003	2,443,276
2004	2,549,278
2005	2,237,057
2006	2,354,377
2007	2,757,639
2008	2,773,941
2011	2,820,587
2012	2,843,625
2013	2,908,370
2014	2,973,613
TOTAL	26,661,763

Models were fitted to existing annual snapshots of the licensed New Zealand light vehicle fleet from 2003-2014 (excluding 2009 and 2010 – see Table 1) decoded to VSRG groupings. These groupings combined makes and models of vehicles with similar specification as regards secondary safety, and are used to compile the Used Car Safety Ratings. Where possible, each vehicle was also decoded to market group. Year of manufacture was also available for each licensed vehicle. To each licensed vehicle, crashworthiness ratings, aggressivity ratings and total safety ratings were allocated according to recent estimates that include data on crashed vehicles to 2013 (Newstead et al, 2015). As described previously (Keall and Newstead, 2011), where the VSRG category could be assigned, ratings were allocated at this (most specific) level; where the VSRG category could not be assigned, but a market group had been identified, ratings were allocated at the level of market group and year of manufacture; where neither VSRG nor market group were assigned, just year of manufacture was used as the basis for allocating the ratings. Table 2 shows the proportion of vehicles that were allocated the TSR by each method in each fleet year. The much lower proportion allocated ratings according to methods 1 and 2 in earlier years is partly a function of the cut-offs applied where method 1 and 2 ratings were not estimated for vehicles manufactured pre-1982.

Table 2 Data analysed: proportion of licensed light 4-wheeled vehicles in each fleet year allocated TSR by each method

Fleet year	TSR method		
	1	2	3
2003	38%	13%	49%
2004	42%	14%	44%
2005	43%	15%	42%
2006	46%	15%	39%
2007	55%	18%	28%
2008	59%	18%	22%
2011	69%	22%	9%
2012	72%	23%	5%
2013	72%	23%	5%
2014	72%	23%	5%
Overall	58%	19%	23%

3. METHODS

3.1 Australia

The Australian scenarios involved the expansion of the used import program to higher proportions, up to 100% used imports:

1. A fleet consisting of 100 times the 2012 proportion of used imports, maintaining the age and market group distribution of these. The remainder of the fleet ('first registered as new') is reduced, maintaining its age and market group distribution. Total fleet size remains the same.
2. A fleet consisting of 50% of vehicles in the 'first registered as new' vehicle age distribution and 50% in the New Zealand used import vehicle age distribution. The used import vehicles were allocated to market groups in the same proportion as 'first registered as new' vehicles in the 2012 fleet of the same age.
3. As above, but using the safest model for each used import vehicle age and market group in terms of crashworthiness and total safety ratings. These safest models are listed in the Appendix.
4. A fleet consisting of 0% of vehicles in the 'first registered as new' vehicle age distribution and 100% in the New Zealand used import vehicle age distribution. The used import vehicles were allocated to market groups in the same proportion as 'first registered as new' vehicles in the 2012 fleet of the same age.

3.2 New Zealand

3.2.1 Models to estimate secondary safety of used imports vs New Zealand new

Models were fitted to estimate the way that the overall risk of fatal and serious road user injury (given that a tow-away crash occurred) was related to the year of manufacture of the vehicle, the market group, and the vehicle origin (New Zealand new or used import). Although logistic models fitted estimated the odds of fatal and serious injury, as these odds are small values, the odds are almost identical to risk, and can be interpreted as such (Breslow and Day, 1980). Models were fitted using the SAS procedure LOGISTIC (SAS Institute Inc., 2014). To account for the fact that the secondary safety indices were attached to every vehicle in the fleet, quasi-likelihood methods were used to estimate P values and confidence intervals using the deviance divided by degrees of freedom as a measure of over-dispersion.

3.2.2 Models to estimate primary safety of used imports vs New Zealand new

Models were fitted to 2012 licensed vehicle data to estimate the way that the injury crash involvement was related to the year of manufacture of the vehicle, the general location of the owner's address, the market group of the vehicle and its import status. This used an approach for estimating the primary safety of vehicles developed previously (Keall and Newstead, 2015).

The outcome variable was a count of frontal impact multi-vehicle crashes or single vehicle crashes resulting in injury. Counts of multi-vehicle crashes where the focus vehicle was impacted from the rear or to either side were included as an explanatory variable to account for aspects of the vehicle's exposure (Keall and Newstead, 2015). Rates were estimated by

including as an offset to the model a log of the number of licensed vehicles in the fleet with the characteristics assessed.

3.2.3 Scenarios tested for New Zealand fleet

The scenarios tested focused on potential effects of the used import program on aspects such as vehicle scrapping; motorcycle usage; the used import program expansion or contraction:

1. Increasing the proportion of used imports in the fleet at the expense of new vehicle sales (same age and market group).
2. Replacing some used imports with motorcycles (as at start of used import programme in New Zealand)
3. A fleet comprised of only vehicles sold new but changing age profile to pre-used import profile
4. Entire fleet as used imports
5. Increasing the proportion of newer used imports in the fleet to encourage the retirement of older vehicles in the existing fleet
6. Decreasing the proportion of used imported vehicles in the fleet in preference for new vehicles
7. Decreasing the proportion of used imported vehicles in the fleet with the effect of aging the fleet through retaining vehicles longer

4. RESULTS

4.1 Australia

4.1.1 Australian vehicle age profiles

The Australian crash fleet was separated into two groups of vehicles: those sold new in Australia and concessional vehicles. Figure 1 displays the distribution by vehicle age of each of these groups in the crash year 2012. These show that the concessional vehicles were considerably older on average than the fleet of vehicles first licensed in Australia as new vehicles, largely reflecting the nature and restrictions of the current concessional vehicle schemes.

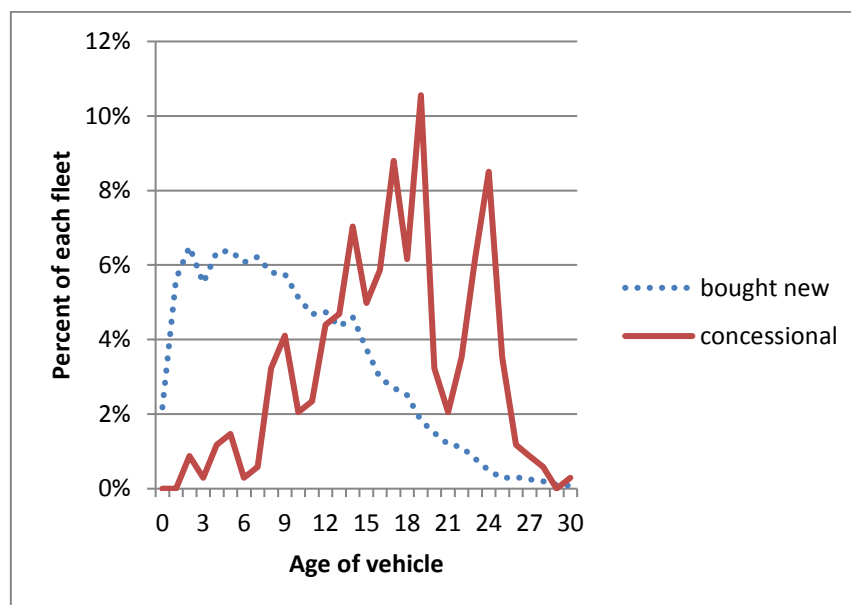


Figure 1

Distribution by vehicle age of crashed vehicles that were first registered as new and concessional vehicles for combined jurisdictions in crash year 2012

Figure 2 shows the proportion of crashed vehicles that are concessional for the years 2008 to 2012. This figure shows that the proportion of crashed vehicles that were concessional has more than halved since 2008, falling in 2011 and 2012 to around 0.2% of crashed vehicles.

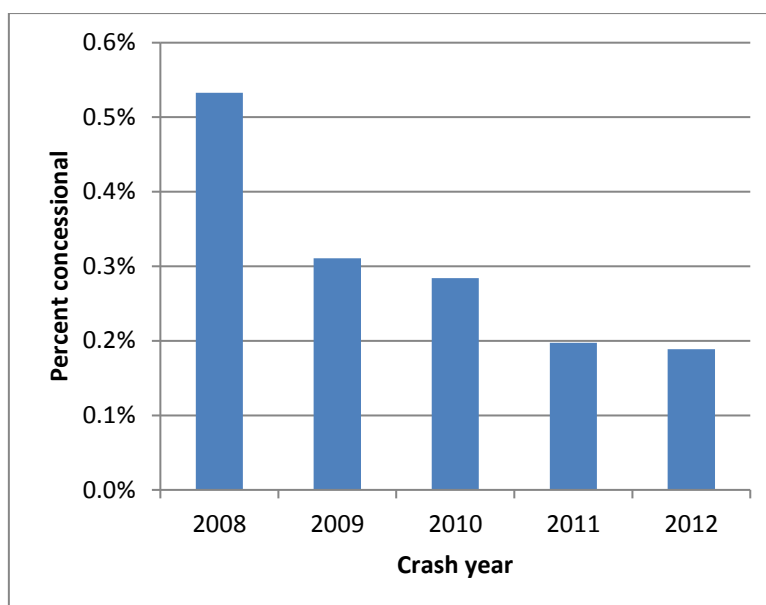


Figure 2

Proportion of Australian crashed vehicles that were concessional in the years 2008 to 2012

The average 2012 fleet crashworthiness and Total Safety Ratings for concessional (bought used) and vehicles first registered as new (bought new) are presented in Table 3. These are weighted averages that reflect the distribution of vehicles by year of manufacture. The generally earlier years of manufacture for the concessional vehicles mean that the crashworthiness is on average inferior (the risk is higher), whereas the mean TSRs are very similar. These mean ratings can be expected to be related to fatal and serious injury outcomes. For example, the 29% higher crashworthiness measure for the concessional vehicles implies that – given precisely the same crash experience – there would be a 29% higher risk of driver fatal and serious injury in the concessional vehicles than in the fleet sold new.

Table 3 For the 2012 Australian crash fleet, weighted mean crashworthiness and Total Safety Rating for vehicles bought new and concessional (first licensed as used)

Source	CWR	TSR
Bought new	0.0344	0.0350
Concessional	0.0444	0.0354

The TSRs for the concessional vehicles was approximated by using mean TSRs by YOM and market group from the overall fleet ratings. These could not be estimated for concessional vehicles specifically as these are too rare in the fleet. However, the crashworthiness ratings for the concessional vehicles were estimated using actual crash data for the fleet divided into five groups.

The crashworthiness and safety ratings were used respectively to estimate injured drivers and injured road users for each crashed vehicle and fleet type. In addition, Crashworthiness and Total Safety ratings were averaged by vehicle age and market group.

4.1.2 Australian scenarios

Table 4 shows the proportional changes in killed and seriously injured road users from baseline as modelled in the five expansion scenarios. The aging of the fleet due to modelled expansion of used imports would generally increase the number killed and seriously injured road users from passenger vehicle crashes unless safer vehicles were imported (fourth row of Table 4). If 100% of crashed vehicles originated from used imports, serious driver casualties were expected to increase by 22% and overall road users by 15%. However, if the imports were only made up of the safest possible models, decreases in serious casualties were estimated: 17% and 13% respectively. This demonstrates the clear benefits of being able to influence which models might be included in import schemes.

Table 4 Proportional change per expansion scenario in killed and seriously injured by road user from business-as-usual

Scenario	Proportional change in killed & seriously injured	
	Driver	Road User
S1 100 times the 2012 used imports	5.7%	4.2%
S3 50% New Zealand used imports, 50% existing	11.9%	8.3%
S3 50% New Zealand used imports, 50% existing but with superior used import CWR/TSR	-16.7%	-12.6%
S4 100% the New Zealand used import age distribution	21.8%	14.7%

It is evident from Figure 3, which shows estimates of changes in numbers of killed and seriously injured road users compared to baseline by vehicle age, that increasing the existing number of concessional used imports by a factor of 100 (with corresponding decreases in the rest of the fleet) would be expected to increase the injury burden arising from older vehicles (often vintage vehicles, over 20 years old). Imposing a New Zealand used import age distribution has the biggest effect on injuries occurring in vehicles aged between 15 and 25. Note that the same proportional change as indicated in this graph can involve large numbers where the baseline number of injuries is large or small numbers where the baseline numbers are small.

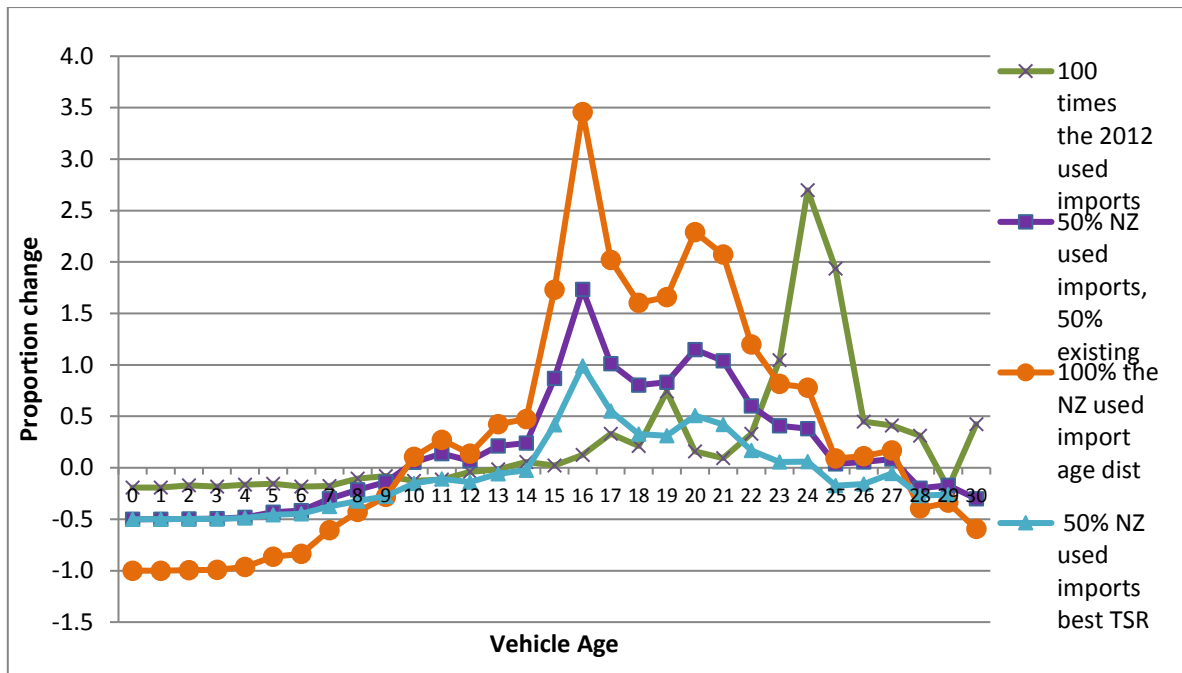


Figure 3

Estimates of change in the killed and seriously injured road users involved in crashes with passenger vehicles from baseline by vehicle age for expanded import scenarios

4.2 New Zealand

4.2.1 New Zealand fleet characteristics

The following analysis looks at snapshots of the fleets over the 11 year period from 2003 to 2014. Figure 4 shows that over the period studied, the proportion of licensed vehicles that had been imported to New Zealand as used vehicles was relatively constant, hovering at a little over half the fleet. Figure 5 shows that in terms of those vehicles in the fleet in the years studied (2003 to 2014), the mean age (years since manufacture) of those vehicles originating as used imports was very similar to the mean age of those sold new at the beginning of the period. The mean ages gradually diverged subsequently to a gap of 3.5 years in 2014.

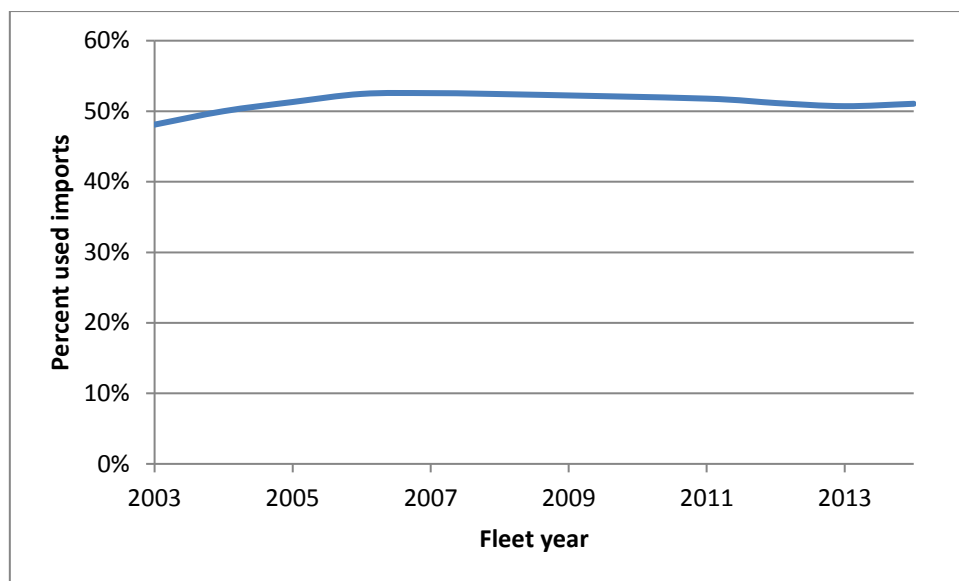


Figure 4

Proportion of New Zealand licensed vehicles per fleet year that originated as used imports

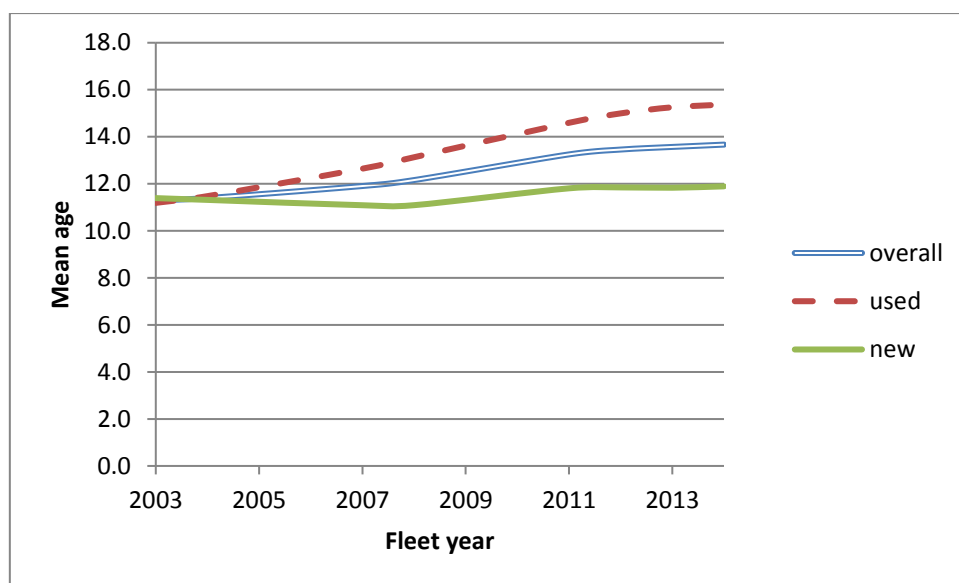


Figure 5

Mean age of vehicles by fleet year overall and according to origin (used imports or sold new)

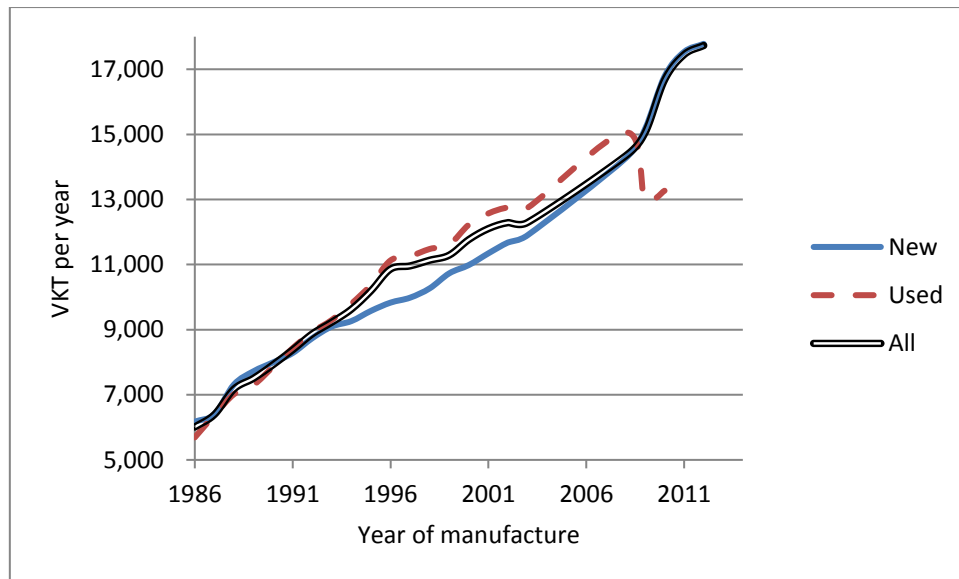
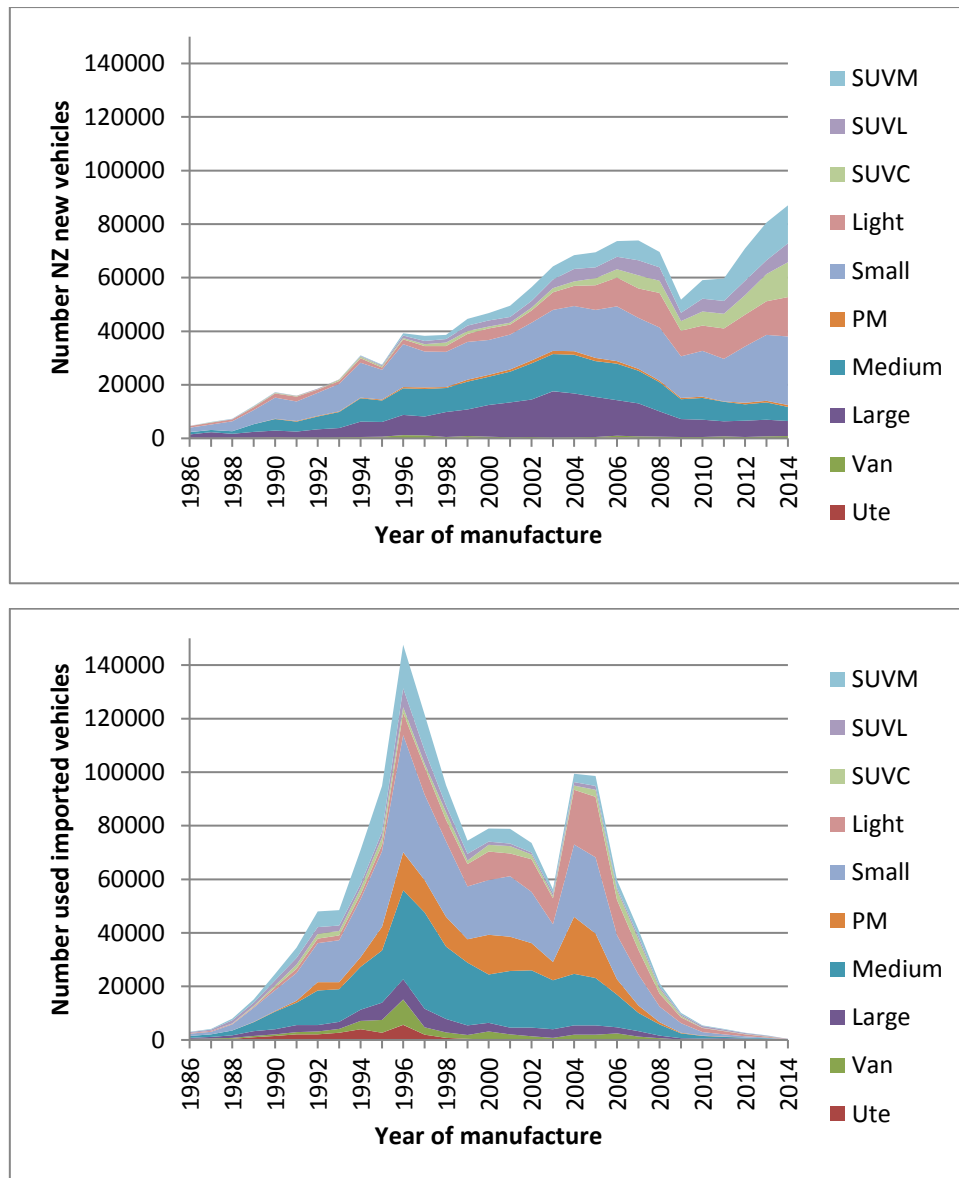


Figure 6

Mean kilometres travelled per vehicle per year for 2014 fleet, by year of manufacture and import status

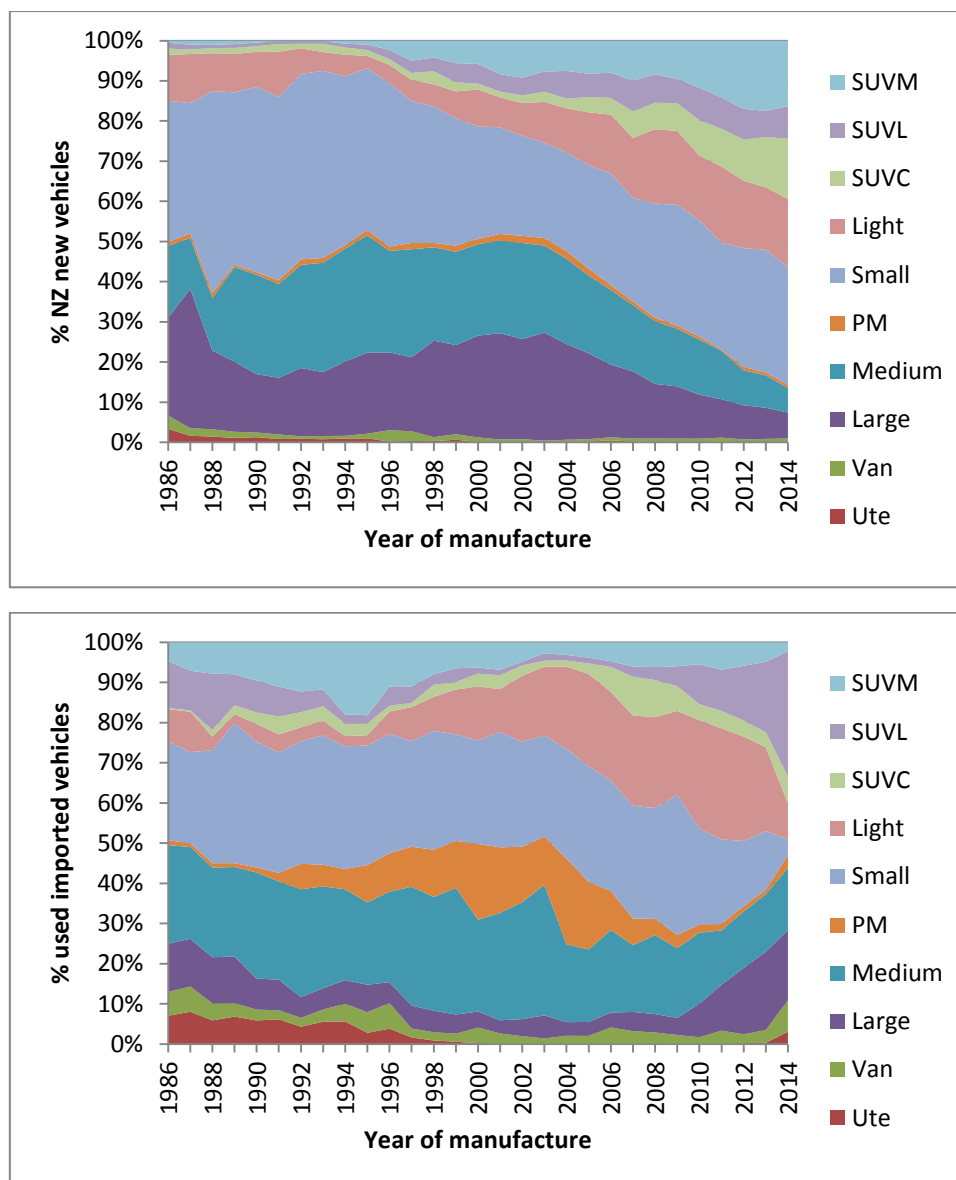
Figure 6 shows a comparison of vehicles licensed in 2014 in terms of kilometres driven according to year of manufacture and importation status. This shows that vehicles with more recent year of manufacture are generally driven more than older vehicles. In general, vehicles imported used into New Zealand are driven more than vehicles sold new of the same age. Distance driven was derived from consecutive odometer readings as recorded at the warrant of fitness (roadworthiness) inspection. For the vast majority of used imported vehicles sold from 2004 onwards, consecutive readings were missing, so there is considerable uncertainty as to the accuracy of the mean VKT shown for these vehicles in Figure 6, including the curious dip downwards after 2008.

Figures 7a and 7b shows two clear peaks in numbers of vehicles by year of manufacture for used imports: one for 1996 vehicles and the other for 2004 and 2005 vehicles. For vehicles sold new, there was a peak in 2007 and then another most recently, in 2014. Of course, new vehicles are normally sold in the same year as the year of manufacture. Vehicles gradually leave the fleet as time passes, with the rate of attrition from the fleet increasing with vehicle age.



Figures 7a and 7b

Distribution by market group and year of manufacture of 2014 used imports and New Zealand new vehicles



Figures 8a and 8b

Within manufacture year distribution by market group and year of manufacture of 2014 used imports and New Zealand new vehicles

As shown clearly in Table 5, the majority of large cars arrive in the fleet as new vehicles. Medium cars are mainly used imports, particularly those with years of manufacture between 1995 and 2003. People Movers are even more dominated by the used imports – only one in seven was purchased as a new vehicle. Commercial vehicles (Utes and vans) are mainly used imports. Although small cars, light cars and SUVs are equally sourced from used imports or sold new, the used imports dominate manufacture years 1995-2003 and New Zealand new vehicles dominate more recent vehicles (2004 onwards). This is as expected, given that used imported vehicles by definition will be older than vehicles sold new at the time they are sold.

Table 5 **Distribution of 2014 fleet manufactured 1986 onwards by market group and origin (used imports or New Zealand new)**

year of manufacture		Ute	Van	Large	Medium	PM	Small	Light	SUVC	SUVL	SUVM	Total
1986-1994	Used	0.5%	0.3%	0.6%	2.3%	0.4%	2.9%	0.3%	0.3%	0.5%	1.2%	9%
	NZ new	0.1%	0.1%	0.9%	1.2%	0.0%	2.2%	0.4%	0.1%	0.0%	0.0%	5%
1995-2003	Used	0.4%	1.0%	1.5%	8.0%	3.7%	8.4%	2.9%	0.7%	0.8%	2.7%	30%
	NZ new	0.0%	0.2%	3.5%	3.6%	0.2%	4.5%	1.1%	0.3%	0.6%	0.9%	15%
2004-2014	Used	0.0%	0.3%	0.5%	2.4%	1.8%	3.5%	2.8%	0.5%	0.3%	0.5%	13%
	NZ new	0.0%	0.2%	3.8%	3.9%	0.3%	7.8%	4.4%	2.3%	2.0%	3.3%	28%
all 1986-2014	Used	1%	2%	3%	13%	6%	15%	6%	2%	2%	4%	52%
	NZ new	0%	0%	8%	9%	1%	15%	6%	3%	3%	4%	48%
Grand total		1%	2%	11%	21%	6%	29%	12%	4%	4%	9%	100%

4.2.2 New Zealand Total Safety Index ratings and Crashworthiness ratings

This section analyses the safety performance of New Zealand new and used imported vehicles according to the Total Safety Index, which is the estimated risk of fatal and serious injury to road users who are in tow-away crashes involving the given vehicle studied.

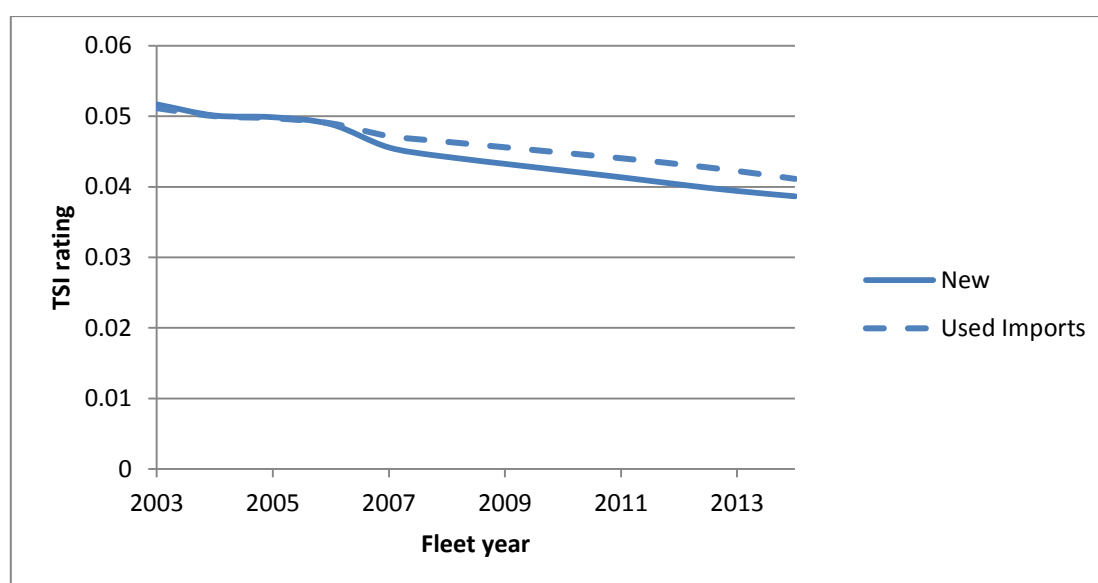


Figure 9

Mean Total Safety Index rating (TSR) for vehicles in each fleet year according to origin (sold new or imported used)

Figure 9 shows that the average TSR at the fleet level was very similar for used imported vehicles and New Zealand new vehicles at the start of the period studied, but the fleet of New Zealand new vehicles have tended to be safer (with lower TSR) on average from around 2007 onwards. More generally, there is a strong trend towards improving TSR levels with time (with more recent year of manufacture). The divergence between the used import fleet and the New

Zealand new fleet in terms of mean TSR is strongly associated with the relative ages of these fleets, as shown in Figure 5.

Figure 10 shows how the Total Safety Index varies by year of manufacture for the vehicles originally either imported used or new in the 2014 fleet. This shows that the used imports are generally safer in terms of the TSR than those sold new with the same year of manufacture. Of course, these differences may arise because of the different constitution of the fleets in terms of market groups. Some market groups perform better on average in terms of the TSR.

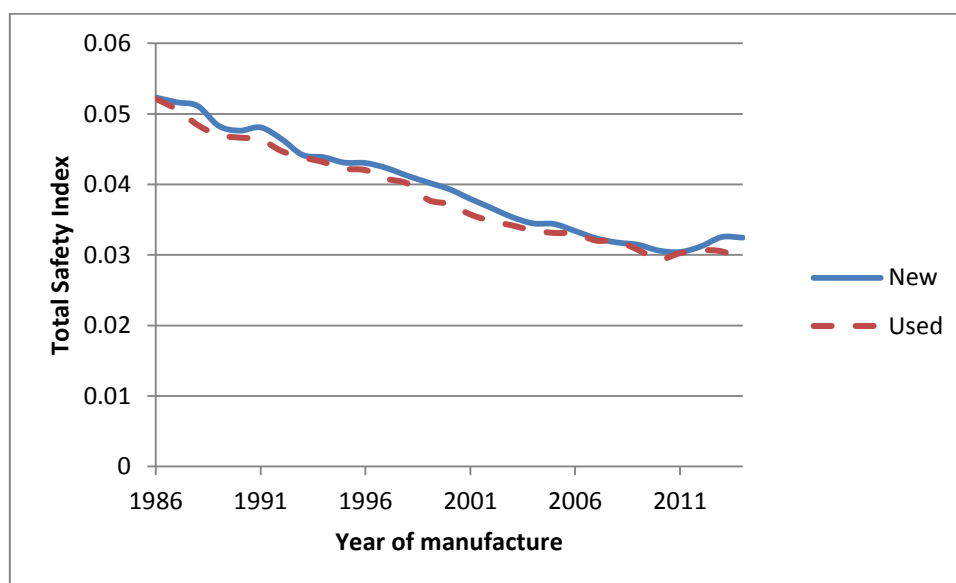


Figure 10

Mean Total Safety Index in 2014 fleet by vehicle year of manufacture

4.2.3 Comparison of secondary safety of used imports vs New Zealand new

Models were fitted to estimate the way that the overall risk of fatal and serious road user injury (given that a tow-away crash occurred) was related to the year of manufacture of the vehicle, the market group and vehicle origin (New Zealand new or used import). An interaction term was also fitted to see whether the New Zealand new and used imports might have different relative levels of safety according to market group. A logistic model was fitted using the SAS procedure LOGISTIC (SAS Institute Inc., 2014) using “events” and “trials” set to be 1000 for the latter and 1000*TSR for the former. This enabled the model to estimate risks associated with the explanatory factors. To account for the fact that the secondary safety indices were attached to every vehicle in the fleet, quasi-likelihood methods were used to estimate P values and confidence intervals using the deviance divided by degrees of freedom as a measure of over-dispersion (a heterogeneity factor), as described above. These values were quite large because of the large size of the licensed vehicle fleet compared to the crash fleet on which the secondary safety indices are based. For example, for the first model reported, the covariance matrix was multiplied by the heterogeneity factor of 377.

For New Zealand new vehicles, the TSR was estimated to be 1.037 times the TSR for equivalent vehicles imported used (with 95% CI 1.028 to 1.046), controlling for year of manufacture (each individual year appearing as a dummy in the model) and market group. This can be interpreted as an estimated 3.7% higher TSR for New Zealand new vehicles compared to equivalent used imports (controlling for year of manufacture and market group).

When a model was fitted for vehicles manufactured between 2004 and 2013 with a continuous variable for model year, the odds ratios (which can be interpreted as risk ratios) were estimated as shown in Table 6. This model was restricted to data for more recent vehicles to obtain an estimate of the average decrease in risk per model year, which appeared to be approximately linear between 2004 and 2013. Despite the more restricted data set and fewer parameters estimated, the New Zealand new vehicles were still estimated to impose between three and four percent greater risk of fatal and serious injury than equivalent used imported vehicles. For each consecutive model year, an approximate reduction in risk of 1.4% was estimated. Controlling for market group, this means that the average used imported vehicle had a similar risk to a New Zealand new vehicle that was between two and three years newer.

Table 6 **Estimated risk of fatal or serious injury given tow-away crash occurrence for New Zealand 2014 fleet of model year 2004 to 2013 according to market group, import status and year of manufacture (a continuous variable)**

Effect (relative to specified comparison group)	Point Estimate	95% Wald Confidence Limits	
Year of manufacture (per 1 year increase)	0.986	0.983	0.989
Commercial Ute vs Medium SUV	0.984	0.786	1.233
Commercial Van vs Medium SUV	1.004	0.934	1.079
Large car vs Medium SUV	0.984	0.949	1.02
Medium car vs Medium SUV	0.942	0.911	0.974
People Mover vs Medium SUV	0.948	0.906	0.992
Small car vs Medium SUV	1.008	0.978	1.04
Light car vs Medium SUV	1.157	1.121	1.195
Compact SUV vs Medium SUV	1.053	1.011	1.096
Large SUV vs Medium SUV	0.849	0.812	0.889
Import status New Zealand new vs used import	1.033	1.013	1.053

4.2.4 Comparison of the primary safety of used imports vs New Zealand new

Models were fitted to 2012 licensed vehicle data to estimate the way that involvement rates of frontal impact and single vehicle crashes were related to the year of manufacture of the vehicle, the general location of the owner's address, the market group of the vehicle and its import status. When controlling for the other factors (market group, year of manufacture and owner location), the import status of the vehicle had no significant effect on this rate (an estimated 1% reduction in risk for New Zealand new vehicles $P=0.87$). A term representing the interaction between import status and market group was also tested in the model using a joint test for the effect, which tests that all the parameters associated with that effect are zero. This was marginally not statistically significant ($P=0.055$).

4.2.5 New Zealand Scenarios

Using statistical modelling based on estimated risk per vehicle type and importation type for vehicles of different market groups and ages, eight scenarios for changing used import vehicles in the New Zealand fleet were considered compared with the status quo.

1. Increasing the proportion of used imports in the fleet at the expense of new vehicle sales (same age and market group).

As described above, for used imports of the same year of manufacture and market group, primary safety was identical and the TSR was slightly lower. Of course, this is a function of the makes and models arriving in the country from the different sources. But assuming current practices continue, scenario (1) is more likely to increase safety than decrease safety.

When considering primary safety, the results reported above indicated no significant difference in risk for vehicles of the same year of manufacture and market group.

2. Replacing some used imports with motorcycles (as at start of used import programme in New Zealand)

Table 7 shows key data used to model the impact on trauma levels of increasing motorcycle riding in New Zealand at the expense of car driving. The table shows the total number of driver/rider and passenger injuries for each vehicle type (light 4-wheeled passenger vehicle or motorcycle/moped) and estimated vehicle kilometres (VKT) driven/ridden. Casualty numbers come from police recorded crash data (Ministry of Transport, 2013) and the VKT data are derived from odometer readings (Ministry of Transport, 2014). These show that the rate per distance travelled of fatal and serious injury for motorcyclists was 28 times that for light passenger vehicle occupants and the rate of all injury (including non-hospitalised injuries) was 14 times higher. This means that – all other factors being equal – the overall number of road injuries will increase as the proportion of motorcycles in the fleet increases, even though the total distance driven and ridden remains constant. At the extreme, if all cars were replaced by motorcycles, the number of road casualties would be around 14 times as high as they are currently.

Table 7 2012 data*: total driver and passenger casualties, VKT and rate per distance driven or ridden

Vehicle type	Total km (billion km)	Total F&S	All injuries	Rate per billion km F&S	Rate per billion km all
Light 4-wheeled passenger	36.79	1,310	8,222	36	223
Motorcycle/moped	0.39	390	1,188	1,000	3,046

*From Ministry of Transport (2014) and (2013)

A complicating factor is that around half of all motorcycle crashes currently involve a car colliding with the motorcycle. Some such crashes may not have happened if that car had been replaced by a motorcycle, partly because of the larger size of a car (a motorcycle vs. motorcycle

encounter might result in a proportion of near-misses that would otherwise have been collisions with a car), partly because of the greater mass of the car (an impact with a smaller vehicle, such as a motorcycle, would result in less severe injuries). To accommodate these uncertainties, the scenario of increasing the motorcycle fleet is modelled under two scenarios:

- (*High scenario*) The motorcycle crash rate per km remains as it is currently;
- (*Low scenario*) The motorcycle crash rate per km is as it is currently when motorcycles constitute 1% of the VKT of cars and motorcycles combined; as they take on a greater percentage of VKT (using the model), an increasing proportion of collisions between a car and a motorcycle will be assumed to be between a motorcycle and a motorcycle, for which no consequent fatal or serious injury is assumed.

The *low scenario* will clearly underestimate the injury rate and the *high scenario* will overestimate this rate, providing bounds under the assumptions described.

The formulas used to model casualties per year based on current *casualties* and *rate* per km (both defined for motorcycles, mopeds and light 4-wheeled passenger vehicles combined) and specific rates per km for motorcycles (mc) and light 4-wheeled (car) were as follows:

(High condition) Total casualties per year=

$$casualties \times ((p_{mc} \times rate_{mc}) + (p_{car} \times rate_{car}))/rate \quad (1)$$

Where p_{mc} =proportion of combined fleet that is motorcycles

$$p_{car}=1 - p_{mc}$$

(Low condition) Total casualties per year=

$$casualties \times ((p_{mc} \times rate_{mc} \times p_{mc} \times p_{crash\ mc\ no\ car}) + (p_{mc} \times rate_{mc} \times p_{car} \times p_{crash\ mc\ vs\ car}) + (p_{car} \times rate_{car}))/rate \quad (2)$$

Where $p_{crash\ mc\ vs\ car}$ is the proportion of motorcycle crashes currently that involve collisions with a car.

To calibrate equation (2) with the current proportion of VKT contributed by motorcycles, 0.01 was subtracted from p_{mc}

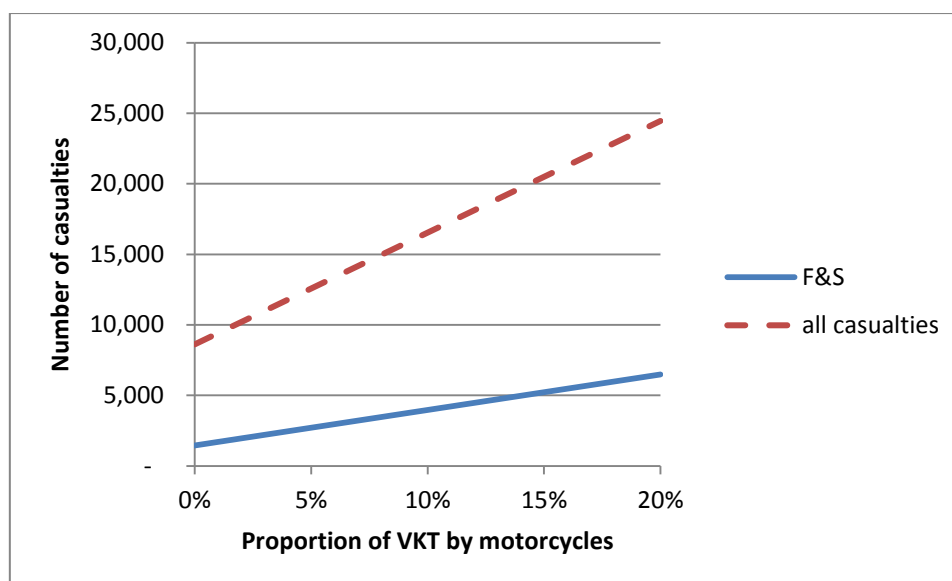


Figure 11

High condition of modelling total annual casualties against the proportion of motorcycle VKT

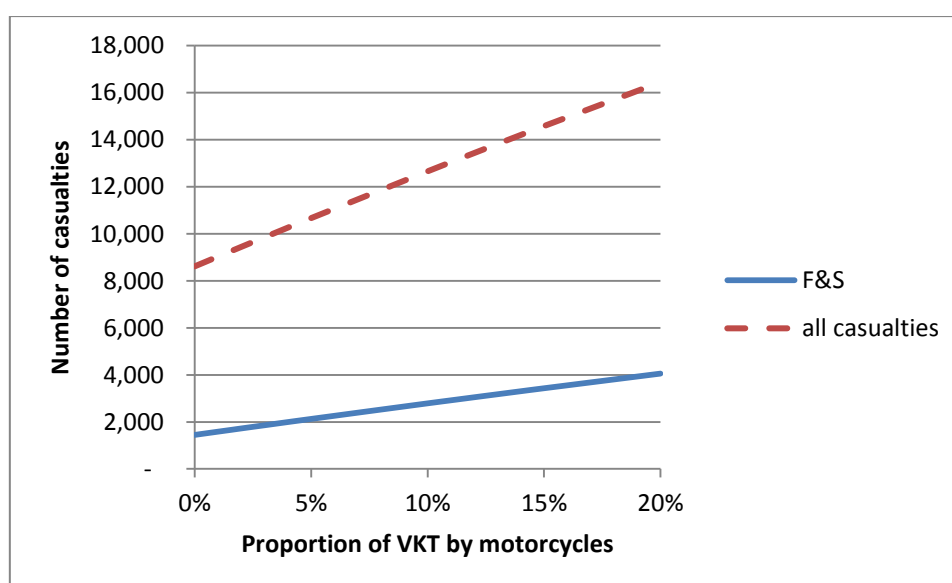


Figure 12

Low condition of modelling total annual casualties against the proportion of motorcycle VKT

For both Figure 11 and Figure 12, showing modelled estimates of total casualties, the rate of fatal and serious injuries actually increases more steeply relative to the baseline level than the rate of all injuries because of the higher rate of more serious injuries per km for motorcycles. For Figure 11, the higher condition, fatal and serious injuries approximately double when the proportion of VKT done by motorcycles increases from the current 1% to 8%. The numbers of *casualties in total* reach double the baseline level when motorcycles contribute 13% of VKT. For Figure 12, the lower condition, fatal and serious injuries approximately double when the

proportion of VKT done by motorcycles increases from the current 1% to 13%. For this lower condition, the numbers of *casualties in total* double when motorcycles contribute 24% of VKT.

3. A fleet comprised of only vehicles sold new but change age profile to pre-used import profile

The New Zealand used importation programme came into effect in the 1990s. To compare the age distribution of the fleet pre-programme, the age (years since manufacture at the time of the crash) of crash-involved light passenger vehicles was compared for 1990 and 2014, as shown in Figure 13. The fleet was clearly newer in 1990, with an average age of 10.2 compared to 13.3 in 2014.

It is worth noting that the crash fleet can have a different average age from the licensed vehicle fleet arising from two main mechanisms, influencing the average in opposite directions: (i) generally higher annual distances are driven in newer vehicles; (ii) young drivers – who have substantially higher risk on average than other drivers – generally drive older cars (Keall and Newstead, 2011). The licensed fleet average age in 2014 was 14.3 overall, 12.6 for vehicles sold new and 15.9 for those originating as used imported vehicles (Ministry of Transport, 2014).

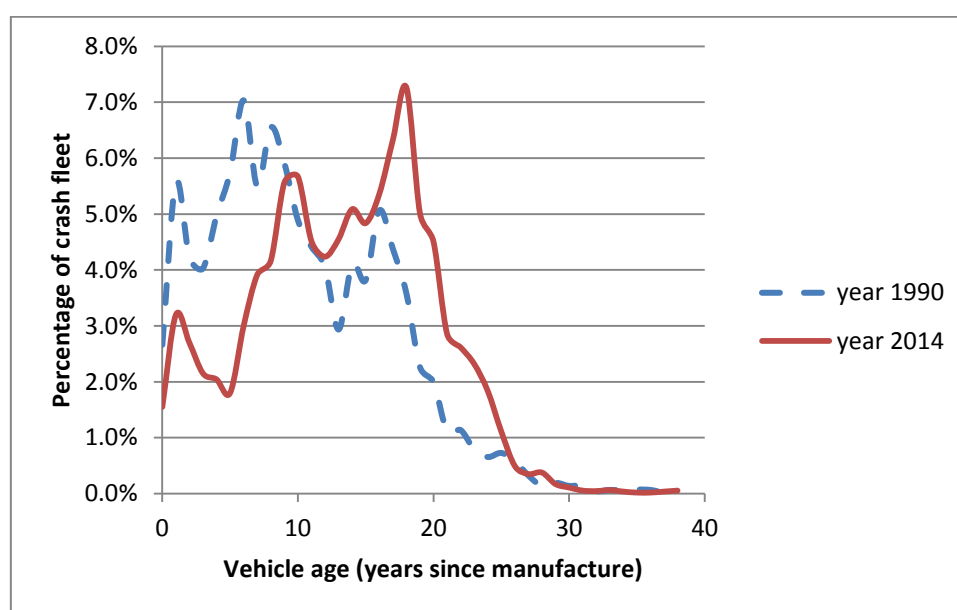


Figure 13

Distribution of light 4-wheeled passenger crash fleet in 1990 and 2014

The last column of Table 8 shows the effect on the average TSR for the current fleet if it had an age distribution such as existed prior to the importation programme, in 1990. This shows that the estimated savings in fatal and serious injuries due to improved secondary safety of a newer fleet would amount to 7.1% of the current fatal and serious injury rate, or just over 146 fatal and serious casualties.

However, fleet safety should be considered in a wider road safety context. For example, it is likely that more motorcycles were purchased and ridden prior to the used importation

programme as the costs of alternatives (such as car ownership) were higher. Once used imported cars brought down the cost of cars, it is also likely that a substantial amount of travel that would have occurred on motorcycles was replaced by the safer mode of travel, by car. Increases in safety have occurred over the 25 years from 1990 to 2014, consisting of road improvement, road use behaviour improvements (IRTAD, 2014) and vehicle fleet improvements (Keall et al, 2007). Motorcyclist safety will generally have benefited from the first two aspects of safety, but not from the last. In 1990, there were 1013 fatal and serious casualties in crashes involving motorcycles; in 2014, there were 458, which is 555 fewer. It is beyond the scope of the current study to estimate the different components of safety over the past 25 years to place these 555 fatal and serious casualties in perspective.

4. Expanding used import program to higher proportion (to estimate what Australia safety would be if it had New Zealand fleet profile)

Controlling for vehicle age (years since manufacture) and market group, the used imported vehicles in New Zealand have very similar safety to those sold new. Increasing the supply of used vehicles can theoretically increase safety if a buyer with a given budget can afford a more recent model of vehicle, with generally improved safety.

5. Entire fleet as used imports

See above. Secondary safety can be expected to improve and primary safety remain unchanged.

6. Increasing the proportion of newer used imports in the fleet to encourage the retirement of older vehicles in the existing fleet.

Table 8 For 2014 light 4-wheeled crash fleet, age range, TSR average, along with scenarios of age range cut-offs with TSR and F&S injury savings based on TSR

	Crash fleet 2014	Remove oldest 1%	Remove oldest 5%	Remove oldest 10%	Crash fleet age dist. 1990
Age range	0-38*	0-27	0-23	0-21	0-38 ⁺
TSR average (%)	3.747	3.735	3.696	3.645	3.476
F&S savings	0.0	6.4	27.3	52.9	146
%F&S savings	0.0%	0.3%	1.3%	2.6%	7.1%

*ignoring 0.2% of fleet older than 38

⁺ignoring 0.1% of fleet older than 38

Table 8 shows as a baseline the average TSR for the 2014 light 4-wheeled crash fleet along with the age range of 99.8% of the fleet. Also shown are scenarios of 100% scrappage of vehicles beyond a certain age along with the estimated average consequent fleet TSR and F&S injury savings based on this TSR. It is assumed that the fleet younger than the cut-off retains its age distribution (so mobility is equally redistributed across the age groups of existing

vehicles). For example, if the oldest 5% of vehicles in the fleet were removed (manufactured 1991 and prior) and the crashes of older vehicles were distributed equally amongst vehicles aged 0-23, then the consequent savings in fatal and serious injuries due to improved secondary safety would amount to 1.3%, or just over 27 fatal and serious casualties. Also shown is the effect on the average TSR of an age distribution of the crash fleet such as existed prior to the importation programme, in 1990, which is discussed above.

7. Decreasing the proportion of used imported vehicles in the fleet in preference for new vehicles.

This would be likely to have little effect. Potentially, reducing the supply of used vehicles would increase the price, effectively increasing the cost of safety (in terms of the safety that can be purchased for a given price).

8. Decreasing the proportion of used imported vehicles in the fleet with the effect of aging the fleet through retaining vehicles longer.

Figure 14 shows the 2014 and 1990 crash fleet age distributions along with a scenario that increases the proportion of vehicles aged over 25 from 1.8% of the fleet to 9.6% of the fleet, such as might arise if access to imported vehicles were restricted. This results in an increase in fatal and serious injuries (over the 2014 baseline) of 75, representing 3.7%. If a similar change is modelled but with a legislated maximum age of 35, as shown in Figure 15, the increase in fatal and serious injuries is slightly less: an increase in fatal and serious injuries (over the 2014 baseline) of 61, representing 3%. These two last scenarios show that increased retention of older vehicles will push up the consequent injury rate, but somewhat less so if there are regulations (via vehicle standards or otherwise) that discourage very old vehicles.

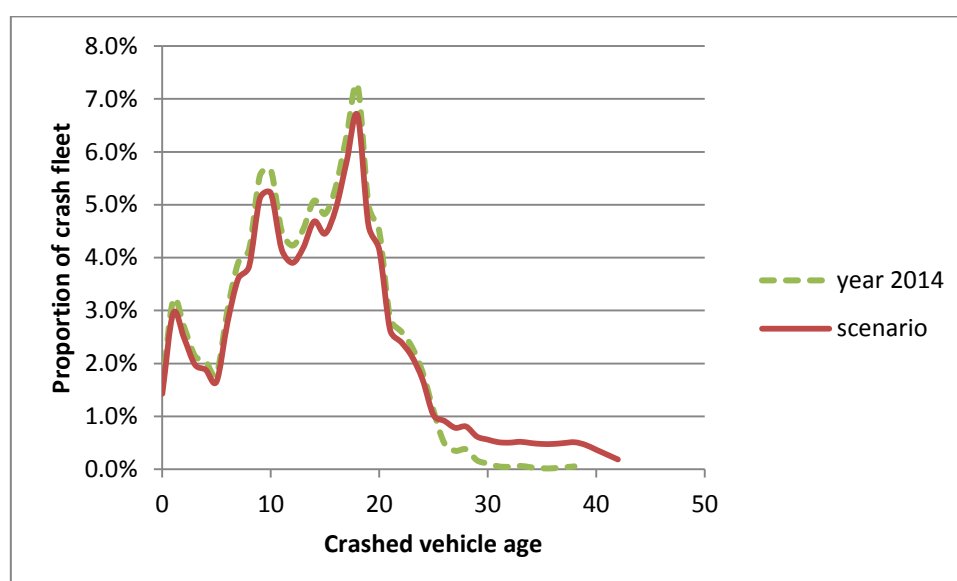


Figure 14

Distribution of light 4-wheeled passenger crash fleet in 2014 with scenario (2014 fleet but increases the proportion of vehicles aged over 25 from 1.8% of the fleet to 9.6% of the fleet)

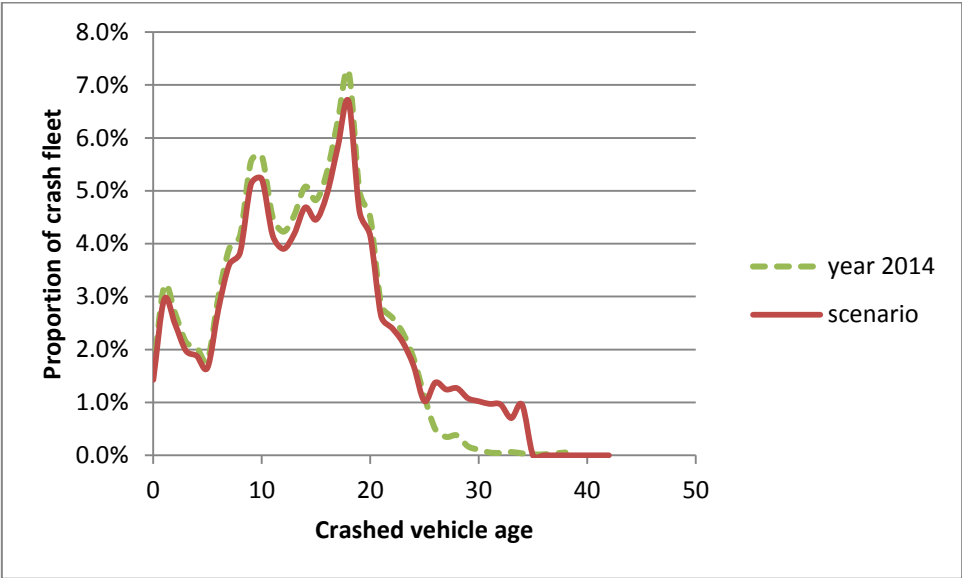


Figure 15

Distribution of light 4-wheeled passenger crash fleet in 2014 with scenario (2014 fleet but increases the proportion of vehicles aged over 25 from 1.8% of the fleet to 9.6% of the fleet, but legislated 35-year-old limit)

5. DISCUSSION

5.1 New Zealand

On average, New Zealand new vehicles were 3.7% less safe in terms of total safety than used imported vehicles of the same age and market group. This finding will have arisen from the particular makes and models imported into New Zealand via the different sources. Overall, the evidence is that the used import programme in New Zealand has had the *potential* to increase safety. In fact, if consumers had continued to spend – in real terms – the same amount for vehicles (whether new or used) over the past 25 years, there would have been a marked improvement in fleet safety. Although the assessment of market effects is outside the scope of the current study, the availability of used imported vehicles will have lowered the price of used vehicles more generally, meaning that a vehicle buyer with a given budget can theoretically afford a more recent vehicle, which is likely to be safer on average.

Statistics New Zealand monitor household expenditure via their Household Expenditure Survey (Statistics New Zealand, 2014). The 2013 data indicate that households on average spent between two to three times as much on second hand vehicles as on new vehicles. The fleet age profile prior to the advent of used imports was clearly superior: the fleet in 1990 was on average newer, with concomitant safety benefits. Over a period of 25 years, it is possible that households and individuals have budgeted less for vehicle purchases as a result of the availability of relatively cheap used vehicles. This is confirmed by data from the Consumers Price Index (Statistics New Zealand, 2015) and its component subgroup “Purchase of vehicles” shown in Figure 16. This latter series is consisted of adjusted prices for the following, with weights: purchase of new motor cars 1.48; purchase of second-hand motor cars 1.89; purchase of motorcycles 0.07; purchase of bicycles 0.04.

Hence second-hand cars form the most important constituent, followed closely by new cars, with motorcycles and bicycles contributing relatively little. For new cars, Statistics New Zealand collect actual prices of a range of small, medium, and large cars of various brands at dealerships across New Zealand, quality-adjusting these prices as the models change. For example, if a car is fitted with a more powerful engine and sold at the same price, this would be treated as an effective price fall for consumers. For used cars, they collect prices of about 300 cars from dealerships across the country, analysing price data with a hedonic regression model using make, model, year of manufacture, engine size, and odometer reading to account for quality changes. Although the CPI (Consumers Price Index) increased consistently overall during the period from the end 1985 to the end of 2014, representing inflation, the costs of purchasing vehicles in New Zealand (weighted as above) has remained fairly flat overall, representing a drop in real costs adjusted for inflation, as shown in Figure 17. So rather than converting effectively lowered prices for safety into a safer fleet, New Zealanders have apparently benefited in other ways, by having funds freed up to be used for other purposes.

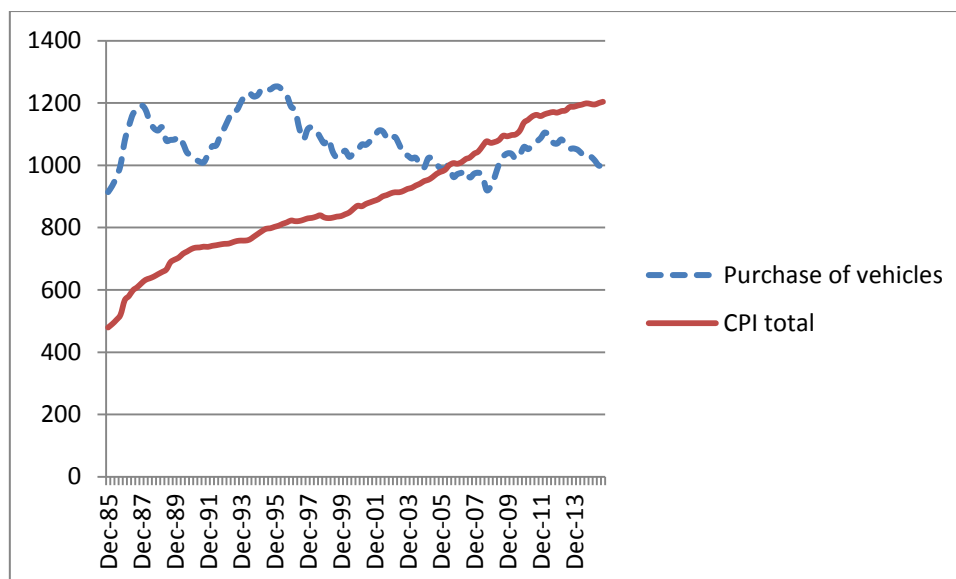


Figure 16

New Zealand overall Consumers Price Index (CPI) and subgroup Purchase of Vehicles.
Base for both series: June 2006 quarter (=1000) (Statistics New Zealand, 2015)

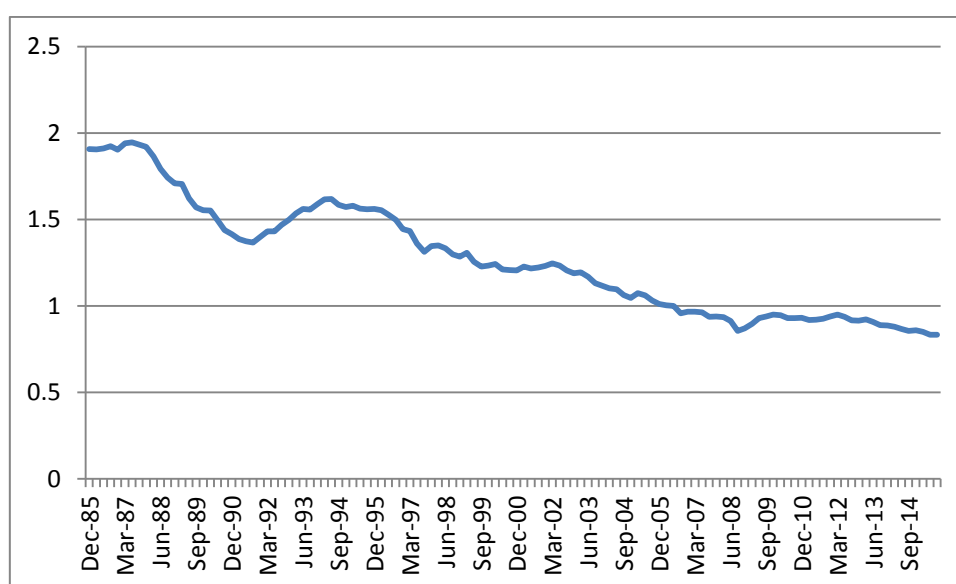


Figure 17

New Zealand subgroup Purchase of Vehicles divided by overall Consumers Price Index (CPI). Base for series: June 2006 quarter (=1) (from: Statistics New Zealand, 2015)

5.2 Australia

The existing program of used vehicle importation into Australia is currently very small and its effects on fleet safety are hence negligible. The constitution of these concessional vehicles in terms of the ages and market groups favoured would almost certainly change if the program were expanded, perhaps mimicking the makeup of the New Zealand used import fleet to some extent, which reflects the availability of used imported vehicles from Japan as well as vehicle

purchasing preferences. Although preferences are clearly affected by price, nevertheless the Australian buyers are likely to continue to prefer large cars, including SUVs and commercial utilities – at least in the short term – over other sorts of vehicles, and New Zealand buyers are likely to prefer medium cars. In keeping with this, the scenarios tested maintained the Australian fleet constitution in terms of market groups, but imposed an age distribution based on the used imports in the New Zealand fleet. It is the age distribution of the fleet, with concomitant safety implications, that is the most important feature of the New Zealand fleet, heavily influenced by the used import program.

Despite the general reductions in fleet secondary safety levels that accompany an aging fleet, one scenario tested showed that important improvements in safety could occur if regulation or consumer preference could influence the types of used vehicles imported such that only vehicles that performed well in terms of safety were imported, even if these vehicles were generally older than those ‘first registered as new’. It is unlikely that such a scenario would be realised in practise.

Although Australia and New Zealand are different in many substantial ways, not the least being the larger size of the Australian population, it is likely that a relatively unconstrained used vehicle importation program in Australia might lead to similar outcomes as seen in New Zealand that have led to generally poorer vehicle secondary safety levels even though the price of a given level of safety has fallen considerably.

6. CONCLUSIONS

Approximately half of the current New Zealand light vehicle fleet was imported from overseas as used vehicles, which can be expected to have had a substantial effect on the safety of the fleet. To assess such an effect, the safety of light vehicles in the New Zealand fleet was estimated for vehicles sold new compared to vehicles imported used (mainly from Japan).

An examination of average levels of total secondary safety for used imports vs vehicles sold new showed that the used imports in the current (2014) fleet were on average older than those vehicles sold new, with consequent poorer secondary safety. However, for given years of manufacture and market groups, the used imports were found to be safer than those vehicles sold new in terms of secondary safety, and neither safer nor less safe in terms of primary safety (injury crash involvement rates).

A number of scenarios involving changes in the New Zealand fleet were tested. As there was little difference in the safety of vehicles according to their origin, merely changing the proportions of used imported vehicles in the fleet on an age for age basis would have little effect on safety per se. If, however, there were other effects from reducing access to used imports, such as increased motorcycle usage, there could be significant reductions in safety.

Examination of the real cost of vehicles to New Zealand consumers as a consequence of the used vehicle importation programme (and other market effects) showed that the real cost of purchasing motor vehicles has fallen considerably, approximately halving in the past 30 years. This indicates that the used importation programme should have improved safety considerably by decreasing the real costs of safer vehicles. However, rather than choosing to improve the quality of the vehicles they drive, New Zealander consumers have preferred to spend their money on other things.

It is the older age distribution of the New Zealand fleet compared to the Australian fleet, with concomitant safety implications, that is the most important feature influenced by the used import program. Despite the reductions in fleet secondary safety levels that accompany an aging fleet, important improvements in safety can still occur if regulation or consumer preference can influence the types of used vehicles imported such that only vehicles that perform well in terms of safety are imported. Although Australia and New Zealand are different in many substantial ways, not the least being the larger size of the Australian population, it is quite possible that a relatively unconstrained used vehicle importation program in Australia might lead to similar outcomes as seen in New Zealand. This has led to generally poorer vehicle secondary safety levels even though the price of a given level of safety has fallen considerably.

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APPENDIX 1

Vehicles with lowest Crashworthiness in their market group for each year of manufacture from 1982

Market group	Manufacture		Model	Crashworthiness		
	Years	Make		Average	lower 95%	Upper 95%
Commercial - Ute	82-92	Ford	Ford F-Series	0.035	0.024	0.050
Commercial - Ute	93-95	Nissan	Navara	0.043	0.036	0.052
Commercial - Ute	96-96	Mitsubishi	Triton MK	0.031	0.024	0.038
Commercial - Ute	97-02	Nissan	Navara	0.028	0.024	0.033
Commercial - Ute	03-04	Ford	Falcon Ute BA/BF	0.027	0.023	0.032
Commercial - Ute	05-05	Toyota	Hilux	0.024	0.021	0.028
Commercial - Ute	06-07	Mitsubishi	Triton ML / MN	0.023	0.018	0.030
Commercial - Ute	08-12	Ford	Falcon Ute FG	0.022	0.010	0.047
Commercial - Van	82-87	Ford	Falcon Panel Van	0.043	0.036	0.052
Commercial - Van	88-94	Volkswagen	Caravelle / Transporter	0.036	0.017	0.073
Commercial - Van	95-97	Volkswagen	Caravelle / Transporter	0.025	0.016	0.039
Commercial - Van	98-00	Mercedes Benz	Sprinter	0.022	0.014	0.035
Commercial - Van	01-05	Ford	Transit	0.016	0.011	0.024
Commercial - Van	06-12	Mercedes Benz	Sprinter	0.011	0.003	0.045
Large	82-86	Rover	3500	0.027	0.010	0.071
Large	87-89	Jaguar	XJ6	0.024	0.014	0.043
Large	90-94	Lexus	LS400 / Celsior	0.024	0.012	0.049
Large	95-98	BMW	7 Series E38	0.021	0.009	0.045
Large	99-99	Jaguar	S-Type	0.018	0.008	0.041
Large	00-07	Volvo	V70 / XC70	0.017	0.007	0.042
Large	08-10	BMW	5 Series E60 / E61	0.018	0.008	0.040
Large	11-12	Ford	Falcon FG	0.019	0.015	0.026
Light	82-86	Mitsubishi	Mirage / Colt	0.072	0.068	0.077
Light	87-94	Peugeot	205	0.050	0.031	0.081
Light	95-95	Holden	Barina SB	0.053	0.048	0.059
Light	96-96	Volkswagen	Polo	0.047	0.033	0.067
Light	97-01	Proton	Satria	0.036	0.018	0.074
Light	02-06	Mini	Mini Cooper	0.027	0.017	0.043
Light	07-08	Peugeot	207	0.019	0.007	0.049
Light	09-12	Honda	City	0.018	0.007	0.049
Medium	81-81	Toyota	Celica	0.053	0.044	0.063
Medium	82-85	Peugeot	505	0.033	0.023	0.049
Medium	86-96	Saab	9000	0.026	0.018	0.039
Medium	97-97	Mercedes Benz	SLK R170	0.024	0.009	0.063
Medium	98-98	Volkswagen	Passat	0.024	0.015	0.038
Medium	99-00	Lexus	IS200 / IS300	0.017	0.009	0.031
Medium	01-02	Volvo	S60	0.016	0.006	0.043
Medium	03-03	Mazda	RX-8	0.008	0.002	0.024
Medium	04-12	Volvo	S40/V50	0.007	0.001	0.047
People Mover	83-83	Toyota	Tarago	0.072	0.064	0.081
People Mover	84-84	Nissan	Prairie	0.058	0.041	0.082
People Mover	85-90	Mitsubishi	Nimbus / Chariot / Space	0.055	0.040	0.075
People Mover	91-91	Toyota	Tarago / Previa / Estima	0.037	0.031	0.044
People Mover	92-93	Nissan	Serena	0.034	0.021	0.055
People Mover	94-99	Mazda	MPV	0.023	0.011	0.047
People Mover	00-00	Mazda	MPV	0.024	0.011	0.055
People Mover	01-07	Chrysler	Grand Voyager RG	0.015	0.004	0.060
People Mover	08-11	Kia	Carnival	0.017	0.009	0.030
People Mover	12-12	Toyota	Tarago	0.026	0.014	0.046
Small	82-83	Nissan	Stanza	0.055	0.036	0.083
Small	84-85	Alfa Romeo	Sprint	0.057	0.026	0.124
Small	86-94	Citroen	BX	0.011	0.003	0.035
Small	95-96	Peugeot	306	0.034	0.026	0.044
Small	97-98	Volvo	S40/V40	0.023	0.015	0.035
Small	99-00	Honda	S2000	0.021	0.009	0.047
Small	01-09	Peugeot	307	0.017	0.011	0.026
Small	10-12	Holden	Cruze JG / JH	0.021	0.014	0.032

Market group	Manufacture	Make	Model	Crashworthiness		
	Years			Average	lower 95%	Upper 95%
SUV - Large	82-87	Land Rover	Range Rover	0.036	0.027	0.049
SUV - Large	88-94	Nissan / Ford	Patrol / Maverick / Safari	0.031	0.028	0.035
SUV - Large	95-97	Land Rover	Range Rover	0.025	0.013	0.046
SUV - Large	98-99	Mercedes Benz	M-Class W163	0.023	0.014	0.038
SUV - Large	99-00	Jeep	Grand Cherokee WG	0.022	0.013	0.038
SUV - Large	01-02	BMW	X5	0.018	0.009	0.035
SUV - Large	03-04	Volvo	XC90	0.017	0.008	0.038
SUV - Large	05-11	Mercedes Benz	M / GL -Class W164 / X164	0.006	0.001	0.024
SUV - Large	12-12	Mazda	CX-9	0.008	0.002	0.032
SUV - Medium	82-87	Holden / Isuzu	Jackaroo / Bighorn	0.042	0.032	0.055
SUV - Medium	88-94	Nissan	Pathfinder / Terrano	0.033	0.025	0.044
SUV - Medium	95-00	Nissan	Pathfinder / Terrano / Reg	0.025	0.019	0.033
SUV - Medium	01-04	Hyundai	Terracan	0.020	0.010	0.040
SUV - Medium	05-05	Nissan	Pathfinder	0.013	0.007	0.026
SUV - Medium	06-07	Hyundai	Santa Fe	0.013	0.003	0.053
SUV - Medium	08-12	Suzuki	Grand Vitara JT	0.009	0.002	0.037
SUV - Small	82-83	Holden / Suzuki	Drover / Sierra / Samurai	0.071	0.063	0.080
SUV - Small	84-97	Lada	Niva	0.049	0.031	0.077
SUV - Small	98-00	Kia	Sportage	0.038	0.028	0.051
SUV - Small	01-05	Nissan	X-Trail	0.032	0.027	0.038
SUV - Small	06-12	Mitsubishi / Peugeot	Outlander / 4007	0.014	0.008	0.025

APPENDIX 2

Vehicles with lowest Total safety rating in their market group for each year of manufacture from 1982

Market group	Manufacture		Model	Total Safety Rating		
	Years	Make		Average	lower 95%	Upper 95%
SUV - Large	82-87	Land Rover	Range Rover	0.0463	0.0373	0.0576
SUV - Large	88-90	Nissan / Ford	Patrol / Maverick / Safari	0.0427	0.0397	0.0459
SUV - Large	91-97	Land Rover	Discovery	0.0352	0.0297	0.0419
SUV - Large	98-00	Mercedes Benz	M-Class W163	0.0261	0.0192	0.0355
SUV - Large	01-02	BMW	X5	0.0236	0.0142	0.0392
SUV - Large	03-04	Volvo	XC90	0.0216	0.0131	0.0357
SUV - Large	05-05	Mercedes Benz	M / GL -Class W164 / X164	0.0186	0.0108	0.0323
SUV - Large	06-12	Lexus	RX270/350/400h/450h	0.0169	0.0092	0.031
SUV - Medium	82-87	Holden / Isuzu	Jackaroo / Bighorn	0.0492	0.0404	0.0598
SUV - Medium	88-91	Nissan	Pathfinder / Terrano	0.041	0.0337	0.0499
SUV - Medium	92-94	Land Rover	Defender	0.0402	0.0294	0.0549
SUV - Medium	95-96	Nissan	Pathfinder / Terrano / Regul	0.036	0.0302	0.0429
SUV - Medium	97-01	Subaru	Forester	0.0308	0.0265	0.0358
SUV - Medium	02-03	Subaru	Forester	0.0286	0.0246	0.0332
SUV - Medium	04-04	BMW	X3 E83	0.0248	0.0129	0.0477
SUV - Medium	05-05	Nissan	Pathfinder	0.0246	0.0166	0.0364
SUV - Medium	06-12	Ford / Mazda	Escape / Tribute	0.0194	0.0103	0.0368
SUV - Small	82-83	Holden / Suzuki	Drover / Sierra / Samurai / S	0.0568	0.0514	0.0627
SUV - Small	84-96	Lada	Niva	0.0487	0.035	0.0678
SUV - Small	97-97	Daihatsu	Terios	0.0465	0.0382	0.0566
SUV - Small	98-00	Kia	Sportage	0.0389	0.0314	0.0482
SUV - Small	01-05	Nissan	X-Trail	0.0347	0.0307	0.0392
SUV - Small	06-12	Mitsubishi / Peugeot	Outlander / 4007	0.0189	0.0133	0.0269

Market group	Manufacture		Model	Total Safety Rating		
	Years	Make		Average	lower 95%	Upper 95%
Commercial - Ute	82-85	Nissan	720 Ute	0.0442	0.0373	0.0524
Commercial - Ute	86-88	Holden / Isuzu	Rodeo / Pickup	0.0467	0.033	0.066
Commercial - Ute	89-89	Ford / Nissan	Falcon Ute / XFN Ute	0.0473	0.0441	0.0507
Commercial - Ute	90-93	Holden	Commodore Ute VG/VP	0.0448	0.0383	0.0524
Commercial - Ute	94-95	Nissan	Navara	0.0465	0.0407	0.0532
Commercial - Ute	96-02	Mitsubishi	Triton MK	0.0348	0.0298	0.0407
Commercial - Ute	03-10	Proton	Jumbuck	0.0275	0.0156	0.0482
Commercial - Ute	11-12	Mitsubishi	Triton ML / MN	0.0313	0.0261	0.0375
Commercial - Van	82-82	Ford	Falcon Panel Van	0.044	0.0388	0.05
Commercial - Van	83-87	Honda	Acty	0.0348	0.0225	0.0538
Commercial - Van	88-94	Volkswagen	Caravelle / Transporter	0.0407	0.0251	0.0659
Commercial - Van	95-97	Ford	Transit	0.0414	0.0337	0.0509
Commercial - Van	98-98	Mercedes Benz	Sprinter	0.0356	0.027	0.0471
Commercial - Van	99-00	Mercedes Benz	MB100 / MB140	0.034	0.0238	0.0485
Commercial - Van	01-05	Ford	Transit	0.0269	0.0217	0.0335
Commercial - Van	06-12	Mercedes Benz	Sprinter	0.0219	0.0112	0.0425
Large	82-86	BMW	7 Series E23	0.031	0.0171	0.0562
Large	87-94	Jaguar	XJ6	0.0311	0.0212	0.0455
Large	95-97	Audi	A8	0.0239	0.011	0.0521
Large	98-05	Saab	9-5	0.0205	0.0113	0.0372
Large	00-07	Volvo	V70 / XC70	0.0213	0.0114	0.0397
Large	08-12	Ford	Falcon FG	0.0214	0.0177	0.0257
Light	82-86	Mitsubishi	Mirage / Colt	0.0561	0.0529	0.0596
Light	87-94	Peugeot	205	0.0368	0.0238	0.0569
Light	95-95	Holden	Barina SB	0.0447	0.0411	0.0486
Light	96-96	Volkswagen	Polo	0.0381	0.0289	0.0502
Light	97-98	Proton	Satria	0.0377	0.0221	0.0643
Light	99-00	Peugeot	206	0.0371	0.0292	0.0472
Light	01-01	Holden	Barina XC / Combo	0.0354	0.0313	0.04
Light	02-06	Citroen	C3	0.0226	0.0105	0.0488
Light	07-12	Peugeot	207	0.014	0.0064	0.0306
Medium	81-81	Toyota	Celica	0.0487	0.0425	0.0557
Medium	82-85	Peugeot	505	0.0332	0.0246	0.0448
Medium	86-93	Saab	9000	0.0304	0.0235	0.0393
Medium	94-95	Saab	900/9-3	0.0288	0.0232	0.0358
Medium	96-00	Peugeot	406	0.0268	0.018	0.04
Medium	01-02	Citroen	C5	0.0249	0.0127	0.049
Medium	03-03	Mazda	RX-8	0.0193	0.0112	0.0332
Medium	04-11	Peugeot	407	0.0146	0.0074	0.0288
Medium	11-12	Audi	A4 / S4 B8 / AllRoad	0.015	0.0068	0.0331
People Mover	83-83	Toyota	Tarago	0.0624	0.057	0.0684
People Mover	84-85	Nissan	Prairie	0.0526	0.0399	0.0693
People Mover	85-90	Mitsubishi	Nimbus / Chariot / Spacewa	0.0445	0.0341	0.0579
People Mover	91-91	Toyota	Tarago / Previa / Estima	0.0399	0.0352	0.0452
People Mover	92-95	Nissan	Serena	0.0308	0.021	0.0452
People Mover	96-96	Toyota	Spacia	0.0372	0.022	0.0627
People Mover	97-98	Chrysler	Voyager	0.032	0.0224	0.0457
People Mover	99-00	Mitsubishi	Nimbus	0.0268	0.0176	0.0409
People Mover	01-07	Chrysler	Grand Voyager RG	0.0173	0.0064	0.0469
People Mover	08-12	Toyota	Tarago	0.0243	0.016	0.037
Small	82-85	Alfa Romeo	Sprint	0.0427	0.0215	0.0848
Small	86-94	Citroen	BX	0.0124	0.0054	0.0284
Small	95-96	Peugeot	306	0.0313	0.0256	0.0382
Small	97-98	Volvo	S40/V40	0.029	0.0219	0.0382
Small	99-00	Honda	S2000	0.0217	0.011	0.0428
Small	01-09	Peugeot	307	0.0206	0.0154	0.0274
Small	10-12	Audi	A3	0.0207	0.0111	0.0386