# FLEET DYNAMICS: AUSTRALIAN MOTOR CAR FLEET POPULATION ADJUSTMENTS OVER A DECADE OF SIGNIFICANT CHANGE

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*ABSTRACT:*

*Despite stagnation in sales of new vehicles since the mid nineteen seventies, both the size and total usage made of the domestic population of cars and station-wagons continued to grow unabated. This paper looks at the factors behind this apparent contradiction, as well as attempting to assess whether the 'downsizing' phenomena observed overseas was reflected by the Australian experience. It was found that the prime causes of continued vehicle population growth were increased vehicle life expectancy and a favourable (i.e. young) initial population age structure. Growth in total vehicle usage was found to reflect higher utilisation of light/ medium vehicles over their operating lifetime. Available tare mass data indicated no clear trends with respect to 'downsizing'. Examination of Motor Vehicle Census data indicates that while there was a shift away from vehicles in the heaviest tare classes this was matched by a similar decline in relative numbers of vehicles in lightest tare categories. A small reduction in fleet average tare will result if current new registration patterns persist. Analysis of the stock adjustment process indicates that while the growth rate of the total population would decrease in the event of a continuation of current vehicle market conditions, stagnation is unlikely in the immediate future.*

## 1. INTRODUCTION

This paper reviews the changes that have occured in the Australian population of cars and station wagons from the viewpoints of, numbers in use, stock turnover, population composition, and usage in the period since the mid 1970's. The period is of interest as it was characterised by adverse general economic conditions which placed cost and budgetary pressures on private vehicle usage and ownership. The period was also one where there was a general perception by the public that vehicles were becoming "smaller". Analysis has been concentrated on the aggregated data compiled by the Australian Bureau of Statistics (ABS) covering new vehicle sales, total vehicles registered for road use, and vehicle usage. The developments described should provide a wider backdrop to studies of particular segments of the vehicle population such as commercial vehicles (Schou 1980) and particular groups or panels of road users such as the Sydney-based longitudinal survey of vehicle purchase and use over time (Hensher 1983).

Statistics maintained by the Australian Bureau of Statistics indicate that in aggregate terms the economy experienced a period of difficulty which took the form of a slow rate of growth in real output, rising unemployment, significant inflation, and high interest rates (ABS 1984a,1984b,1984c). A particular feature of the inflationary experience was the rapid escalation of petol prices,which increased by more than consumer prices in general. Petrol price behaviour reflected the combined influences of the introduction of parity pricing of domestic crude oils, new state retail taxes, and increasing costs of imported crude oil. However it should be noted that available price index numbers indicate that this above average rate of inflation did not apply to new vehicle prices and other vehicle operating cost items. Available data also indicates that in response to domestic market forces and supply factors, a larger range of advanced fuel efficient low mass vehicles became available from local producers and overseas sources than was the case previously. Many of these fell into the 'World Car' category and provided an alternative to larger more indigenous designs. Light vehicles designed initially for commercial freight applications, and recreational vehicles, also found increasing favour with households fo private travel. Unfortunately data is as yet insufficient for detailed analysis. There are thus some significant parallels with the experiences of other Western style economies over the same time period.

## 2. POPULATION TRENDS

### 2.1 Numbers of Vehicles

Perhaps the most striking development that can be observed during the period was the continued growth in total numbers of cars and station-wagons on register despite stagnation in the rate of growth of vehicles registered as "new" (ABS1984d). These developments were also accompanied by a growth in total vehicle usage, of roughly the same order of magnitude as the the increase in total vehicle numbers (ABS1983b). These trends are shown in Figure 1. It would appear then that the travelling public adopted strategies other than new vehicle purchase to increase vehicle access and mobility. While the link between low new vehicle registration levels with the state of the economy appears obvious, the factors which facilitated the continued growth of the vehicle stock invite further consideration.

The apparently contradictory trends shown by new vehicle sales and aggregate population data is reconcilable in terms of the other two elements of the vehicle stock adjustment process, namely population age distribution and vehicle life expectancy. In 1975 the age distribution of the car fleet was weighted towards the younger age groups, indicating that a significant stock adjustment lag could be expected before trends in new vehicle sales would be reflected in the the rate of change of total numbers on register. In addition vehicle life expectancy can be shown to have increased over the period considered, further altering the link between new sales and total numbers. As a result of the interplay of these two factors relatively fewer vehicles were scrapped than was the case previously, the balance between vehicles scrapped and new vehicle sales being such that overall numbers continued to grow. An immediate implication of this process was that the penetration rate of desirable vehicle attributes introduced into the vehicle fleet through the sale of new vehicles slowed in comparison with previous periods which had been considered by the authors (Thoresen and Wigan 1980, Wigan and Thoresen 1979). These developments beg the question of the extent to which the vehicle population can continue to grow assuming these factors remained unchanged.

## 2.2 Age Structure.

Continued population growth has, not unexpectedly, been accompanied by an ageing of the vehicle stock. This is illustrated in Figure 2 which shows the vehicle population age distrubitions as at 30 September 1976,1979,and 1982 in age pyramid form (ABS 1978, 1981a, 1983a). The dates referred to are those of the three most recent Motor Vehicle Censuses carried out by ABS. For comparative purposes the profile for the 1971 Census is also shown(ABS 1973a). Age profile data was not available from annual statistics. The age pyramids clearly show the extent to which growth in aggregate numbers was secured by an ageing of the vehicle stock. In addition to showing an increase in average age from 6.4 years in 1976 to 7.4 years in 1982, the Census data shows that that the large numbers of young vehicles observed in 1976 had by 1982 translated itself into a middle aged bulge in the population distribution, highlighted by the releative lack of vehicles in the younger age groups. The older vehicles fall within the age range where, in the past, the incidence of scrapping has been the highest. This implies that unless there is a significant increase in the residual life expectancy of these older models, there may be limits on the ability of the population continue to grow at current rates assuming a continuation of current levels of new car sales. Alternatively, if a revival in new car sales is observed in the near future it is likely that a significant part of this will reflect a high replacement element.

## 2.3 Life Expectancy Variations

Vehicle life expectancy functions estimated from historical data indicate an increase in vehicle longevity over the period considered. Functions estimated by the Authors' for the years 1976, 1979, and 1982 for cars and station wagons in general are shown in Figure 3. An estimate for 1971 is also provided for comparative purposes. It remains to be determined to what extent these changes reflected an increase in intrinsic technical vehicle durability, economic conditions adverse to vehicle retirement, and an improved road environment. If the fiftieth percentile of the estimated functions are treated as appropriate measures of vehicle longevity, an increase in the average life expectancy of cars and station-wagons of approximately one year is indicated between 1976 and 1982.

Life expectancies have been calculated by fitting a modified version of the logistic form proposed by Walker (Walker 1968) to data derived from motor vehicle registration records. The basic equation is shown as equation (1) below. For the descriptive purposes of this paper life expectancy has been calculated as a simple function of vehicle age. Due to problems experienced with data similar to those noted in the United Kingdom (Tanner 1984), it was necessary to use two alternative but related methods in fitting this functional form to observed data. Where reliable data describing both new and total numbers of vehicles on register was available, it was possible to construct data points which represented the proportion of vehicles first registered as new which survived a specified period of time. In such cases it was methodologically acceptable to fit the logistic function directly to vectors of such data. However, cases occured in which data enumerating new vehicles registered was unavailable, incomplete, or incompatible with data detailing total vehicles on register. In such cases data points were generated by comparing "snapshots" of total numbers on register profiled by "year of model" at successive points in time. Attrition rates were derived from these comparisons. A conditional transformation of the simple logistic function, as shown by (2), was fitted to data points generated in this fashion to estimate the co-efficients of the assumed underlying life expectancy function.

$$Pr(S_t) = [\alpha + (1 - \alpha)\, e^{\beta X_t}]^{-1} \tag{1}$$

$$Pr(S_{t+i}/S_t) = [\alpha + (1 - \alpha)\, e^{\beta X_t}]/[\alpha + (1 - \alpha)^{\beta X_{t+i}}] \tag{2}$$

where $S$ = proportion of vehicles which have survived

$X$ = age of vehicle

$t$ = time initially survived

$i$ = time subsequently survived

The Authors have previously used the second method to good effect with respect to United States, Japanese, and U.K. data (Thoresen and Wigan 1980).

## 3. VEHICLE CHARACTERISTICS

As cars and station wagons registered after 1976 accounted for some 41 percent of the vehicle population at the time of the 1982 Census, there remained considerable potential for change in the technical characteristics of the overall fleet, despite the relatively slow rate of vehicle stock turnover. Previous work had indicated that data describing vehicles in terms of a range of characteristics including physical dimensions, mass, drive-train details, type and size of engine, and engine driven peripherals was required if the nature and direction of change were to be adequately assessed. Data of this type was required as classification by some single characteristics could prove misleading (Thoresen and Wigan 1980).

Unfortunately on a national basis vehicle tare weight was the only attribute apart from vehicle make, body type, and year of model, for which adequate data was available. Examination of changes in tare mass is nevertheless worthwhile as it is one of the better single attributes that can be used to define consistent vehicle classes. It had been found that tare weight tended to be associated with narrow ranges of vehicle size, and could be related to vehicle power requirements, hence the fuel used in propelling the vehicle. Changes in the distributions of tare masses in the period considered are shown in Table I, which sets out the numbers of cars and station wagons in each of five tare weight categories utilised by ABS, at the time of the three most recent Vehicle Censuses. New registration data classified by tare weight which has recently become available at a national level is also shown for 1982.

While data on other relevent attributes is available to a certain extent, it has tendered to be fragmentary. Data is available for a few states only, for limited time periods or single points in time, and has seldom been listed so as to cross classify the population by its multiple attributes. The data is still of some use. For example a new tabulation included in the 1982 Survey of Motor Vehicle Usage (ABS 1983b ) indicated that an estimated 44 percent of cars and station wagons on register were fitted with automatic transmissions, a significant finding which has major implications for studies of automotive energy usage.

### 3.1 Tare Weight Distributions

An indication of the extent to which "downsizing" of cars and station-wagons occurred in the period considered can be obtained by examining changes in the frequency distribution of the vehicle population classified by tare weight. Such data as shown in Table 1 also provides an indication of the rate of change in addition to direction. From Table 1 it can be seen that while numbers in each of the five tare categories shown increased, there was no uniform shift in the distribution of vehicles towards the lighter categories. Shifts from heavier to lighter tare categories were balanced to a significant extent by shifts within the lighter categories. Thus while the overall proportion of the population in the the second lightest, or 901 to 1100 kilogram tare category, increased from 19.4 to 22.7 percent of the total population of cars and station-wagons between the 1976 and 1982 Censuses, this appears to have occurred primarily at the expense of tare categories on either side, rather than at the expense of the two heaviest categories. The relative demise of the lightest of the categories was unexpected, and warrants further investigation. So does the maintenance of the population shares associated with the two heaviest of the tare categories. With respect of the latter there appear to be two phases; an increase in population shares in the period 1976 to 1979, with a reversal of this situation occurring between 1979 and 1982.

While it can be seen that in terms of the tare weight frequency distribution changes did occur, in terms of fleet average tare weight, changes were offsetting resulting in small changes, which varied in direction over the period. Average population tare weight in fact increased between 1976 and 1979, but fell slightly in the succeeding three year period, to a level marginally above its 1976 level. These changes indicate the likelihood of a change in consumer preferences for larger heavier vehicles during the period considered.

A more detailed consideration of the causes of the changing tare weight distributions shown in Table 1 would require the development of a stock adjustment model capable of discriminating between individual tare classes. Unfortunately neither the necessary new registration nor the age profile data was available which would have permitted the development of a model for the period considered. New registration data for cars and station- wagons in which separate tare categories are distinguished has only been available on a national basis since 1982. This data is contrasted with Census data in Table 1. New registration data listing vehicle numbers by tare category available for some of the years in the study period for the States of Victoria (ABS Vic 1976-84), Western Australia (ABS WA 1976-84), and Tasmania (ABS Tas 1976-84) only. This data while it shows that some variations can be observed between the states in terms of tare distributions, also exhibits some common trends. The two most important of these are; the consistent growth of the proportion of new vehicles in the 901 to 1300 kilogram tare category, and a decline in new registrations of vehicles over 1300 kilograms commencing in 1979. The latter is consistent with the trends shown in Table 1.

When comparisons are drawn between the 1982 Motor Vehicle Census tare weight profile and that shown by new registration data for 1983, differences do not appear to be great. This could be interpreted as indicating that the weight distribution of the current vehicle stock is not markedly different from the desired stock at the present time. However, there are some differences. For example the tare weight distribution for new vehicle is more weighted towards lighter vehicles, which is reflected by the lower average mean tare weight. If this pattern persists, it will exert a small but significant downward pressure on the overall average tare weight of the Australian vehicle population. The rate at which this change occurs will also be affected by the average life expectancies and age profiles applying to to the existing stock of vehicles in each tare class.

3.2 Age Distributions by Tare Category

The age distribution associated with each of the five tare categories as at 30 September 1982, the only Census for nationwide data is available in this format is set out in Figure 4. As could be expected there are significant differences in the age profiles of each tare category. A feature of the age distribution associated with the lightest of the five categories is the relatively small number of vehicles found in individual model years subsequent to 1976. This is consistent with reduced popularity with new car buyers, and the falling total population share previously noted. Peak numbers are observed for the three years 1974 to 1976, falling away slowly for older vintage vehicles. Provided there is no substantial change in vehicle durability, this age structure is conducive with above average numbers of vehicles being scrapped from this category in the near future, a factor which in the short term at least may see this tare category continue to contract in terms of population share.

This is also more or less the case for the second heaviest and still numerically significant of the tare categories. The age structure associated with this category bears witness to the popularity of this tare category in the early 1970's. The age frequency distribution for the 901 to 1100 kilogram class, which previous data showed to be the class in which growth was greatest in the 1976 to 1982 period, as could be expected shows numbers heavily concentrated in recent model years. In fact for each complete model year since 1975 excluding 1980, numbers are greater than for any other category. Consequently a low rate of attrition by scrapping matched only by the numerically unimportant heaviest category might be expected in the near future. This will serve to increase the dominance in numerical term of this tare category.

In contrast to the other tare categories, the age frequency for the 1100 to 1300 kilogram tare category was categorised by a the lack of a clear age distribution pattern. In fact there appear to be a series of local maxima in vehicle numbers, centred around 1981, 1973, and 1969 indicating varying popularity overtime. As was the case for the lightest of the tare categories the distribution is consistent with likelihood of high levels of vehicle scrapping in the immediate future, which could counteract the effects of new registrations in this class.

In summary quite significant variations in terms of age profile are observable between the five tare sub-categories in 1982. These differences reflect the combined effects of past sales of new vehicles and levels of vehicle durability. The 1982 age profiles will also affect the future tare mass composition of the car and station-wagon population, via an interaction with new vehicle sales and the residual life expectancy associated with the vehicles in each age group.

### 3.3 Life Expectancies by Tare Category

An indication of the variation in life expectancy which might be expected between the five tare categories is provided in Figure 5, which sets out a series of functions based on data for the State of Victoria only. Data was not adequate to estimate such functions on an Australia wide basis. It needs to be noted that when all tare categories are combined Victorian cars and station-wagons had a life expectancy greater than the national average. In 1982 for example Victorian vehicles lasted on average an estimated 15.3 years compared with an average for Australia of 14.4 years. Consequently Victorian estimates cannot be used as a proxy for unavailable national estimates at a tare class level. However the differences in observed historical life expectancies between tare categories may have some indicative value.

The functions estimated have been presented in terms of non cumulative scrapping distributions. These more clearly illustrate the differences between the estimated functions than would comparisons formulated in the "s" shaped cumulative life expectancy format used to date. The estimated functions would appear to indicate that measured solely in terms of the fiftieth percentile, lighter vehicles remained on register as long, and possibly longer than their heavier counterparts. It can also be seen that if the functions were standardised about a common modal value it could be demonstrated that the scrapping functions differ not only in terms of location but also in terms of variance. While there is no clear tare weight to variance correlation, the smaller variances associated with the 900 to 1100kilogram and 1100 to 1300 kilogram tare classes should be noted, as these indicate that scrapping tended to be concentrated into a relatively narrower time period than was the case for other categories. Differences in variance will affect the rate of stock turnover associated with each tare category. Variability may be as much related to to differential usage as to differences in inherent durability between the tare classes.

## 4. VEHICLE USAGE

Valuable information on the usage characteristics associated with the national vehicle stock is provided by successive Surveys of Motor Vehicle Usage carried out by the Australian Bureau of Statistics (ABS 1979 1981b,1983b). Surveys are closely related to Censuses insofar as common definitions and terminology are employed, Censuses are used to provide Survey sampling frames, and the single years of usage considered by each Survey terminate on Census dates. As the basis for sampling is the vehicle and not the user , and as the Surveys are cross sectional rather than longitudinal, care needs to be taken in the uses to which data is put. For example survey data has some limits in the tracing changes in utilisation of given model years over time, and for examination of usage associated with multiple vehicle ownership.

The data provided by the Surveys does permit analysis of changing vehicle utilisation patterns which accompanied the changes in the vehicle population considered to date. In Table II estimated total and average annual distances travelled by cars and station-wagons at the times of the 1976, 1979, and 1982 Surveys are set out broken down into three as opposed to the five tare categories utilised in Censuses. The smaller number of tare categories which reflects sample size considerations, was arrived at by ABS through amalgamation of the two heaviest and the two lightest tare classes into single groups respectively.

It is of some importance that the data in Table II shows that, despite contractionary economic forces, and the related ageing in the vehicle stock, total utilisation as measured by total distance travelled by cars and station-wagons increased significantly in the period 1976 to 1982. In fact, total distance travelled by all cars and station-wagons grew at an annual rate of 3.4 percent per annum in the period, which was roughly equivalent to the growth in total vehicle numbers. The average annual growth rate in total distance travelled in the five years from 1971, was by contrast 4.5 per cent (ABS 1973b). The continued growth in total utilisation, like that of the vehicle stock further illustrates the apparent community resistance to any reduction in private vehicle access and mobility that characterises the period considered.

### 4.1 Average Vehicle Usage

If statistics computed for all cars and station-wagons, irrespective of tare weight, are considered in isolation then it would appear as if growth in fleet utilisation in the period 1976 to 1984 was achieved through maintenance of average annual distance travelled per vehicle. While this is arithmetically correct, it can be seen that this trend was not uniform across the three tare categories considered. The apparent constancy in average distance travelled reflected the complex interplay between the relative contributions of each tare category rather than a uniform trend. In fact levels of utilisation varied both between the categories, and within each tare category, over time.

### 4.2 Vehicle Usage by Tare Weight Class

A significant positive correlation between tare weight and annual distance travelled can be observed in Table II. This is of interest in its own right, and because it indicates that the proportions that the various tare classes may be encountered while in use will reflect usage in addition to numerical representation in the registered population. This basic point is in fact supported by roadside and car-park based surveys (Fehon 1979).

In terms of the data presented in Table II the weight to usage correlation reduced the impact of the increase in relative numbers of lighter vehicles previously noted, in terms of total distance travelled by all cars and station-wagons. In the period considered it can be seen that the percentage share of total distance travelled by vehicles with a tare weight less than 1100 kg increased by less than their share of total numbers. Nevertheless numerical growth more than offset the effects of lower average annual utilisation, resulting in an increase in the share of total distance travelled by this category from 34.6 percent in 1976 to 38.6 in 1982.

Significant changes in average annual utilisation occurred both within, and between categories between 1976 and 1982. The two most significant changes as shown in Table II were the increase in average annual utilisation associated with vehicles with a tare less than 1100kg, and the reduction in average utilisation associated with vehicles over 1300kg. The former increased by 6.2 percent between 1976 and 1982, while the latter contracted by some 8.5 percent. Utilisation associated with the 1100 to 1300kg category increased by a nominal 2.5 percent. The combined effect of these changes was to give the appearance of a weakening in the traditional weight-to-usage relationship observable for cars and station-wagons for Australia. Survey data also shows a significant decreases in vehicle utilisation with age. This suggests that an issue to be resolved is the extent to which developments noted reflected; changes in actual vehicle age to usage relationships on a tare category basis, changes in sub-population age structures previously considered, or a combination of both of these factors.

### 4.3 Average Usage by Age by Tare Class

In Figure 6 average vehicle usage to age relationships estimated in the course of the 1976 and 1982 Surveys are compared for each of the three tare categories. It should be noted that the relationships plotted represent cross sectional "snapshots" of average vehicle age to usage relationships, rather than the results of longitudinal studies which trace changes in the utilisation of particular vehicles over their lives. Nevertheless the data plotted is consistent with decreasing use with age, and also demonstrates a positive weight to use correlation across age groups. Examination of Figure 6 indicates that the utilisation gap between the lightest of tare categories and the two heavier categories narrowed significantly between 1976 and 1982. The upward shift of the age-to-usage relationship for the lightest of the three vehicle tare categories over the period is the most significant change shown in Figure 6. This shift combined with the relatively young age distribution associated with this category accounts for the increase in average utilisation displayed by this class of vehicle in Table II.

In contrast the age utilisation relationship for vehicles over 1300 kilograms did not alter significantly in the study period, indicating that the decrease in average utilisation shown for this class in Table II reflected the influence of an ageing vehicle sub-population rather than decreased usage with age. The small change in average utilisation for the 1100 to 1300kg category is less easy to account for insofar as it reflects small changes in both factors. What is of interest for the future is whether the utilisation gap between tare classes will continue to narrow under the influences of changing vehicle technology, road environment, and economic and demographic conditions. If the gap continues to narrow, this will further accentuate the number of light vehicles encountered on Australian roads.

## 5. IMPLICATIONS FOR THE FUTURE

In the discussion to date the question has been begged as to the extent to which the overall population of cars and station-wagons can continue to grow in the face of stagnating new vehicle sales in to the immediate future. To examine this issue and other alternatives, numbers of cars and station-wagons on register at the time of the 1982 Motor Vehicle Census have been projected to 1990, using a range of possible scenarios. The results are graphed in Figure 7. Projections have been made using a set of simple assumptions regarding new sales and life expectancy, which are unlikely to precisely apply in practice. Associated with each population level shown in Figure 7 is a population age frequency distribution. Together these two measures can provide some indication of not only the number of vehicles available but also the residual level of service embodied in that vehicle stock. It was not possible to extend analysis to numbers of vehicles in individual vehicle tare weight categories, or directly examine likely changes in vehicle utilisation.

From Figure 7 it can be seen that if new registrations were to remain at 460 thousand units per annum till 1990, and if average life expectancies remain unchanged, the overall population would continue to grow to 1990. This situation is a simplified approximation to current conditions. The projected vehicle population would however be growing at a declining rate, and in the last year of period the rate of population growth would be less than 1 percent per annum. Thus a continuation of current behaviour would result in continued population growth to 1990, which would not be exhausted till some later date. Associated with this case would be a progressive ageing of the vehicle stock with population mean age increasing from an estimated 8.0 years in 1982 to an estimated 8.3 years in 1990. Population ageing would tend to impart an indirect downward pressure on aggregate fleet utilisation assuming a continuing negative correlation between vehicle age and usage. This scenario is somewhat unlikely, as on the basis of recent experience an increase in average vehicle life expectancies is likely in the event of continued depressed new vehicle sales, where the latter reflects less than buoyant economic conditions. To illustrate this variation, projections are shown in Figure 7 of total numbers of cars and station-wagons on register up to the 31 December 1990 assuming an increase in average life expectancy to 15.4 years. The particular life expectancy function utilised is that estimated for the State of Victoria for 1982. This is by no means unreasonable if difficult economic conditions persist. Comparison Australian vehicle life expectancies with the life expectancies estimated in New Zealand (NZERDC 1984) show scope for increased longevity albeit in conjunction with significant changes in vehicle operating costs and usage. The New Zealand estimates which apply to a vehicle fleet which has some technically similarities to the Australian population are substantially in excess of those estimated for Australia. The fiftieth percentile of the life expectancy function estimated for N.Z. yields a fiftieth percentile of 23.3 years. Such an increase in vehicle life expectancy would be compatible with continued growth of the overall vehicle population. As shown in Figure 7 with new registrations held constant at 460 thousand units per annum the estimated rate of population growth is higher than in the preceeding case, but has been achieved at the cost of an older vehicle population age profile. Under the assumptions made the estimated average population age would be 8.7 years in 1990.

The interelationship of the various elements of the stock adjustment process, as could be expected, indicate that any return to the high rates of growth in new vehicle registrations typical of the late 1960's and early 1980's would, ceteris paribus, need to persist for some time, before these would be reflected in the rate of growth of the overall population. This stock adjustment lag effect can be seen in Figure 7. Assuming no change in vehicle life expectancy, a sustained 5 per cent growth rate in new registrations would result in a population growth rate of only 2.9 per cent in 1990. However associated with this scenario would be a younger population, with an estimated average age of 7.8 years, which would be consistent with an increase in average vehicle utilisation. To achieve an annual population growth of around 5 per cent by 1990 assuming no change in vehicle life expectancy, a sustained growth rate in new vehicle sales in the order of 9 per cent per annum would be required from 1982.

A yet higher population growth rate again would result if a 5 per cent rate of growth in new registration were combined with the above mentioned increase in life expectancy as can be seen in Figure 7. This combination would result in an increase in the vehicle population of 22.3 percent between 1982 and 1990 with an average annual rate of growth of 3.1 percent being achieved in the last year of the period. However, the average age of the population generated for 1990 would be only slightly above the 1982 figure indicating that age structure would have a fairly neutral effect on aggregate vehicle usage.

With respect of average vehicle expectancies, while these were observed to increase between the Motor Vehicle Censuses of 1976, 1979, and 1982 it is not inevitable that this trend will be followed in the future. While it is arguable that improved vehicle technology, and perhaps the road environment, may promote increased longevity, an improvement in economic conditions by increasing disposable income may exert a pressure in the opposite direction by promoting earlier vehicle retirement. This appears to have been the case in the period 1962 to 1971, a period of very rapid growth in new registrations, during which average vehicle life expectancies declined significantly. The historical experience is thus that high levels of new registrations and substantial increases in average vehicle life expectancies have tended not to occur together. Assuming a sustained economic upturn in the near future this could well recur. A fully developed econometric model of vehicle demand and use would be required to estimate the particular combination of life expectancy and new demand that would be likely.

## 6. SUMMARY AND CONCLUSIONS

The period considered is an interesting one as, despite a stagnation in new vehicle sales, both the overall stock of cars and station-wagons and the aggregate use of roads made by this stock continued to grow at a significant rate. Numbers of cars and station-wagons increased due to changing vehicle longevity and a favourable (i.e. young) initial age structure. These changes were not, however, associated with a significant uniform continuing shift towards lighter, smaller, and presumably more fuel efficient and economic vehicles. On the contrary, there was a shift towards vehicles in the light/medium tare categories which occurred as much as at the expense of light and medium weight vehicles, as heavier categories. Heavier vehicles tended to maintain their share of the population in numerical terms, although new vehicle acquisition data showed a weakening in their share of new vehicle sales towards the end of period considered. Recent vehicle acquisition data has also shown a continuation of the relatively low popularity of vehicles at the light end of the tare weight range. The relative similarity between the tare weight profiles of the vehicle population on register in 1982 and subsequent new vehicle sales would appear to indicate that in the immediate future only a weak tendency towards significantly increasing proportions of lighter vehicles in the overall population is likely. No radical changes thus appear imminent in the short term.

Trends in total vehicle numbers appear to have been matched by trends in total vehicle usage in the period 1976 to 1982. Changes in utilisation observed were consistent with changes in vehicle numbers. On a fleet wide basis, from vehicle usage survey data it would appear as if average vehicle utilisation remained constant between 1976 and 1982 despite an ageing in the vehicle population. Further investigation indicated that this in fact reflected a series of compensating factors, the most important of which was an increase in the lifetime utilisation of of lighter vehicles.

Projections of total vehicle numbers to 1990 indicated that continued lack of growth in registrations of new vehicles would be reflected in a slow down in the rate of growth in the overall population of cars and station-wagons, rather than stagnation or a decline in numbers. In such a case the attendant ageing of the population would be a factor constraining growth in total vehicle usage. Conversely, in the medium term, the presence of stock adjustment lags would tend to limit the extent to which a return to rapid growth in new registration would be reflected in the growth rate of the overall vehicle population.

The developments observed are consistent with the private vehicle using public adopting a series of measures other than new vehicle purchase to maintain it's mobility in the face of less than favourable economic circumstances. Mobility appears to have been maintained by retaining vehicles in service for longer periods, and extracting higher levels of utilisation out of lighter vehicles than had previously been the case. This was supplemented by a limited move towards lighter presumably less costly vehicles in the later years of the period considered. Supply side factors such as increased technical durability of vehicles and improved road environments may also have affected these changes.

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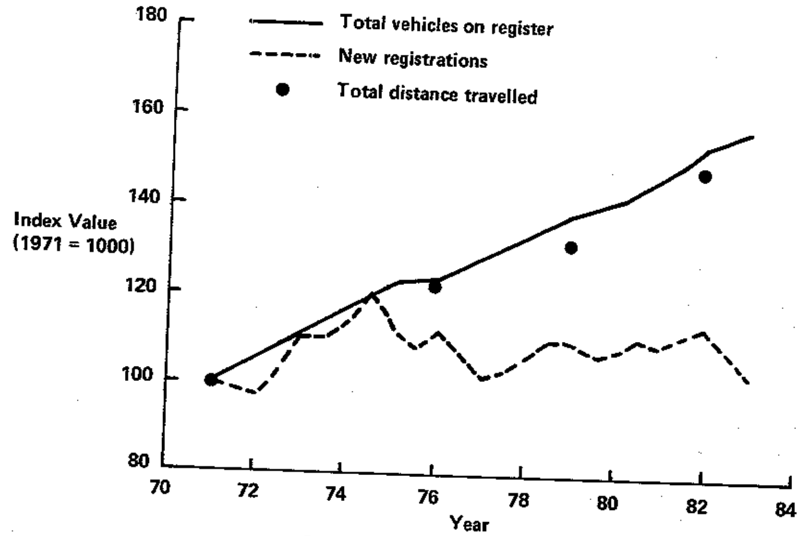
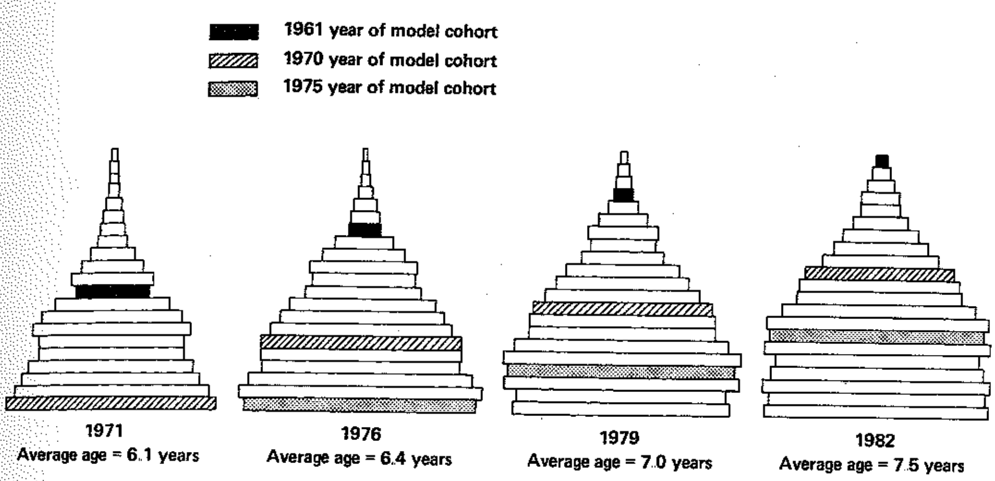



Source. Australian Bureau of Statistics

Fig 1 — Changes in vehicle numbers and usage
Cars and station-wagons
New and total registrations, total distance travelled
Index values (1971 = 1000)
Australia




Source: Australian Bureau of Statistics

Fig 2 – Age distributions of cars and station-wagons on register
Motor vehicle census data, 30 September 1971, 1976, 1979 and 1982
Complete calendar-years only
Australia

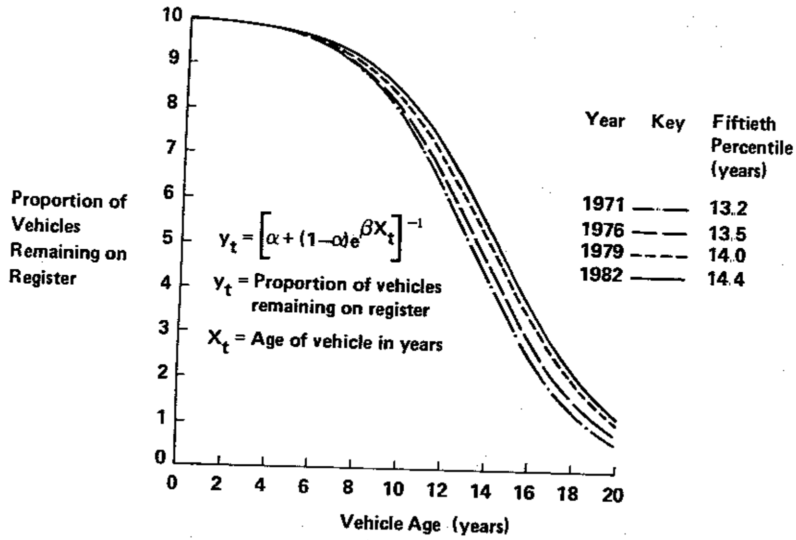
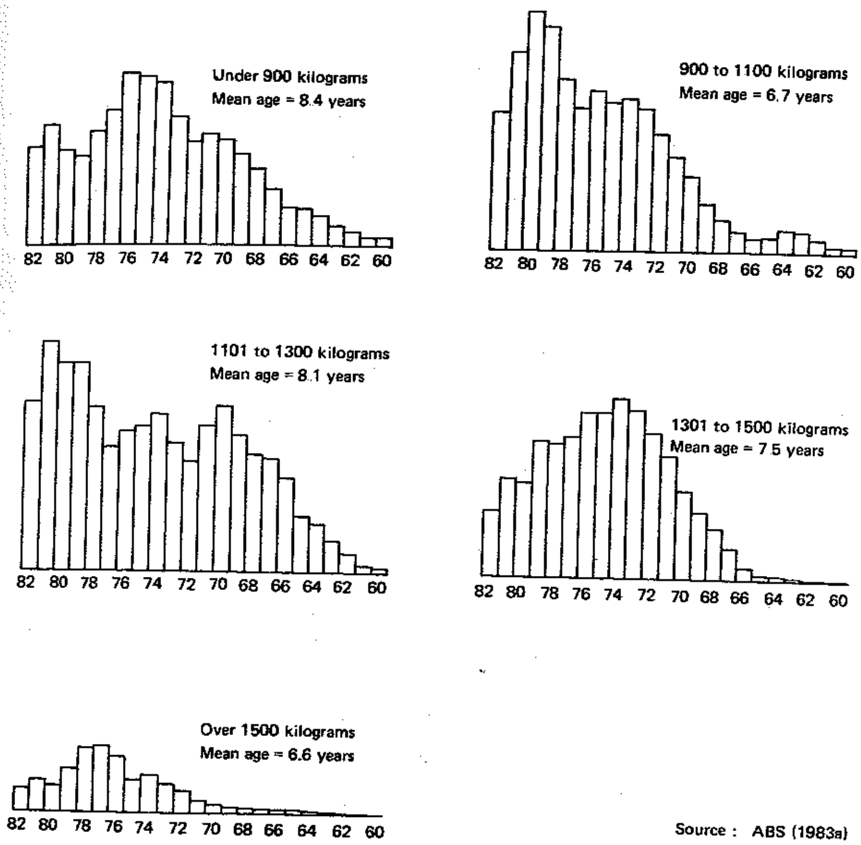



Fig 3 — Estimated historical vehicle life expectancies
Cars and station wagons
Australia
1971, 1976, 1979 and 1982




Source : ABS (1983a)

**Fig 4 — Age structure of the vehicle population**
**Cars and station wagons**
**Year of model by tare weight category**
**1982 census of motor vehicles**

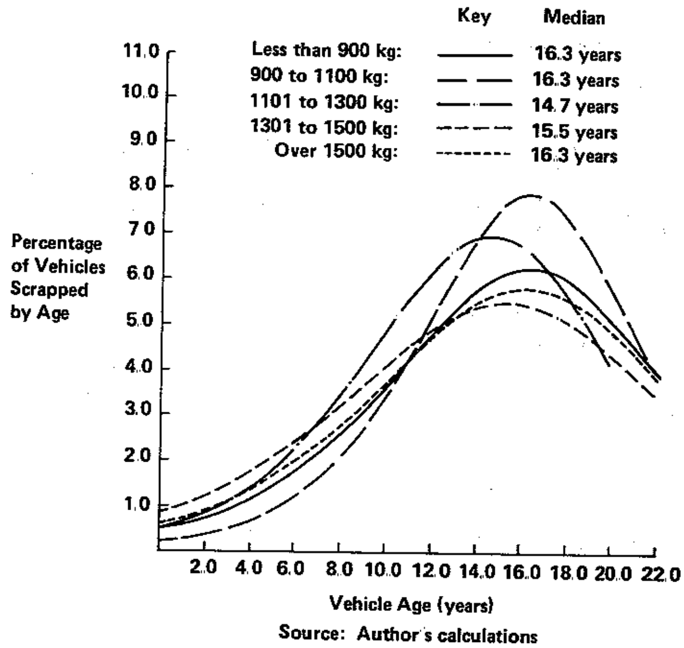



Fig 5 — Estimated scrapping frequency functions
Cars and station wagons classified by tare weight
Estimates for the State of Victoria 1982

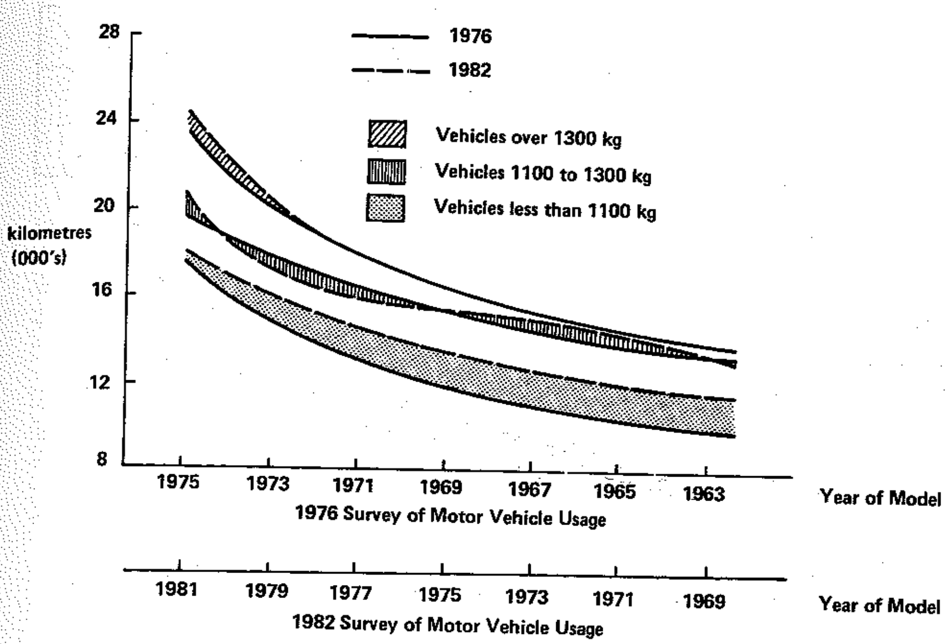



Fig 6 — Estimated annual distance travelled per vehicle
Cars and station-wagons
Tare weight by year of model
Years ending 30 September 1976 and 1982
Australia

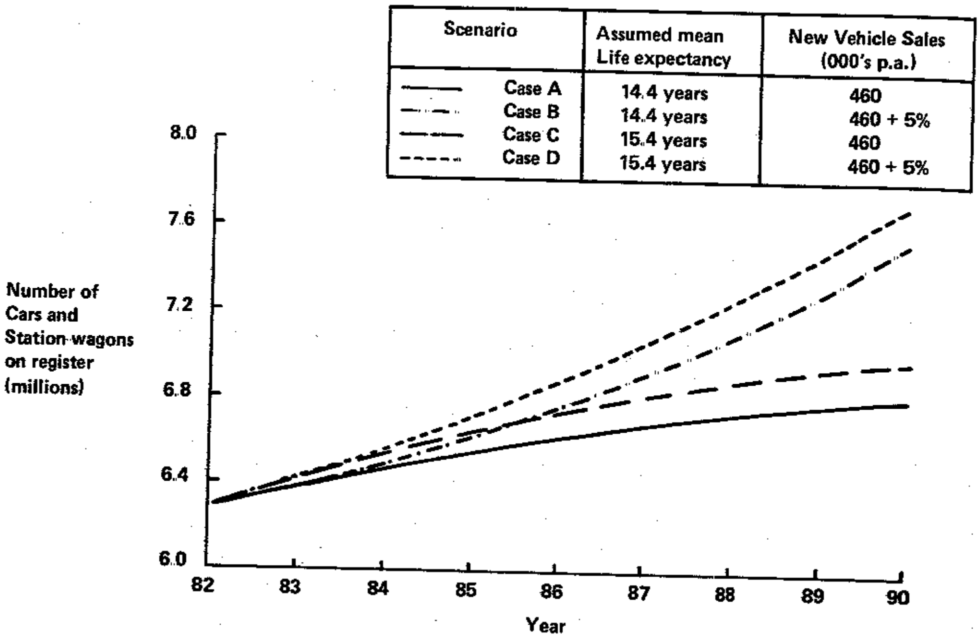



Fig 7 — Projections of Total Numbers of Vehicles on Register to 1990
Cars and Station-wagons

TABLE I

TARE WEIGHT DISTRIBUTIONS OF CARS AND STATION WAGONS ON REGISTER.
MOTOR VEHICLE CENSUSES OF 1976, 1979, 1982, AND 1982 NEW VEHICLE REGISTRATION DATA
AUSTRALIA

THOUSANDS OF VEHICLES

| Vehicle Tare Mass Category | Total Vehicle Numbers on Register as at 30 September | | | | | | New Vehicles Registered | |
|---|---|---|---|---|---|---|---|---|
| | 1976 | | 1979 | | 1982 | | 1982 | |
| | Number | % | Number | % | Number | % | Number | % |
| 900 kg and under | 1 205.3 | 23.6 | 1 239.5 | 21.9 | 1 262.2 | 20.3 | 39.6 | 17.6 |
| 901 to 1100 kg | 991.8 | 19.4 | 1 151.8 | 20.3 | 1 416.1 | 22.7 | 78.9 | 35.0 |
| 1101 to 1300 kg | 1 696.0 | 33.3 | 1 649.2 | 29.1 | 1 727.3 | 27.7 | 59.5 | 26.4 |
| 1301 to 1500 kg | 996.9 | 19.5 | 1 186.6 | 20.9 | 1 207.7 | 19.4 | 29.6 | 13.1 |
| Greater than 1500 kg | 180.5 | 3.6 | 288.3 | 5.1 | 319.3 | 5.1 | 7.4 | 3.3 |
| Not stated | 31.7 | 0.6 | 154.2 | 2.7 | 300.8 | 4.8 | 10.4 | 4.6 |
| Total | 5 102.2 | 100.0 | 3 569.6 | 100.0 | 6 233.4 | 100.0 | 225.4 | 100.0 |
| Estimated average vehicle mass | 1 119 | - | 1 132 | - | 1 129 | - | 1 094 | - |

Sources: ABS (1978, 1981a, 1983a)

TABLE II

ESTIMATED TOTAL AND AVERAGE DISTANCES TRAVELLED
CARS AND STATION WAGONS
YEAR ENDING 30 SEPTEMBER 1976, 1979, 1982

| Tare Weight Category (kilograms) | Total Annual Distance Travelled kilometres (millions) | | | Average Annual Distance Travelled kilometres (000's) | | |
|---|---|---|---|---|---|---|
| | 1976 | 1979 | 1982 | 1976 | 1979 | 1982 |
| Less than 1100 kg | 27,156 | 33,127 | 37,059 | 12.9 | 13.4 | 13.7 |
| 1100 but less than 1300 kg | 24,219 | 22,894 | 28,783 | 15.6 | 14.4 | 16.0 |
| 1300 kg and over | 27,156 | 28,851 | 30,267 | 18.8 | 18.0 | 17.2 |
| All tare categories | 78,531.0 | 84,872 | 96,109 | 15.4 | 15.1 | 15.3 |

Source: ABS (1979, 1981**b**, 1983**b**)