Economics drove our first sustainable urban transport system and the unsustainable one that followed

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1 Introduction

Typically New Zealanders look to learn from experience in other countries but then need to assess whether those situations are applicable to New Zealand. This Paper instead looks to New Zealand's own past experiences for circumstances that have influenced the success and sustainability of public or private transport systems. While the Paper draws on historical data the Paper is not intended as a comprehensive history of transport in New Zealand. Rather the Paper reviews the eras in which different forms of transport were dominant, highlights a number of the economic issues influencing transport behaviour, illustrates that people's transport behaviour in New Zealand has been economic rather than emotive, and concludes that if we want behaviours in transport that are sustainable then we need the economic settings to direct this type of behaviour.

This Paper divides the period 1900-2005 into four key phases of urban transport in New Zealand cities, showing the key role of economics in first supporting sustainable forms of urban transport, then the role of economics in driving and reinforcing the shift to unsustainable forms.

2 Sustainable transport

There are numerous representations of sustainability that link parameters such as environment, society, economics, and sometimes justice and governance. The depictions use a variety of geometric shapes, such as pyramids with the factors in the corners, or concentric rings, or overlapping rings, and the like. Whatever their style the common thread of these depictions is that sustainability is located in the region of overlap of the separate factors so that sustainability is the optimum mix of a number of desirable outcomes.

Sustainability has predominantly been defined descriptively, not mathematically, and hence it has not been quantified. People describe situations as either "more sustainable" or "less sustainable" with an inherent assumption that "more" or "less" can be quantified when sustainability itself has not been.

Economics is commonly one of the factors contained within sustainability depictions. Economics is typically seen by many people as a constraint to be applied to activities of business rather than to their own individual or household-level activities. However, outside of subsistence living, economic interaction is fundamental to all people's lives.

A sustainable urban transport system must connect people to their economic activities and the economic activities to one another. This highlights the limitations of the walking and cycling forms of transport that are commonly described as "sustainable", and implies that if "large cities" type settlements are accepted as sustainable then there is a need for "quick" transport to facilitate economic and social interactions. This is supported by data from a 1959 study in Christchurch. (1) Being flat and essentially circular, in Christchurch all available transport modes are equally

possible but, as Figure 1 shows, as journey distance increases walking and cycling give way to the faster buses.

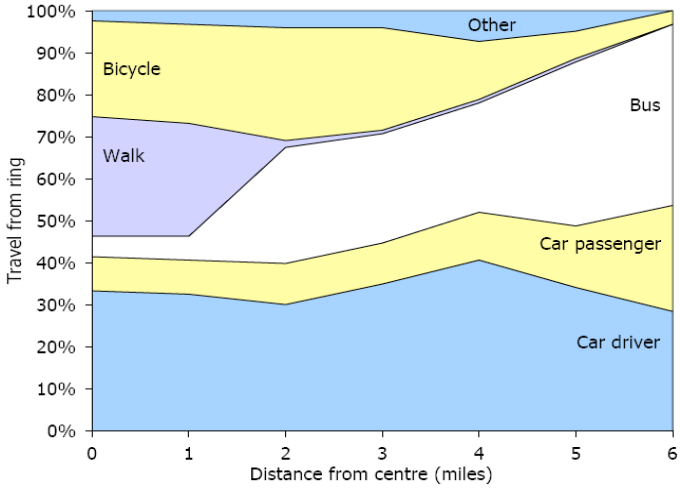

Figure 1 Mode of transport used versus distance from centre of Christchurch CBD, 1959

There can be an inherent assumption that public transport is a more sustainable transport form and private cars are a less sustainable form. This need not *necessarily* be true as the form of public travel may be of low sustainability. For example, a poorly patronised public transport bus will be less sustainable than a high-occupancy car. Context is also important. For typical trip purposes within rural settings, car travel is probably the most sustainable option.

The *New Zealand Transport Strategy* (2) demonstrates a wider perspective than just environmental sustainability and gives emphasis to economic and social objectives also. The *Strategy* lists five goals for the complete New Zealand transport system but this Paper suggests a more specific set of sustainability criteria for a transport system for individual or household travel could be:

1 Facilitate our economic interactions.
2 Facilitate our social interactions.
3 Promote the health and safety of individuals.
4 Make efficient and wise use of energy, including selection of energy resource and investment.
5 Complement the urban form and its liveability.
6 Impact only minimally on the natural local and global environment.

Comparing the travel offered by public transport systems (such as trams, buses, and trains) with private car travel against the above list of criteria, the high mobility given by car travel ensures a wide accessibility and means that car travel will score highly for the first two objectives in contrast to the current limited and fairly slow public transport system. But public transport, so long as it is reasonably patronised, will score more highly on the last three objectives. The balance as to which transport system, private-car or public, is most sustainable is dependent on the weighting given to each criterion. At present climate change and peak oil issues make the last three "environmental" criteria critical. Recent experiences are also showing that once car use reaches a high level, congestion can cause mobility to decline rapidly, so that car travel becomes increasingly ineffective at delivering those outcomes that arise from its "quick" journey speed.

3 Growth of the first sustainable urban transport system

The period 1899-1916 was the start of a new era in New Zealand transport with twelve Local Authorities investing in publicly owned electric tram systems. (3) The trams replaced the privately owned horse- or steam-powered systems and this was the first time in New Zealand that electricity was used as a significant source of transport energy.

The resident populations to support these tram networks were not large. The four main cities (Auckland, Wellington, Christchurch, and Dunedin) had populations ranging from 50,000 to 180,000, while the smaller towns had populations of only 6,000 to 20,000. Three of these tram systems were short-lived, but the remainder continued until the 1950s and had a dominant share of urban passenger travel until their replacement by motor-buses or by trolley-buses.

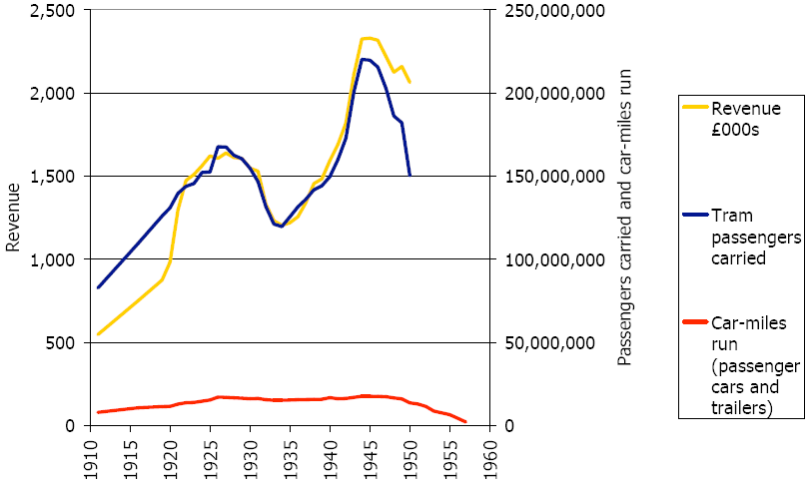

Figure 2 Urban public tram systems operations, 1911-1957

Initially these tram systems were essentially run on a user-pays basis with the intention not to make a profit but to operate so as to produce the barest possible surplus, usually no more than 2-5 %. (Where a system went slightly into arrears the difference was made up from general Rates.) The tram systems provided very affordable urban transport for individuals and households, as is shown by patterns of household expenditure over time:

- In 1920, 2% of household expenditure was needed for transport fares.
- In 1950, 9% of household expenditure was spent on transport.
- In the car-age at the end of the century, transport was 15% of household expenditure. (3)

In those settlements with operating tram systems, the developing growth and form were focused around the "permanent" and prominent public transport routes. As the systems developed, small adjacent settlements that had previously been separated became amalgamated into the wider settlement area. The *New Zealand Railway and Tramway Atlas* (4) shows that the final extents of these tram networks had reaches of about 12 km and extended close to the limits of their settlement at the time. The Central Business Districts (CBDs) served by the tram systems also grew. Comparing historic photographs of the CBDs from 1910 to 1920 with the same scenes twenty years later shows a much larger and grander scale of buildings and strong pedestrian presence on the streets. (5)

The tram systems of this "first phase" of New Zealand transport operated successfully with the residential density of that time, that is, detached housing on 300 to 1000 square metre lots. This density is broadly comparable with that present today yet public transport system patronage then

was about 300 % greater than current levels. This historical evidence challenges the current "new urbanism" philosophy that proposes densified residential living to make public transport more viable.

It appears that from the 1920s trams experienced strong competition from cycling and private cars but most especially from privately operated motor bus services. Buchanan (6) identified that the First World War exposed many soldiers to the uses of trucks, and that post-war many soldiers set up small bus companies and trucking firms or motor repair services. A similar trend appears to have happened in New Zealand and both countries passed legislation (1926 and 1928) to economically protect tram systems from the competition of buses, so the tram network was not undermined by losing passengers off the most profitable routes.

4 1950s to 1970s: The mixed system of the second urban transport phase

The period from the 1950s to the 1970s marks New Zealand's transition from public transport as the dominant urban system to systems of mixed road-based public and private transport; public transport, of mainly buses, and private cars would exist side by side and share the road space. The period included the formulation of Master Plans for New Zealand's current urban motorways, lost opportunities to establish high quality public transport systems for the *metropolitan* scale settlements, and vehicle assembly and manufacturing as a key employer of an urbanising population.

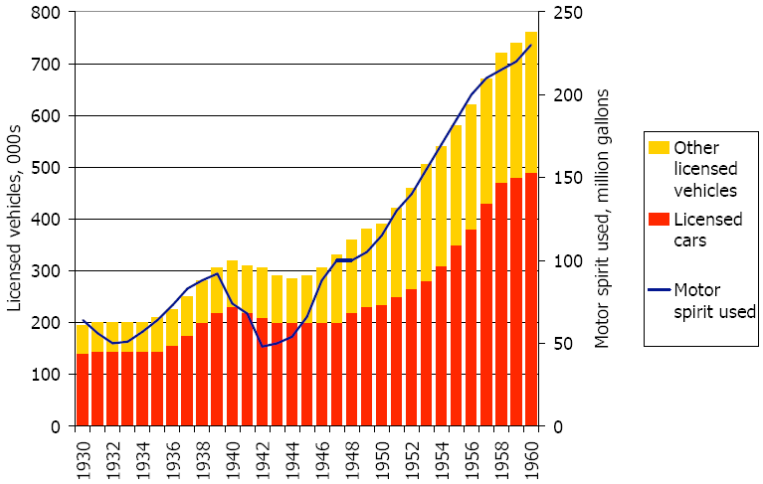

Figure 3 Licensed vehicles and motor spirit usage, 1930-1960

Car usage and uptake increased markedly after 1945 and on through the 1950s, with mirroring falls in public transport usage. Firstly most of the restrictions of the 1930s Depression and the Second World War, that may have constrained private car uptake and use in the previous two decades, had disappeared. Therefore the initial decline in passenger transport use immediately post-World War Two is principally attributed to a greater use of *existing* private cars once fuel and tyre restrictions were eased, rather than additional cars entering the fleet. Then the 1950s was a period of great wealth in New Zealand, and private car ownership and use increased rapidly so that by the early 1960s, on average, there was one car per household. Figure 3 shows the trend of private car uptake and usage (represented by fuel used) over this period. (3) A related study indicates that social recreational travel was another significant factor in this vehicle uptake. (7)

As New Zealand's population grew, cities began to expand but this time in a form governed by the private car, making a form in which it was increasing difficult for public transport to operate. The CBD was the common and increasingly congested destination of both the private car and the public bus. Whereas the earlier tram systems had operated in dedicated road-space, the bus-based systems, which replaced the trams in the 1950s (Wellington 1963), generally operated in the same road-space as private cars and were subjected to the same congestion as private cars. Thus some of the priority and advantage that was held previously by public transport was eroded, furthering the loss of public transport's appeal.

The 1950s were also the time when Auckland and Wellington expanded into larger metropolitan centres. While transport studies recommended upgrade of public transport systems in both Auckland and Wellington, only the Wellington public transport system was upgraded to a metropolitan scale, through electrification and double-tracking of the rail lines and integrating rail to link with the various bus systems. Instead, motorways were chosen as the dominant infrastructure form for travel between the component cities and boroughs of the emerging metropolitan regions.

The 1960s transport studies advocated stronger transport connections into the CBDs, for both public and private transport modes. The governance sector was hesitant to spend heavily on public transport given the ongoing falls in patronage of the period and, in Auckland and Wellington, rail remained poorly linked to the CBDs, thereby further reducing the appeal of rail relative to car use. Transport investment was directed towards tying the motorway systems into the CBDs, so as to free the congestion around the CBDs. (8, 9, 10, 11) Recent works around Spaghetti Junction in Auckland and the Wellington Inner City Bypass are essentially completing these old plans.

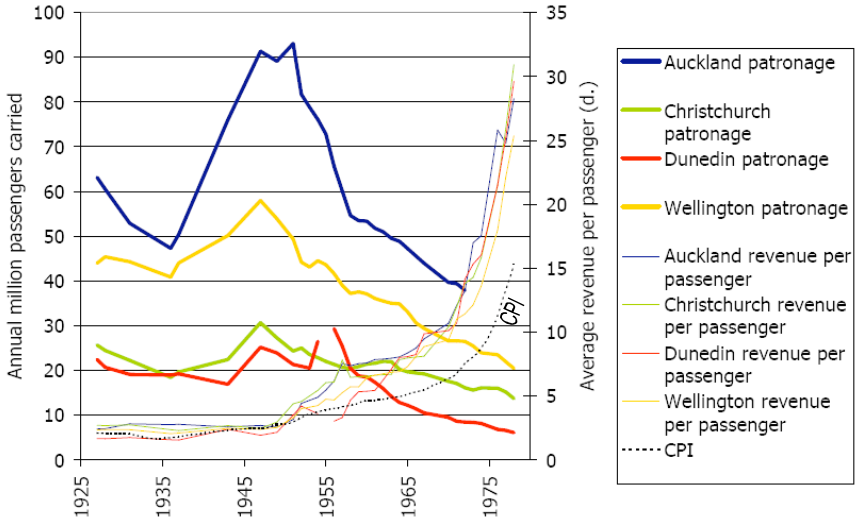

Figure 4 Public transport operations in main urban areas

Figure 4 shows the history of urban public transport patronage, for buses and trams combined, in New Zealand's four "metropolitans": Auckland, Wellington, Christchurch, and Dunedin. (3) The figure shows the total public transport patronages peaking around the early 1950s and the generally continuous decline of patronages since then. The trends of "revenue per passenger" are also shown on Figure 4 and are similar for each metropolitan public passenger system. The "revenue per passenger" is seen to increase steeply, as did New Zealand's Consumer Price Index (shown as the black dotted line on Figure 4), around the 1950s in particular and again in the

1970s. Both occasions coincide with falls in patronages. The declines in patronages of the 1970s are discussed in the next section.

5 A third urban transport phase during the 1970s

The 1970s was a difficult decade for New Zealand as the economy had to adjust to restricted access to its main export market for farm products following the United Kingdom's entry into the European Economic Community. This setback was compounded by the steep rise in international oil prices following the oil export embargoes/price increases by OPEC of 1973 to 1975 and then further price rises at the end of the decade surrounding the Iranian Revolution. These resulted in first a threefold increase in fuel prices followed then by a further doubling of prices. The Government introduced a number of fuel restriction measures, mainly focused around the "Oil Shock" events (but some imposed for longer periods) including:

- Reduction of open road speed limit from 90 or 100 km/h to 80 km/h;
- Graduated vehicle sales taxes and licensing costs that favoured smaller engine sizes;
- Banning of petrol sales on the weekend;
- Carless days, where for each household vehicle one day per week was nominated when that vehicle would not be used (imposed from July 1979 to May 1980);
- Rules on the extent of hire purchase arrangements for car purchase.
- Allowing Government workers flexible start times so as to spread congestion (late 1970s); and
- Establishing agencies to identify alternate energy sources, including as CNG, LPG, and biofuels. (12)

Most of these measures were focused on discouraging travel that used more fuel but several measures sought to alter vehicle-purchasing behaviour. Although vehicle numbers continued to rise over the decade, and travel restriction measures were resented and often circumvented, those measures targeting purchasing behaviour were more successful. Figure 5 shows vehicle-purchasing patterns of new vehicles over the 1970s decade. The combination of increased petrol prices, the fuel-efficiencies offered by smaller-engines, and weighting of vehicle-taxation rates against engine-size are attributed as key factors in the dramatic changes.

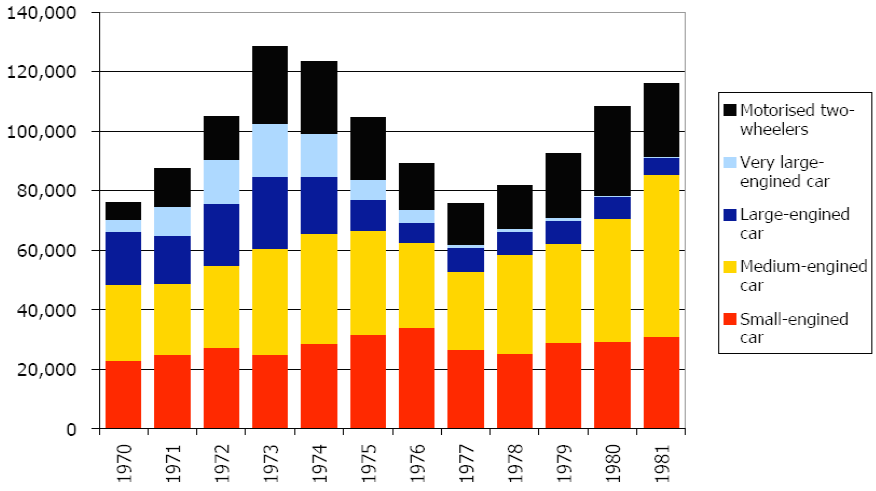

Figure 5 Vehicle registrations, representing vehicle-purchasing patterns, 1970-1981

The Government's measures were notable for there being almost no encouragement to shift travel to public transport. Even without this encouragement, given that petroleum fuels rose steadily in

price (600 %) over the period 1973 to 1979, and there were also restrictions on its use, an increase in public transport use would have been expected. However, concurrently bus fares rose steeply, and this may have weight in explaining the decline in patronage.

The *Urban Public Passenger Transport Council* noted in its reports of the period that the effects of the rapidly rising operating costs were worsened by the age of their bus fleet. For the Local Authorities' fleet of about 1,200 buses, 50 % were over 15 years old and 30 % more than 20 years old. In short, the buses that had been bought in the 1950s to replace the trams and expand the service in that period, needed in the 1970s to be replaced, but the justification and finance to do so were becoming increasingly difficult. (13) Faced with ongoing budget deficits and sliding currency devaluations the Government first had little money for, and second even less commitment for public transport expenditure. Government focus was on liquid fuel self-sufficiency to insulate New Zealand against overseas trends, and the "Think Big" expenditure that followed in the early 1980's was to further this goal.

5.1 Energy and resilience

New Zealand has had two major periods of fuel restriction: the Second World War when petrol for cars was rationed, and in the 1970s when the price first tripled then doubled again and there were intermittent periods of restrictions when fuel could not be bought or cars used. The effects of these two periods on public transport were markedly different.

In the Second World War the tram system was operated by local hydro-electric power (so its energy supply was unaffected by the wartime restrictions). Throughout the period, tram services were expanded, and it proved to be a resilient system, helping to cushion the impact of fuel shortages. Average fares remained constant throughout the period. Public transport patronage increased markedly, by about 25 %.

The 1970s were a stark contrast. The public transport system had been converted over to be a largely diesel-based system in the 1950s. Fuel costs rose steeply in the 1970s period and these rising operating costs were translated to the public transport system as rising fares. The fuel price rise also triggered wage and price inflation also compounding the rise in public transport operating costs. The *Urban Public Passenger Transport Council* reports service impacts from an ageing fleet. Fares rose steeply to attempt to cover these rapidly rising expenditures. Though public transport patronage was already falling prior to the oil shocks, patronage started falling at an even greater rate. The result was patronage declined by more than 25 % over the period.

6 Economic Reforms of the 1980s and 1990s marking the fourth urban transport phase

The New Zealand economy up until the early 1970s was highly regulated. Slow Reforms had occurred between 1970 and 1984 but in 1984 and the years following, the economy was greatly liberalised. However with respect to transport and cars the main effects occurred in the early 1990s with the removal of tariffs on imports, the closure of all local vehicle assembly, and the effective privatisation of public transport. The outcomes are that since 1995 new car prices have decreased by over 30 % and simultaneously second-hand cars began to be imported into New Zealand with a dramatic impact on used car prices so that over the same ten-year period used vehicles have decreased in price by about 50 %.

The effects of these lower prices show in several ways. As Table 1 shows, car numbers increased by 550,000 vehicles in the period 1996 to 2005, essentially double the rate of the previous thirty years. Figure 6 also shows the number of cars per household has increased so that 50 % of the

households have two or more vehicles (even though 60 % of households have only one or two residents) and only 8 % of households have no vehicles.

Table 1 Trends of population and vehicle numbers

Year	Population ('000)		Total number of licensed cars[1*] ('000)	Cars/Person		Cars/Household
	Total	20+ years		Total	20+ years	
1961	2,450	1,450	541	0.221	0.373	
1966	2,700	1,550	766	0.312	0.434	1.07
1971	2,850	1,700	933	0.327	0.549	1.16
1976	3,150	1,900	1,172	0.372	0.616	1.25
1981	3,200	2,000	1,333	0.416	0.666	1.33
1986	3,300	2,200	1,480	0.448	0.672	1.36
1991	3,400	2,300	1,700	0.500	0.739	1.44
1996	3,650	2,510	1,800	0.490	0.717	1.41
2001	3,750	2,600	2,100	0.560	0.808	1.56
2005	4,110	2,921	2,350	0.573	0.804	

1* Data to 1976: Statistics New Zealand; Data from 1976: Ministry of Transport - Vehicle Fleet Model

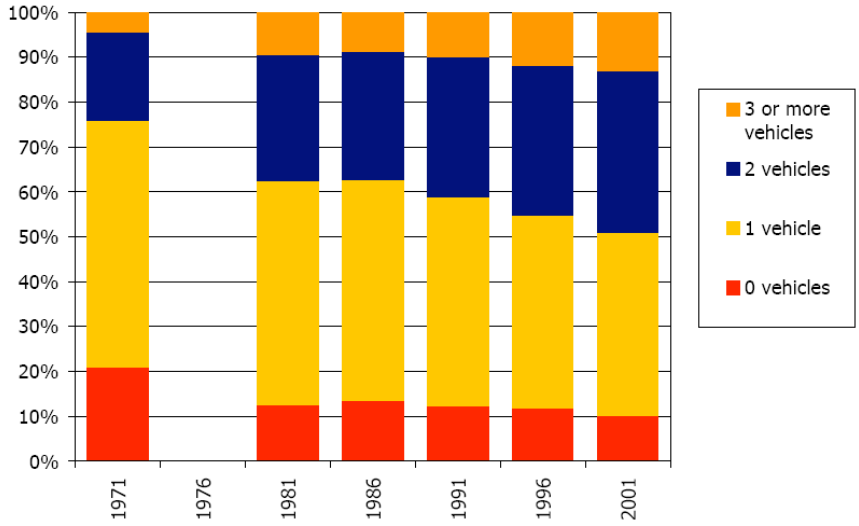

Figure 6 Cars per household, 1971-2001

The *Household Expenditure Survey* (14) shows the amount spent by households on a range of items, including transportation. Table 2 shows the household expenditure for transportation over a thirty-year period, subdivided between high and low income groups. The downward trend over time is evident. It is also evident that increased wealth is directly associated with increased transport. While there is some fluctuation across all survey periods it appears that:

- Pre-1984, 14.7 to 16.3 % was spent on private transport and
- Post-1984, 11.5 to 13.4 % was spent.
- Pre-1984, 1.0 to 1.2 % was spent on public transport and
- Post-1984, 1.0 to 0.8 % was spent.

Therefore even though households, on average, have more cars than before and have increased their usage and vehicles are much larger, still transportation costs have fallen by 3 % of total household expenditure or 18 % of transportation expenditure.

Table 2 Percentage of household expenditure for transportation

Percentage of household expenditure for transportation		1973-1974	1975-1976	1979-1980	1981-1982	1983-1984	1987-1988	1989-1990	1991-1992	1993-1994	1995-1996	2000-2001	2003-2004
High income	Public	1.0	1.2	1.0	0.9	1.0	1.0	0.9	0.8	0.7	1.3	0.8	1.0
	Private	14.5	16.8	15.4	14.1	15.6	12.6	13.1	12.7	10.8	14.1	11.8	13.3
Low income	Public	1.9	1.3	1.6	1.4	1.1	1.6	0.8	1.3	0.8	1.0	0.9	0.9
	Private	7.8	14.8	8.3	10.7	12.6	12.2	10.9	12.7	10.1	10.0	8.8	11.2

7 Discussion

The four phases defined in this Paper show that with respect to transport, people's behaviour has been largely economic rather than emotive. The period of public transport's success was when it was by far the best option for travel. The trams were established as city-wide networks and provided much faster transport than was possible earlier by walking, bicycling, or horse-drawn vehicles. Fares were set low. It appears that money spent on fares comprised about 2 % of the total household budget (1909 and 1920). (15)

The success of trams is readily explicable in terms of the space-time prisms used mainly to explain accessibility. (16) These prisms are anchored by key fixed activities located in space. Other activities can be included if the travel to and from this activity *and* the activity can be completed in the unused time. By greatly shortening travel times, trams increased the range of activities available. They also had a beneficial effect on the CBDs by increasing concentrations of customers and workers, and the CBDs grew significantly in scale.

Cars were reasonably available in the early 1900s but the uptake was slow because of their cost. Local assembly started in 1926 and reduced selling prices by 50 % but uptake was limited by the expense of spare parts and vehicle-availability issues. (17) The Depression and Second World War restrictions also suppressed demand. The rapid uptake of cars, through 1950 to 1965, owed much to the high prosperity of the time but indications are that a major motivator for the purchase was for social recreational travel and then the vehicle, once purchased, was used also for the work trip and other trips. (18) Being able to get out of town, weekend trip-making, and travel for visiting friends were highly-valued trips. In large metropolitan centres this travel was either not feasible by public transport because of the locations of origins and destinations and/or timing and duration of travel.

The 1970s economic behaviour was clear cut. With car operational costs and ownership costs being skewed towards smaller vehicles, purchasing behaviour followed. Both smaller cars and two-wheelers increased significantly in sales. The public transport services were already poorly patronised but fare increases decreased patronage further. In Wellington seven successive fare rises coincided with seven successive declines in patronage. Transport operators noted that their passengers were increasingly concession tickets of the elderly or school-children. (19) Although fares were subsidised from rates, given the make up of passengers, this was done with overtones of welfarism. The wider benefits of public transport were articulated in the 1972 *New Zealand Transport Policy Study* (20): the main beneficiaries of transport are the businesses, employers, or property owners of the CBD and industrial areas as it delivers them a workforce and customer base. This view was not specifically enacted other than by the coincidence in Wellington where businesses paid 60 % of the rates.

The market deregulation since the 1980s removed differential charges for large vehicles and the size make-up of the New Zealand fleet now matches that of the 1960s with a high proportion of large cars. Car operation costs have fallen to such an extent that even the increased use has not offset the fall so still an approximate 20 % decrease in the cost of travel has occurred. The result has been significant decreases in walking, cycling, and public transport usage (21), although recent efforts to reverse these trends are showing some effect, but from a very low base.

8 Conclusions

1. Sustainable transport has a wider framework than just environmental sustainability. Facilitating our economic and social connections is a crucial role of transport, and whether public transport or the private-car is more sustainable also depends on context. Overall, an urban transport system underpinned by a quality public transport service would be the more sustainable.
2. All indications from New Zealand's past are that economics is the major factor behind users' choice of travel mode and vehicle-purchase decisions.
3. Economic deregulation has greatly reduced vehicle costs promoting non-sustainable behaviours such as high-vehicle ownership, use of high fuel-consumption-vehicles and consequent poor use of public transport. Returning to more sustainable transport is unlikely until the economic framework within which people live drives them in this direction.

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