Transformative Transport: Transport and Economic Transformation

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ABSTRACT

Transport networks are inextricably intertwined with processes of economic transformation. Julius Vogel's infrastructure investments of the 1870s transformed the New Zealand economy. Factories and mines mushroomed around the railways; whole provinces and industries opened up for production. More recently, the Auckland and Tauranga harbour bridges transformed those cities.

The Ministry of Economic Development is charged with leading government's efforts to create a substantial lift in living standards for all New Zealanders. Productivity across the economy has to rise materially to deliver this outcome. Modern understanding of economic growth processes indicates that much of this growth will occur within large agglomerations. In New Zealand's case, this means that productivity growth in Auckland is pivotal (although, of course, productivity growth across all regions is desirable).

Successful agglomerations raise productivity by improving linkages between firms and by creating thicker labour markets. These effects mean that firms within cities can access higher quality and more suitable labour and supplies, and can service greater numbers of customers, than firms in smaller urban areas. Thus cities create increasing returns to scale, with rising living standards. Agglomeration benefits are constrained when congestion and other negative externalities outweigh the productivity benefits. The balance between these forces determines optimal city size and overall living standards. Transport investment, and other decisions that affect negative externalities (including congestion), are therefore central to the process of economic transformation. Investments that increase connectedness within and between agglomerations boost productivity. Where costs of the investment are less than these productivity enhancements, the new investment bolsters economic growth.

In this paper, we review recent international evidence on the forces of agglomeration and the links between agglomeration and transport investments. We then focus on New Zealand evidence. In particular, we consider whether productivity benefits are apparent from agglomeration within Auckland and whether there is evidence that these benefits are affected by transport systems. In considering the implications of this evidence for policy, we take a long-term perspective since outcomes will be shaped over very long periods by transport infrastructure decisions taken now.

1. INTRODUCTION

Transport networks are inextricably intertwined with processes of economic transformation. Julius Vogel's infrastructure investments of the 1870s transformed the New Zealand economy. Factories and mines mushroomed around the railways; whole provinces and industries opened up for production. More recently, the Auckland and Tauranga harbour bridges transformed those cities.

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2. TRANSPORT AND AGGLOMERATION ECONOMIES

2.1 THEORY AND INTERNATIONAL EVIDENCE

2.1.1 Agglomeration

Throughout the developed and developing world, cities are increasing in importance, both in their share of population and in their relative productivity. Holding other factors constant, larger cities tend to have higher productivity per person than do smaller cities within a country. Crawford (2006) summarises recent agglomeration studies; here, we focus on issues that are particularly salient for the links between agglomeration and transport.

Sassen (1991, 1994, 1995) and Daniels (1995) highlight the shift in industrial base from manufacturing to services within successful cities. This shift has been observed globally and has accelerated over time. Business services are now an indispensable factor of production that has a growth potential of its own. Building on this work, Derudder et al (2003) conceive world cities as places where knowledge-based services to other corporations are concentrated. They calculate a hierarchy of world cities based on the roles of service firms within those cities. Cities such as New York and London are at the heart of the world economy. Sydney is a world city (albeit not at the same level as London) along with cities such as Buenos Aires and Toronto. Other major Australasian cities – Melbourne, Auckland, Adelaide, Brisbane, Perth - are included at a lower level in the hierarchy. This analysis implies that Auckland currently occupies an important, but clearly not pre-eminent, role within the Australasian economy.

'New economic geography' exponents discuss the factors that give rise to major cities and which strengthen certain cities' pre-eminent positions. Krugman (2005) divides the causes of productivity differences across cities or regions into factors related to fundamentals and factors due to external economies (positive spillovers) that create increasing returns within cities. Fundamentals include a well-educated local population, a local culture of entrepreneurship, natural advantages of climate or resources, and sustained public policy differences such as differences in tax rates and quality of infrastructure, including transport. External economies arise from proximity to specialised suppliers of intermediate inputs and services, thick labour markets and knowledge spillovers from local contacts (Marshall, 1920).

One way to examine the importance of location for productivity is to examine land rents – why do they generally fall from the centre to the edge; and why are they higher in cities than in rural areas? Costs of distance and determinants of clustering activity are important here. Venables (2005) postulates that the economic importance of distance has increased over time as expenditure has shifted to sectors such as personal services, creative industries, design and media where face-to-face contact tends to be important. Glaeser (2005) also argues that economic value now lies primarily in people and ideas whereas once it was embodied in tangible assets such as ports and mines. He reports empirical findings demonstrating that population

growth, wage growth and house price growth are correlated with cities' initial skill levels.[i] In the modern world, successful cities must continue to attract skilled residents, so transport of people may now be more important than transport of products for many firms' location.

More generally, productive efficiency is limited by the extent of the market, and the extent of the market is shaped by geography and quality of infrastructure. Good market access attracts firms, which bid up wages and the price of land. This process continues until alternative locations are equally profitable, with higher wages and higher rents in the higher productivity areas.[ii]

Countering the external economies that lead to agglomeration is the need to service dispersed consumers, coupled with transport, commuting and congestion costs. These latter factors limit the extent of agglomeration that occurs. For instance, if transport links in and around a city are poor, there is a greater offset to the forces of agglomeration and so a city will not develop to the same extent as an otherwise identical city with better transport links.[iii, iv]

Taken together, the theoretical, statistical and case study analyses of agglomeration point to important factors that drive city development. Foremost amongst these are: positive social amenities, good climate and natural amenities, strong skill base, excellent infrastructure (including communications, and internal and external transport links), land availability (to contain property costs), initial clusters with potential for expansion, excellent education system, thick labour markets, and a lack of negative social externalities such as crime and pollution. Interactions amongst these factors may be important. In particular, efficient transport networks may magnify the positive (and negative) impacts of other amenities.

2.1.2 Transport

The theoretical and empirical insights into the forces for agglomeration place a spotlight on the role of infrastructure, especially transport, within cities. Infrastructure availability is a key factor that may promote or stifle agglomeration, productivity and city development. Geographical distance (comprising direct travel or freight costs, time and information/communications costs) is a barrier to economic interaction. Infrastructure matters since its provision and adequacy can reduce distance costs.

Venables (2005) argues that the private trade-off between agglomeration economies and diseconomies (including congestion) does not create an outcome that is socially efficient. For instance, the decision of a migrant to live and work in a city, or of a firm making its location choice, is based on private returns and fails to take into account external effects (positive or negative). Venables (2004) shows that productivity effects from agglomeration and revenue benefits are large. When both effects are included, the overall gain attributed to a typical transport infrastructure investment in the UK may be five times the value of the change in commuting costs. He concludes that there are significant gains from urban transport improvements that exist over and above those that would be contained in a standard cost-benefit appraisal of the type

undertaken to value potential projects in New Zealand.[v] In these circumstances, issues of transport planning and land use in cities become critical public policy questions.

In related work, Rice et al (2005) find that agglomeration benefits of transport investments are greatest for areas within 40 minutes driving time of the urban centre, tapering off quite sharply thereafter and having little or no effect beyond 80 minutes. They argue that bringing population from 60 minutes driving-time away to 30 minutes away increases its impact on productivity by a factor of four.[vi]

Within the UK, the recent Eddington Transport Study (2006) has examined a range of evidence regarding the long-term links between transport, economic productivity, growth and stability. It reports that 55 per cent of commuter journeys are to large urban areas and 89 per cent of delay caused by congestion is in urban areas. The report concludes (p.1):

> *the performance of the UK's transport networks will be a crucial enabler of sustained productivity and competitiveness: a 5 per cent reduction in travel time for all business travel on the roads could generate around £2.5 billion of cost savings – some 0.2 per cent of GDP. Good transport systems support the productivity of urban areas, supporting deep and productive labour markets, and allowing businesses to reap the benefits of agglomeration. Transport corridors are the arteries of domestic and international trade, boosting the competitiveness of the UK economy. Correspondingly, transport policies offer some remarkable economic returns with many schemes offering benefits several times their costs, even once environmental costs have been factored in.*

The Eddington study, and the work of Venables and Rice, indicates that another look needs to be taken at the methodology used to evaluate transport investments in New Zealand. Existing methodologies do not incorporate the effects of agglomeration externalities, taxation wedges and increases in income accruing to government as a result of productivity rises.[vii, viii]

2.2 NEW ZEALAND EVIDENCE

2.2.1 Agglomeration

Studies of the effects of agglomeration within New Zealand are in their infancy. The most comprehensive studies are by Lewis and Stillman (2005) and Maré and Timmins (2006).

Lewis and Stillman investigate Auckland's economic performance relative to other 'large' cities in New Zealand and relative to medium-sized urban areas and small towns/rural areas. Ignoring Wellington (with its tax-financed capital city role), Auckland has significantly higher average levels of labour income and wage rates

than do the comparison areas within New Zealand. Auckland has also experienced higher growth in wages and salaries than other regions.

These findings imply that Auckland has been a relatively strong performer within the New Zealand context, consistent with agglomeration externalities being at work. However they note that Auckland is unlikely to have been a strong performer in Australasian city terms.[ix]

Maré and Timmins examine the links between geographic concentration and firm productivity across New Zealand urban areas, using a firm-specific longitudinal dataset. Their findings confirm that labour productivity is higher for firms in geographically-concentrated industries (termed 'localisation'), for firms in more industrially-diversified labour markets (termed 'urbanisation') and for firms operating in larger labour markets. Auckland is clearly the largest and most diversified labour market in New Zealand. Further, there is geographical concentration of certain industries within Auckland. The Committee for Auckland (2006a) reports that 44% of all New Zealand's finance sector employees are situated in Auckland and 38% of New Zealand's property and business services employees are in Auckland.

Maré and Timmins find some evidence to support the case that changes in localisation and urbanisation lead to increased labour productivity in New Zealand.[x] Overall, however, the productivity effects attributable to firm concentration found by Maré and Timmins do not appear large relative to the cited international studies. This may mean that the nature of development in New Zealand (including Auckland) has yet to fully realise agglomeration benefits. It is a moot point whether this may be due to inadequacies in the transport links that are required to reap agglomeration benefits, or to other reasons.

2.2.2 Transport

A limited amount of research has been undertaken on the comprehensive value of transport investments in New Zealand. Standard benefit:cost analyses of transport investments are undertaken prior to project investments but these approaches specifically exclude potential benefits arising from agglomeration and other externalities of the type listed above. Here we concentrate on other forms of analysis that relate specifically to Auckland.

The "Allen Report"[xi] of 2004 cites a range of studies conducted between 1997 and 2004 that provide evidence of substantial congestion on Auckland roads compared with other cities. The most reliable study appears to be that of Transit New Zealand in 2003 which used the same methodologies as used in Australia to compare congestion in Auckland and Wellington to congestion in urban areas in the five major Australian states.[xii]

In that study, *uncongested* travel speeds in Auckland averaged 65 km/h, which was within (but towards the bottom of) the range experienced in Australia's urban centres (63-72 km/h). It was well below that of Wellington (78 km/h). *Actual* travel speeds in

all urban areas were well below uncongested speeds, with Auckland having a higher than average gap between uncongested and actual travel speeds. Auckland (at 40km/h) had lower average congested travel speeds than did any of the Australian urban areas (which spanned 41 km/h to 53 km/h). Wellington's average congested travel speed was 57 km/h.

Transit New Zealand has since updated the New Zealand city travel time figures with its November 2005 survey.[xiii] The Auckland am and pm peak travel speeds were 39 km/hr and 40 km/hr respectively. These speeds were comparable with speeds in earlier surveys. Relative to other New Zealand cities, Auckland has the lowest average travel speeds, the highest congestion indicator and the highest level of travel time volatility (i.e. high uncertainty of travel times experienced by road users).

These studies refer to congestion affecting road users. The effects are felt by car users and bus users where there is no bus lane. They are not so relevant to bus users where there is a bus lane and are irrelevant to train travel. As a complementary approach to testing efficiency of transport systems, we report results of an exploratory study that examines the efficiency of public transport in Auckland, relative to similar sized cities in Australasia (Brisbane, Adelaide and Perth). Each of these cities, like Auckland, has a population of between 1 and 1.5 million.

For each city, we identified a major train station 5-10 kilometres from the city centre and another station 10-20 kilometres from the city centre. We made these choices for each train line connecting the city centre to the city's suburbs. Distance in each case is measured 'as the crow flies'. Journey times (obtained from train timetables) were calculated from the city centre station (e.g. Britomart in Auckland) to the chosen destinations at two different times of day: the first train after 10.00am (off-peak) and the first train after 5.00pm (peak). In addition, for each of the chosen stations, we determined bus routes that connected the city centre to that station. Where express services were offered, we included journey times for both the express and non-express service.

Having obtained these data, we determined the fastest trip from the city centre to each station (which in some cases is by train and in others is by express bus) at both off-peak and peak times. These speeds were then averaged for each city to give an average public transport speed for each city at both peak and off-peak times.

As an example, we chose the following stations for Auckland: New Lynn, Henderson, Otahuhu, Manurewa. The fastest off-peak and peak travel speeds (km/hr) for the trip to each of these stations is shown in Table 1. These times show the much slower transport links from Britomart to West Auckland compared with links to South Auckland (for locations on the rail network). They also show that West Auckland (unusually) has faster peak than off-peak travel speeds. This is because of the presence of express buses at peak times which are faster than the trains at those times. Express buses do not operate at off-peak times when trains provide faster access to the city than do buses.

Table 1: Auckland Public Transport Speeds (Off-Peak & Peak)

Station	Fastest travel speeds (km/hr)	
	Off-Peak	Peak
New Lynn	20.6	25.8
Henderson	18.3	22.0
Otahuhu	33.3	33.3
Manurewa	33.0	33.0
Auckland Average	**24.5**	**27.6**

Source: Train & bus timetables; Google Earth; author's calculations

Table 2 summarises the average fastest off-peak and peak travel speeds for each of the four comparable cities. At peak commuter times, Auckland's public transport system provides approximately equal slowest commuter transport to the city centre (together with Brisbane). It ranks behind Adelaide and considerably behind Perth. At off-peak times (when express buses are not running), Auckland's commute speed into the city centre is considerably slower than the other three cities.

Table 2: Australasian City Public Transport Speeds (Off-Peak & Peak)

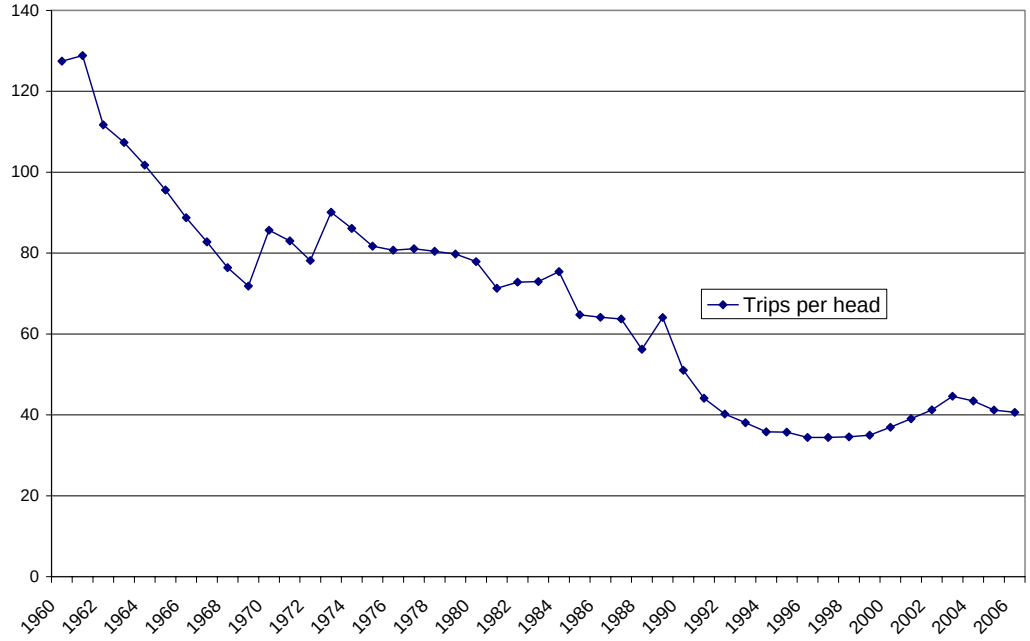
City (Average for each)	Fastest travel speeds (km/hr)	
	Off-Peak	Peak
Auckland	24.5	27.6
Adelaide	30.8	30.8
Brisbane	28.0	27.5
Perth	41.7	42.3

Source: Train & bus timetables; Google Earth; author's calculations

These comparative results for public transport efficiency complement the findings in the Allen Consulting report regarding private vehicle travel speeds. Overall, the Auckland transport system performs poorly relative to similar-sized cities in Australia. The poorly performing public transport and private transport networks reduce the potential benefits of productivity-enhancing agglomeration in Auckland relative to similar Australian cities.

One effect of the system's deficiencies has been to greatly reduce the per capita use of public transport in Auckland.[xiv] Chart 1 records the number of public transport trips taken annually per capita in Auckland since 1960. Per capita trips halved between the early 1960s and the mid-1980s (from over 120 to around 60). The current rate (approximately 40 per head) is two-thirds of the mid-1980s level and one-third of the early 1960s level. The number of trips per capita has been broadly stable since the early 1990s, so the downward trend, at least, appears to have been halted.

Chart 1: Public Transport Boardings in Auckland per head



Source: Abusah and de Bruyn (2007)

The extraordinary fall in Aucklanders' use of public transport over four decades is consistent with the relatively poor performance of the system detailed above. Poor public transport provision encourages greater private transport use which increases congestion. Thus we observe both poorly performing private and public transport systems in Auckland relative to Australian counterparts. The question, from an economic perspective, is whether these deficiencies cause productivity and other losses as a result.

A recent study by Paling et al (2007) examines the relationships between productivity, agglomeration and transport in Auckland. They note that Auckland's CBD has 13% of the Auckland Region's employees and 24% of Auckland City's employees. The CBD employment growth rate was just 0.6% p.a. over 2000-2004, compared with 3.6% p.a. growth for Auckland Region employment and 2.8% p.a. growth for Auckland City employment. Given that agglomeration theory suggests high-income services-oriented CBD employment should be growing faster than other employment, they pose the question of whether there are infrastructure, especially transport, constraints to employment in the CBD.

They note that traffic entering the CBD rose at a rate of just 0.9% p.a. between 1986 and 1999. The authorities' Central Area Access Strategy aims to have nil expansion of the CBD road network with a limit of no more than 37,000 private vehicles entering the CBD between 7am and 9am. If effective, these constraints mean that extra travel into the CBD (arising from extra employment and student activity) requires strong growth in public transport as well as in other travel modes (walking, cycle, vehicle sharing, etc).

The authors cite research that firms have relocated out of the Auckland CBD in part due to travel benefits (proximity to clients) and lower costs of parking outside the CBD. The negative congestion and other externalities within Auckland's CBD limit the potential to increase productivity benefits that would otherwise arise from CBD agglomeration.

Using methods trialled in London transport studies, the authors examine relationships between accessibility, density of employment and average earnings for Auckland using 2001 census data. The accessibility measure combines population and employment location data with data on highway and public transport services. They find a strong link between accessibility and employment density, with sharp increases in the latter at relatively high levels of accessibility. Above a certain cut-off, they also find a substantial positive correlation between employment density and average earnings, with highest earnings in central Auckland zones. These findings are consistent with the patterns in the London data.

The authors conclude that there is prima facie evidence to consider that accessibility (transport) is positively associated with employment density. In turn, employment density is positively correlated with average earnings. They caution that transport may be a necessary, but not sufficient, condition to achieve agglomeration externalities. Further work is required to ascertain what supporting measures are required to achieve agglomeration benefits from improved (private or public) transport links. This issue is related to the question of whether these results are purely associative or whether they are causal. For instance, the correlation between accessibility and density could be due to transport services being provided to areas of dense employment (and population) rather than transport provision determining the location of dense nodes. Additional work, employing data over multiple time periods will be required to ascertain which factors determine others.

These issues are currently being examined in a FRST-funded research programme conducted by Motu Economic and Public Policy Research Trust.[xv] The programme has, as its key objective, the assessment of net benefits flowing from a range of New Zealand infrastructure investments. Included in these investments is an evaluation of the benefits of Auckland's Northern Motorway extension and an evaluation of the benefits of Auckland's passenger rail transport upgrades.[xvi] The studies will examine the impact of infrastructure investments on population movements, local land and property prices, new building activity, firm location, employment and earnings. Data covering a long time span will be used in an attempt to minimise problems associated with reverse causality. The results will be used to help assess systemic issues surrounding funding and selection of infrastructure investments.

Initial modelling work from the programme (reported in Grimes and Liang, 2007) indicates that agglomeration forces are increasingly present in Auckland. CBD land values relative to values more distant from the central distant have risen consistently over 1992-2004. This result is consistent with increasing relative productivity in the international and national services sector that is predominantly located within the

Auckland CBD. Future work will determine the influence that changes to transport networks may be having on these location patterns.

3. WHERE TO NOW?

Evidence is building internationally and in New Zealand that efficient urban transport systems enhance the processes of agglomeration. In turn, agglomeration is a key factor in lifting regional and national living standards. It is vital that this evidence is used when assessing the benefits of infrastructure investment. Planning processes need to account for the agglomeration benefits that exist as a result of new investments over and above the matters accounted for in the standard benefit: cost analyses currently used in New Zealand.

Faced with this knowledge, what can be done now to enhance Auckland's – and New Zealand's - productivity through appropriate transport investment? Auckland's Metro Project Action Plan (2006) advocates a strategy of using the 2011 Rugby World Cup to create long-term benefits and to assist the transformation of Auckland into a world-class destination. This provides a very short timeframe to agree, design, obtain planning consents and construct major legacy projects with those characteristics. Similar legacy projects overseas (e.g. in Barcelona) have often been in the form of major public transport upgrades.

A transport strategy makes little sense without an urban development strategy, and an urban development strategy is meaningless without a transport strategy. The requirement now is to use the current window of opportunity to design and deliver an integrated long-term economic development and transport initiative for Auckland that goes well beyond the plans and investments already agreed to.

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ENDNOTES

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[i] Another strong predictor of US urban growth over the past eighty years is warmth. Glaeser finds that population growth occurs in warm cities irrespective of skills (indicating a shift of consumer preferences). A similar pattern has been observed in New Zealand with a northward drift of population. Non-climate amenities (both natural and human) are similarly important for determining location.

[ii] Venables (2004) summarises existing literature on effects of city size on productivity. He notes that US studies "typically yield the result that doubling city size increases productivity by an amount in the range 3-8%, i.e. an elasticity of productivity with respect to city size of between 0.04 and 0.11." In the UK, Rice et al (2005) find a corresponding elasticity of 0.04, with two-thirds of this attributable to variations in productivity and one-third due to variation in the skills of employees. Ciccone and Hall (1996) and Ciccone (2002) relate productivity to the spatial density of economic activity; they find an elasticity of productivity with respect to density of around 0.06 using data for the US and Europe.

[iii] Negative social externalities, such as crime, also act against the positive forces of agglomeration.

[iv] These positive and negative forces affect urban form. Cars allow expansion of cities with low density at the city edge. This type of property is in high demand by wealthy individuals. "Big box" stores can locate in fringe areas more cheaply and so offer lower prices. City sprawl may therefore enable firms and cities to attract a greater number of wealthy immigrants and to offer retail destinations with lower prices for a wider range of city residents, provided transport links are available between residential and retail locations. See Turner (2007) and Anas and Rhee (2007) for discussion of these issues.

[v] Caveats to this analysis are that journeys are assumed to be made only for commuting. If journeys are made for other reasons, this increases the benefits. The model assumes that productivity outside the city remains unchanged. (These latter effects could conceivably work in either direction.) The effects may also be sector-specific. The productivity relationship varies across sectors, and is generally strongest in those sectors that are clustered in large cities. Thus policy formulation requires careful identification of where the market failures – including tax wedges and agglomeration externalities – are largest.

[vi] Their counterfactual experiments of cutting all UK driving times by 10% raise national productivity by 1.2%, and by twice this amount for areas whose access to large population mass is increased most.

[vii] Optimising the use of existing infrastructure may be as important as investment in new infrastructure for some cities. Krugman (2005) emphasises the value of the physical legacy of previous industrial development: "This includes infrastructure, such as fixed-rail transit systems, which are very expensive to create in new centres but already exist in old ones." In this regard, he notes that congestion in many old industrial US cities is less than that in newer cities such as Houston or Atlanta.

[viii] Glaeser (2005) provides an alternative perspective on the roles of transportation, urban planning and land use policies. In US cities, public transportation involves an average 18 minute fixed time cost (e.g. waiting for a bus) plus the length of the journey (he notes that a 20 minute fixed cost at $15 per hour translates into a US$2,400 p.a. cost). A 40 minute commute by car to/from the city centre by urban fringe dwellers is therefore not large in comparison. Consequently, there is high demand for desirable properties at city edges, serviced mainly by private cars. Public policy has a role in addressing negative externalities relating to pollution and to congestion, for instance through provision of appropriate public transport, new roads and/or congestion pricing.

[ix] The Committee for Auckland (2006a) finds that Auckland's population density is only slightly less than Sydney's and is considerably higher than Melbourne, Adelaide and Brisbane. Given the successful performance of some of these comparator cities, these figures raise questions for the future urban form of Auckland, the case for intensification, and the implications of these issues for transport design.

[x] In this respect, it may be important that 90% of the growth in New Zealand's finance sector has occurred in Auckland over the four years to 2006 (Committee for Auckland, 2006a).

[xi] Allen Consulting Group and Infometrics (2004).

[xii] See Figure 2.7, page 12, of the Allen Report.

[xiii] Transit New Zealand: *Travel Time Indicator Report – November 2005* (released 9 June 2006).

[xiv] Public transport here includes buses, trains and ferries.

[xv] MED provided seed funding to encourage both the Paling et al and Motu studies.

[xvi] Extensions to the programme could include analyses at a regional level; for instance, a measure of the costs to the Gisborne/Poverty Bay economy of the poor transport links to that region.