



economics

Paper to:

Key Stakeholders

**PASSENGER TRANSPORT AND LAND VALUES:
DRIVERS AND LINKAGES LITERATURE REVIEW**

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July 2010

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Passenger Transport and Land Values: Drivers and Linkages Literature Review

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1 Executive Summary

This literature review has been prepared by BERL for key stakeholders, as part of a broader project being completed with Opus Central Laboratories for the Foundation for Research, Science and Technology (FoRST). The FoRST-funded project tackles the question of how to take advantage of transport-related urban form changes to maximise settlement liveability and economic gain.

The literature review aims to build an understanding from the existing body of knowledge on the economics of public transport use, land values and urban form. The review addresses the following three questions.

1. What drives passenger (predominantly public) transport use?
2. What drives land values?
3. What links are there between passenger transport use and land values?

This report documents the evidence base, giving an overview of the literature's findings and some of its limits, and outlines the insights we draw from the literature. It acts as a supporting document for BERL's quantitative studies of the links between public transport and urban form, and between land values and urban form.

1.1 *Passenger transport use drivers*

Passenger transport use depends on system design and service quality factors under the control of providers, psychological factors and price.

1.1.1 *General demand drivers*

The literature highlights the following non-price factors of demand, which can be influenced by providers, as being positively related to public transport use:

- accessibility/availability and network linkages to both destinations and other transport modes
- shorter journey time (or higher commuting speed)
- quality and reliability of services
- low cost (price effects are discussed further below)

Additional non-provider factors that affect transport mode choices include psychological drivers such as peoples' habits and safety concerns.

1.1.2 Transport mode choice and demographic factors

The New Zealand Household Travel Survey finds that most people travel by private car or as a passenger in a private car, and that people on lower incomes also tend to make fewer trips overall. Car ownership is found to have a negative effect on public transport use in a number of surveys and pieces of research.

Passenger transport patronage in New Zealand is low, at approximately 3.6 percent. In terms of passenger transport modal choices, bus use is higher:

- amongst younger age groups
- amongst females than males aged 5-14 years and amongst males than females aged 15-29 years.
- In rural areas (versus alternative passenger transport modes)
- on weekends.

Train use is higher in major urban areas, which likely reflects its relative availability and accessibility.

Transit oriented developments (TODs) have positive effects on passenger transport use, especially for overseas-born residents with a custom of public transport use and demographic groups such as childless couples and “empty-nesters”, which represent “ready-made consumer markets for housing situated near transit nodes”.

1.1.3 Transport prices

The literature describes price as one of the key factors of demand that affect peoples’ use of passenger transport. Shocks such as gasoline price increases induce a shift from private transport to public transport. This response varies, though, according to the availability and accessibility of public transport, and may reflect that people view the shock as temporary so only travellers on the margin of swapping do so.

Congestion charges, which may be interpreted as long term price shocks, encourage a switch to public transport. But the magnitude of this change depends critically on the capability and quality of public transportation to absorb this extra demand.

1.2 Land value drivers

A general finding from the literature is that land prices are higher in areas with high employment densities. But residential prices per square metre may be lower in developments with very high population densities, such as apartment complexes. As such, land values per person may be higher in low density areas such as suburban areas.

House prices generally respond negatively to real interest rates, expected inflation and unemployment. Unexpected inflation, on the other hand, is associated with house price increases. Residential land values also depend on proximity to facilities, such as schools, and the demographic make-up of an area.

1.2.1 Urban form and land values

There is a substantial literature on urban form and land values, and this is often connected with transport system analyses. BERL has produced a number of reports on urban form and land values in New Zealand, and has investigated how this can support improved public transport systems (BERL 2004a, 2004b, 2007, 2008, Sanderson 2007). Key results include:

- Higher residential density can reduce the value of land per resident and reduce living costs even though the land value per hectare is higher.
- The opportunity for higher productivity and higher incomes rises as urban density rises.
- There are areas in New Zealand where land prices per standard-sized residential section are high, but this is a standard pricing response to higher productivity from that land

1.2.2 Policy effects on land value

Central and local government policies have a substantial effect on the value of land in cities. A particular driver is that urban planning restrictions in New Zealand can cause a shortage of land for development within a city. In turn, this can cause a shortage in the supply of housing, driving up house prices. There is some evidence, however, that the effect of urban limits on land prices is complicated by zoning, use and density regulations, as the main determinant of house prices is the build cost rather than the land cost. Allowing mixed or higher intensity use of land means that imposing an urban limit will affect the value of land less than would otherwise be the case.

There is a body of evidence that shows the value of land within or around a city is mainly affected by the value of residential property. Residential land prices are affected by a set of factors that are complementary to the demand for housing. As such, the value of residential land depends on the factors affecting the demand for housing, including:

- the accessibility or 'connectedness' between residential and commercial areas
- local amenities (including access to public transport)
- the quality of local schools
- the perceived level of crime.

1.3 Links between public transport use and land values

The literature supports the conclusion that there are links between passenger transport and land values. There is a substantial body of literature that supports the conclusion that greater or better quality public transport increases land values. There is limited evidence, however, that higher land values drive public transport use. Therefore, we cannot draw the conclusion that land value and passenger transport are multi-directional.

The literature finds a general positive effect of public transport on residential and commercial land values, although there is some evidence that residential property prices might be depressed immediately around the transport investment or station. This literature also shows that:

- the impact area of the transit system on prices in residential developments seems to be wider than those for commercial developments.
- the impacts are more easily identified for tram and metro investments than for bus investments. Most of the research has concentrated on urban rail systems.
- contextual factors are important, so that similar transport investments will have different impacts depending on the local economic conditions

TODs aim to maximise access to public transport and often incorporate features to encourage transit ridership. TODs tend to attract particular demographic groups, such as couples without children, immigrants and “empty-nesters”. These groups represent “ready-made consumer markets for housing situated near transit nodes”. Successful TODs create accessibility advantages that can be capitalised into higher rents of greater occupancy, which increase the potential value of land used in these developments. For example, TODs can “free-up disposable income by reducing the need for more than one car and reducing driving costs”.

A TOD case study of Bogota found that the land values were positively associated with close proximity to a newly constructed bus rapid transit system. The authors found a positive association between use of the new system and affordable ticket prices, time savings and quality of the service relative to the other systems available. Although the results suggest that these are drivers of public transport use, the authors caution against interpreting their results as definitively proving a causal relationship.

However, there is New Zealand evidence that the dominance of private transport means that rural land is relatively accessible, and growing residential demand puts pressure on rural land prices. The dominant type of transport and its supporting infrastructure affects the ‘connectedness’ between a city’s or town’s centre and where people are willing to live. This

dynamic can influence the pattern of growth and the area's urban form over time. For example, the significant reliance on car-based travel in New Zealand makes town centres readily accessible from rural areas. As a result, rural land is converted into residential land over time as growth increases the demand for housing.

The literature reviewed suggests that there can be benefits from investing in public transport links between areas with high residential and commercial value. That is, land values may be associated with the increased development of public transport systems. However, land value appears to have a secondary or indirect effect on public transport use. In other words, the activities on the land are the primary drivers of land value and public transport use.

There is some analysis on the market size required to make various public transport systems economically viable. BERL's 2007 analysis of the economic impact of the Auckland Manukau Eastern Transport Initiative (AMETI) project suggests that the planned transport infrastructure and urban developments could generate high value, high density land uses. In turn, this higher density would attract resident and working populations that would represent a market for public transport.

1.4 Gaps and weaknesses in the literature reviewed

The literature focuses more on public transport (bus and rail) than on the broader area of passenger transport, which includes private passenger transport, such as taxis. We identified a moderate evidence base on the demographic factors related to public transport use, but most research focuses more on overall travel behaviour.

Access to quality public transport systems has an amenity value for residential purposes, connectivity value for commercial purposes and an accessibility and agglomeration value for industrial purposes that lifts the value of proximate land. To the extent that higher value land is involved with such economic activity, higher land values may be associated with greater investment in public transport, in order to serve those purposes.

The literature tends to focus on the connections between residential areas, commercial activity and travel to work. We found little literature that specifically examined how commercial versus industrial uses affects the pattern of public transport use.

There does not appear to be a separate literature exploring how high value land might influence the design, enhancement or expansion of transport infrastructure, and in particular the supply and use of public transport. Rather, such considerations tend to be subsumed into the sub-literatures that examine land management interventions and policies, and urban and transit oriented developments.

2 Introduction

This literature review summarises the international and New Zealand literature on the drivers of passenger transport uptake, urban land value and the links between them.

The aim of this literature review was to answer the following three questions by assessing the readily available literature:

4. What drives passenger (predominantly public) transport use?
5. What drives land values?
6. What links are there between passenger transport use and land values?

The report is organised as follows.

Section 3 describes the method used for the research. The research was carried out in five steps, which fell into the three broader stages of search, assessment and analysis.

Sections 4, 5 and 6 describe the literature that addresses the review's three research questions. Each section is organised according to the themes we identified in the literature. These draw out the information required and provide an evidence base with which to answer the review's questions. The review does not aim to provide a detailed summary or methodological analysis of each publication.

We provide a bibliography of the cited publications at the end of the report.

3 Approach

This section describes the method used for the research. The research involved five steps that fall into the three broader stages of search, assessment and analysis. The first two steps involved designing the search parameters and searching for relevant publications. The next two steps assessed the initial search results for relevance, reviewed and summarised the relevant publications and identified overarching themes in the literature. The analysis was framed in terms of the themes, and described the characteristics and key findings of in the literature. The final step involved synthesising the evidence base, and providing our interpretation and insights of the evidence.

3.1 Search

BERL designed search parameters that would target the relevant set of literature. The search criteria aimed to identify literature with content relating to passenger transport, land value and linkages between these two topics.

Table 3.1 Search criteria

Topic type	This criterion required a focus on the demand factors for passenger transport and land value
Search terms	Specific search terms were: passenger transport, public transport, land value, <i>and</i> demand factors, drivers, incentives, demographics, urban form, access, mobility, industry, and resource prices.

The search criteria included practical limits. The search was restricted to literature published in English since 2005. Older, commonly referenced publications and publications that met the keyword criteria identified in relevant publications were also permitted.

The second step was to implement the search guided by these criteria and parameters. The initial search was wide-ranging and used internet search engines, internet-based bibliographic indices and relevant content published by organisations such as the New Zealand Transport Agency, and local and international academic research units.

The bibliographies of relevant work were cross-checked in a supplementary search. The supplementary search aimed to improve the capture of the most relevant literature while minimising time spent on filtering literature that is not directly relevant to this project.

3.2 Assessment

In the third step the research team filtered the results from step two to identify publications that were most relevant to the review's focus. The relevant publications were summarised and themes in the literature were identified.

A framework was designed to assess the content of each publication. Each publication was examined for information identifying:

- the key factors affecting passenger transport use or land values;
- the nature of the relationship between these factors and the two topics; and,
- the linkages between passenger transport and land value.

3.3 Analysis and synthesis

The next step involved analysing the relevant publications to identify key results and to summarise these findings into an evidence base. This step involved describing the characteristics of the literature and identifying the main findings. The final step synthesised the findings according to the research themes upon which we based our insights into the questions posed for this review.

3.4 Search statistics

Of the literature identified in the initial search:

- half was published in the last five years (2006-2010)
- one third was published between 2001 and 2005
- the remainder was published before 2000.

Much of the analytical and empirical research comes from the United States and Canada. This literature includes a range of techniques, including more sophisticated hedonic pricing¹ analyses, plus a range of case studies on major transit oriented developments.

We also identified a substantial number of New Zealand publications, which reflects the searches of specific local agencies and BERL's research history. The evidence from the UK and Europe, although smaller in volume, includes individual case studies and comprehensive reviews.

¹ Hedonic pricing methods are commonly applied in real estate economics, where it is difficult to estimate a generic demand as property characteristics differ substantially. This approach is based on the assumption that people value the characteristics of a good, or the services it provides, rather than the good itself. Thus, prices will reflect the value of a set of characteristics, including environmental characteristics such as access to public transport, that people consider important when purchasing the good.

4 Passenger Transport

This section examines three themes that appear in the passenger transport literature.²

These are: the general demand factors that affect passenger transport; a specific focus on how price affects passenger transport; and demographic factors. The section also considers what gaps or weaknesses there are in the literature that has been reviewed.

There is also a substantial literature linking passenger transport and land values. This is reviewed separately in section 6.1.

4.1 *General demand factors affecting passenger transport*

A substantial body of literature frames the drivers of passenger transport use in economic terms and focuses on the factors of demand. This section reviews the factors that affect the demand for passenger transport and what effect – positive or negative – that they have on that demand. Nearly all the publications reviewed deal with the demand factors that affect public transport, rather than the more general passenger transport area.

4.1.1 *Provider-influenced factors*

The most important demand factors affecting the use of passenger transport are those factors that are directly controlled by the passenger transport provider. These include:

- the key factor of price, which we specifically focus on in the next section;
- accessibility of the transport service;
- quality of the service; and
- reliability of the service.

These last two factors will be explained in more detail when we review the articles below.

Paulley et al (2006) reports their findings from a collaborative study undertaken to provide guidance on the factors affecting the demand for public transport in the United Kingdom (UK). Their study gives what they view as the most significant factors impacting the demand for public transport in the UK, which are the price of public transport and the quality of the service. The dimensions of service quality vary across articles. The most important dimensions in this study for quality of service are: access to stations, service frequency, in vehicle travel time, information provision and the characteristics of the rolling stock.

² The terms 'passenger transport' and 'public transport' refer to distinct concepts. The former covers both private and public passenger transport services. Public services, for example, relate to scheduled services on fixed routes, while private is vehicles that provide ad hoc services at the riders desire, such as taxi cabs. We make this distinction clear where it is important.

Paulley et al's (2006) study, through calculation of elasticities of these demand factors, can confirm that higher prices for public transport will tend to decrease demand and that as improvements are made in the dimensions of quality of the service, demand will tend to increase.

Paulley et al (2006) also find that income and car ownership levels will have an impact on the demand for public transport in the UK. This study has found that the effect of higher income was to increase the number of trips undertaken. In addition, it was found that because income is a key determinant of car ownership, as income increased, the number of trips increased and these trips had to be split between public transport and car travel, if the person had a high enough income to own a car.

The Currie and Wallis (2008) paper looks at measures which are most likely to grow bus patronage and how cost-effective these measures are. This paper identifies the three biggest measures that affect demand for bus transport as: the fares charged for public bus use; the frequency of bus services provided; and the reliability of the bus service. Reliability of the bus service is defined as how likely the bus service is to arrive at the time it is scheduled to arrive. These three key measures are the same as the factors reported by Paulley et al (2006) with the addition of the service reliability measure.

Currie and Wallis (2008) also identifies a small number of soft measures that can have small effects on the demand. These are the comfort, security and cleanliness of the bus. Improvement in any of these six identified measures can lead to higher usage of bus transport according to the findings of the authors. This paper finds that if money was no object for the provider, significant improvements in these measures that would result in large increases in patronage of buses could be easily achieved, for example halving the fares or doubling the number of services run.

These first two articles dealt with what are seen as the most important demand factors, which are directly controlled by the passenger transport provider. Other articles expanded upon this to look at the demand factors for transport in general, including those demand factors outside of the passenger transport provider's control.

Smith et al (2009) focus on the costs and benefits in New Zealand of different transport modes. These different modes are private car; public transport (buses, rail and taxis); and active travel modes (walking and cycling). This paper highlights factors that affect the demand and supply side of transportation in general, not just public transportation or private car travel. The demand factors include the distance to be travelled; time available for the travel; income and economic conditions; and individual tastes of the consumer. While Smith et al (2009) mention what these demand factors are and indicate that these will have an

impact on the type of mode chosen by the general public to be used to travel between their destinations, there is little evidence provided to support these statements. Smith et al (2009) cover evidence on the supply side of transportation, rather than the demand side. As such this paper will also be of benefit for determining the supply side factors affecting passenger transport.

4.1.2 Additional factors

The articles reviewed above chiefly focus factors of demand that are to some extent controllable by the providers of the public transport.

Goodwin (2008) looks at factors that are often outside the control of public transport providers, yet impact on peoples' demand for passenger transport. The report looks at the travel behaviour of people and what interventions are available to influence these behaviours. Goodwin (2008: 2) states that some believe "travel behaviour is sometimes described as 'too difficult to change'". This report challenges that perception by suggesting that there are many different travel behaviours which are influenced by a range of incentives.

This report provides details some key incentives that influence each such travel behaviour. In addition to the provider-influenced incentives, such as quick journey time, low cost and good reliability, Goodwin (2008) covers psychological incentives such as peoples' habits, safety concerns and perceived service quality (which is influenced by providers to some extent). These factors also play a role in the choice of transport mode.

While psychological incentives affect peoples' demand, they are also much harder to quantify than to economic incentives. Goodwin (2008) indicates that peoples' travel decisions are multidimensional, and include passenger transport; volume and location of their travel; other modes of travel (walking, cycling, etc); vehicle use; level of car ownership; and where to live, work and shop.

Bamberg et al (2007) analyse the role of personal norms in people's decision to use public transportation rather than cars for everyday trips. Two field studies were conducted in Frankfurt and Bochum/Dortmund. Participants were asked about their knowledge of environmental problems and their intentions to use and past usage of public transportation. The field studies found a statistically significant relationship between personal norms and actual public transport use, although the association is an indirect one entirely mediated by public transport use intention.

Carrus et al (2007) assess the role of emotions, past behaviour/habits and desire in the prediction of ecological behavioural intentions such as using public transport. They aim to see if anticipated emotions, frequency of past behaviour, attitudes, subjective norms and

perceived behavioural control predict the desire of people to perform ecological behaviours. The studies were conducted in Rome and Salerno. The results clearly point to the role of emotions and past behaviour in the prediction of public transport use. Positive and negative anticipated emotions were found to be significant predictors of the desire to use public transportation instead of a private car to go to work. The frequency of past behaviour was the best predictor of current desire.

Stradling et al (2007) examined what bus users disliked and liked about travelling by bus in Edinburgh, Scotland, with the aim of characterising the urban bus journey experience and the dimensions of bus service acceptability. They find that safety is the top source of dissatisfaction for these Edinburgh bus users. Safety was followed by a preference for walking/cycling and then by service provision.

4.2 Price and passenger transport demand

Below we consider the literature focusing on the price of passenger transport and its alternatives as an important demand factor.

The literature describes price as one of the key factors of demand that affect peoples' use of passenger transport. The clearest way of seeing the effect price can have on the transport choice of the general public is to look at price shocks.

A price shock is described as an unexpected or unpredicted price change. It should also be noted that there is a significant body of literature that remarks on the elasticity of prices in regard to transportation both public and private (e.g. Hensher and Bullock 1979, Voith 1991, Holmgren 2007).

The first shock reviewed is the effect of a surge in the price of gasoline in the United States. Lane (2010) has looked at the gasoline price shocks which occurred between August 2005 and July 2008 and the effect they have had on public transport in nine major US cities. The results show us that, as expected, there was increased use of public transport directly resulting from the higher gasoline prices. The size of the increase varied across the cities, reflecting the different public transport situations in each city. The results suggest that those most likely to switch from using cars to public transport are those already close to choosing to use public transport due to their economic conditions or who live close to available services. In other words, those people who would find it the easiest to swap transport modes in the short term are the ones swapping from cars to public transport; this is because such price shocks are viewed as temporary.

Lane's (2010) results also tell us that people who shifted to public transport moved to the public transport mode that provided the greatest level of service to the city. This study and

other similar studies (e.g. Sagner 1974, Navin 1974, Nizlek and Duckstein 1974, Keyes 1982; Horowitz 1982) only look at price spikes that occur over a short period of time. Because people see the price rise as temporary, they are more likely to resist changing transport modes. In other words, because the price rises are short-term, people are reacting as expected to these price rises. “However, high gasoline costs for the long term could lead to significant shifts in the market supply of housing, workplace, and transport options” (Lane 2010 p: 224).

Price shocks such as described in Lane (2010) are not the only way prices or costs associated with other forms of transport can affect the demand for public transport.

Jansson (2008) looks at the congestion charge systems that have been set up in Stockholm and London, what problems have been encountered by these congestion systems, and what lessons can be learnt from these problems. The congestion charges aim to ease congestion in the central cities and are levied on non-public transport modes. This paper finds that after the congestion charge was introduced in London, the majority of the displaced car drivers turned to buses rather than trains. The lessons for public transport, according to this paper, are that improving both the capability and quality of public transportation is a necessary condition for any congestion reduction scheme to succeed. This paper also tells us that public transport is going to play an important role in fixing congestion problems in cities and suggests a zero-fare policy for central city-bound public transport, though Jansson does acknowledge that while it might make economic sense, it does not make financial sense.

4.3 Demographic factors that affect passenger transport demand

We located a moderate evidence base on the wider set of demographic factors that might be expected to affect the demand for passenger transport. Most of the literature focuses more generally on overall household travel patterns. We begin with an overview of mode choice patterns in New Zealand.

Abley et al (2008) report on the New Zealand Household Travel Survey. The main findings from the New Zealand survey are listed below.

- The most common travel mode (55 percent of trip legs) for respondents was as a vehicle driver. When vehicle passengers are added in, the percentage of trip legs taken per person per day by motor vehicle rises to 80 percent.
- People whose main means of travel is as a vehicle driver make more trip legs and travel longer distances each year, compared to people who mainly travel by other means.
- People with lower incomes (between \$10,000 and \$15,000) make fewer trips than those with larger incomes.

The survey found that around 3.6 percent of New Zealanders used passenger transport in 2005 (with a peak of 8 percent for 10-14 year old females). Some other key findings were:

- bus use is higher in rural areas than in major or secondary urban areas (2.9 percent of trip legs versus 2.4 percent and 0.8 percent).
- train use is higher in major urban areas than in secondary urban or rural areas (0.3 percent of trip legs versus 0.1 percent in the latter two areas).
- bus use was highest amongst younger age groups (5-24 year olds).
- bus use tended to be higher amongst young women than young men age groups (10-24 year olds), but the overall pattern by gender was similar.
- more trip legs are taken by bus, on foot or by cycle on weekdays than at weekends.

Further investigation of the survey by O'Fallon and Sullivan (2009) shows that older people (65+) travel distinctively less than the younger adult population (aged 25–59). This finding is consistent across the total or mean number of trip segments per day, the typical distance per trip segment, average distance per day using 'surface transport' or average distance driven per day.

Abley et al's report also includes a review of other national travel surveys. The top three reasons for travelling by public transport according to a 2005 household travel survey done in New South Wales, Australia were:

- It avoids parking problems (48%).
- Some public transport users do not have a car (25%).
- Public transport is cheaper than private transport (24%).

They also report that those who travel to work by private transport do so because:

- they feel that their vehicle is faster (48%),
- public transport is unavailable/inaccessible (33%) and
- public transport is problematic (26%).

Cervero et al (2002) examines a range of demographic factors that have worked in favour of transit oriented developments (TODs). TODs attract "groups that form ready-made consumer markets for housing situated near transit nodes". These demographic groups include:

- increasing shares of couples without children
- influxes of foreign immigrants (many of whom come from countries with a heritage of transit-oriented living)
- growing numbers of "emptynesters" seeking to downsize their living quarters.

4.4 Gaps in the literature

The literature review also sought to identify what has not been covered or has not been covered well in the literature.

The literature focuses more on public transport (bus and rail), than on the broader area of passenger transport, which includes private passenger transport, such as taxis. The public transport literature available in New Zealand and internationally, however, provides a wealth of information on the demand factors related to quality and price.

We identified a moderate evidence base on the demographic factors related to public transport use. Most of this information came from more generalised travel or passenger transport surveys.

5 Land Value

This section of the review focuses on urban land value literature. We divide the land value literature into three main themes. These are: urban form; the effects of policy on land value; and, the demand factors for land. Finally, we consider the gaps or weaknesses in the literature that has been reviewed.

5.1 *Urban form and land value*

BERL has done a significant amount of work exploring urban form and land values in New Zealand, which we review below. We complement this review, in section 6.1.1, with an overview of the literature on the links between urban development, transport systems and land values.

BERL (2004a, 2004b) examine the economic and strategic importance of Auckland's Eastern Transport Corridor, and make a case for investment in this transport infrastructure. BERL (2004a) provides a brief review of the cost benefit analysis on the Auckland City Council Eastern Transport Corridor Project. BERL (2004b) shows the effect on large scale investment in transport infrastructure may have on the urban form of the city and the urban density of the area.

This series of work provides a backdrop to Kel Sanderson's (2007) statement of evidence to the ARC. It concludes that a more compact and higher density city will result in a regional economy that is more productive and where housing is more affordable. This conclusion reflects that with higher residential density, the land value per resident is lower even though the land value per hectare is higher. It also states that as urban density rises, so does the opportunity for higher productivity – associated with accessibility, network and agglomeration benefits – and higher incomes.

BERL (2008) examines the role of resource pricing in the allocation of urban land. This report finds that there are areas in New Zealand where land prices per standard-sized residential section are high, but that this is a standard pricing response to higher productivity from that land. The report also finds that in these high priced areas the land price per resident is reduced and opportunities are more available to increase household income and reduce living costs.

5.2 *Policy effects on land value*

After reviewing the literature on what affects the value of land in cities, it seems that one of the biggest factors is the policy interventions that have been used by local and regional

authorities. Below we gauge why this is the case and how these policy interventions affect the value of the land within the city.

Grimes (2007) looks at the effects the supply of housing has on the cost of housing in New Zealand in general, though there is a focus on Auckland. This paper tells us what we would expect: that the supply of housing and the price of housing are inextricably inter-related. Grimes (2007) argues that in New Zealand the main cause of any shortage in the supply of housing for a city's housing market is caused by a shortage in the supply of land.

In the case of Auckland, Grimes (2007) argues that a policy intervention which fixes the outer limit of Auckland (the Metropolitan Urban Limit (MUL)) is contributing to the higher housing prices caused by a shortage in the supply of housing. In addition, Grimes (2007) summarises some of the other policy interventions that can cause problems with the supply of land. These include general restrictions on housing supplies caused by zoning practises of councils, and consent processes required by councils to develop new housing.

Ascari (2007) looks at the factors affecting just the Auckland land and house prices and whether this is caused by the Auckland Regional Council establishing the MUL. The MUL places an absolute limit on the size of the city of Auckland, stopping it expanding past this boundary. This report highlights some of the factors around policy interventions of local and regional councils and how these can affect land and house prices in cities. This report finds that it is the prices of the dwelling or building rather than the land cost which ultimately determines the cost, and that allowing mixed use or higher intensity use of land will show us that imposing a limit on land affects the value of land by less than would otherwise be the case. The MUL policy is restricting the supply of land, thus forcing more intensification of housing and buildings to mitigate the effect of the MUL.

The finding of this report by Ascari (2007) somewhat contradicts the findings from the Grimes (2007) articles. While both agree that there may be some increase in the value of the land within Auckland caused by the introduction of the MUL. The authors have different ideas on the magnitude of the increase. Ascari (2007) tells us that by limiting the amount of land we will see intensification of land use, which will mitigate some of the land value increase, while Grimes (2007) tells us that the MUL will see a significant increase in the value of land within Auckland. What this tells us is that policy intervention can indeed affect the value of land and that it can have quite a large effect although there is debate on the extent of that impact.

5.3 Factors of demand for land

The demand factors we looked at included any factors that affect peoples' demand for land, both commercial and private, and what effect they have on that demand, either positive or

negative. Numerous other papers and articles found links between demand factors for passenger transport and land values. These are examined separately in section 6.1.

Fundamentally, urban land price is determined by the market mechanism consistent with resource pricing theory (BERL, 2008). For urban land we propose that there are two main influences on land prices, commercial (including industrial) demand, and residential demand. The drivers of commercial land relate to the physical product that can be generated from a given piece of land by profit-maximising firms. The same basic principles apply to residential land, except that the output from the land is in 'utility', or the benefit that residents receive.

Gibbons and Machin (2008) have looked at the factors affecting the demand side of house and land prices. In particular, they have looked at the effect that the quality of local schools; the perceived level of crime; and the local amenities (including access to public transport) in an area have on the value of the land and housing.

Clapp et al (2007) examines the effect of school district performance and student socio-economic and demographic composition on local property values. This paper uses hedonic modelling to find that there is a statistically significant effect of school district performance on property values. A one standard deviation increase in performance lead to one and a third percent increase in property values. However, changes in demographic attributes, particularly the percent of Hispanic students, were more important drivers of house prices.

Clapp et al (1994) examines the relationship of between house prices and a range of economic variables. The paper shows that housing prices respond negatively to real interest rates, expected inflation and unemployment. Unexpected inflation, on the other hand, increases house prices.

Hall and Marshall (2000, referenced in RICS 2002) analyse the impact of transport on land use/development and note that contextual factors such as the general economic situation and regulatory context are important. These are likely to important considerations in general for developers, and which would affect the demand, and price, of land for development. Particular contextual factors found to be relevant included:

- Complementary zoning;
- Taxation policies;
- Availability of land (appropriately assembled); and
- A 'hospitable' setting.

5.4 *Gaps in the literature*

The literature on land value tends to focus on the connections between residential areas, commercial activity and travel to work. We found little literature that specifically examined whether public transport use was higher for commercial/CBD areas versus industrial areas.³ Ryan's (2005) analysis of over 1,000 office and industrial properties in San Diego found that access to highways was positively associated with office property rents, but access to light rail systems was not significant. Despite the potential accessibility and agglomeration benefits, there was no evidence that industrial firms in the San Diego area paid rent premiums to locate near either highways or light rail transit.

It is possible that the design and usage patterns of road, rail (and potentially) sea infrastructure for industrial uses is not conducive to public transport. For example, freight train schedules may conflict with the regularity of passenger train services. Similarly road infrastructure designed to meet industrial needs may reduce congestion and improve accessibility, thereby encouraging private car use.

³ Kawamura (2001) provides an empirical analysis of firm location and proximities to freeway ramps and transit stations. The findings suggest firms in the urban core areas value access to rail stations to a greater degree, whereas those in the suburbs are placing more importance on proximity to freeway ramps. However, the data set for this study is too limited to provide an analysis by industry type.

6 Links between passenger transport and land value

This section considers the linkages between the drivers of passenger transport and land values. We reviewed the literature to see:

- if and how these two areas are linked.
- whether there is any indication as to causality within an identified relationship.

6.1 *What are the links between passenger transport and land value?*

A broad ranging and detailed literature review by RICS (2002) finds a general positive effect of public transport on residential and commercial land values, but a weak or negative effect for industrial land. There is some evidence that residential property prices might be depressed immediately around the transport investment or station. This review also shows that:

- the impact area of the transit system on prices in residential developments seems to be wider than those for commercial developments.
- the impacts are more easily identified for tram and metro investments than for bus investments. Most of the research has concentrated on urban rail systems.
- contextual factors are important, so that similar transport investments will have different impacts depending on the local economic conditions

Dravitzki (2007) studied the implications for strategic planning of cities and their effect on the urban form of a city. His study shows how over the past century or so the level of transportation technology available, including public transport technology, has affected how cities grow, and thus the value of the land within and around cities. As the technology has improved, people have been able to live further from the city centre. For example when electric trams were the latest travel technology, people were able to effectively travel around 10kms into the city centre with cars people can now effectively travel around 60kms into the city centre. This additional range allows cities to expand out large distances from the city centres.

The ability of cities to grow has affected the value of land within or around a city. Dravitzki (2007) indicates that it mainly does this through residential property. Dravitzki finds that the forms of our current cities in New Zealand are dominated by car-based travel. With people now able to live further from the town centre and still able to travel there relatively quickly, rural land is bought and turned into housing. The report goes on to argue that the dominant

type of transport in the future will define the form of cities. In this way; the transport infrastructure influences the demand for land.

Winston et al (2006) consider how contemporary urban form affects the economics of public rail transport. They suggest that new patterns of urban development in the United States with geographically dispersed residences and employment sites means that rail tends to fail attract sufficient patronage to make it economic. They note that the Bay Area Rapid Transit⁴ (BART) system in San Francisco is an exception to this finding.

Karp (2008) finds that new or upgraded public transport infrastructure will generally cause an increase in land value in the proposed areas. Karp (2008) also informs us about his findings that new public transport hubs can greatly encourage higher density housing at their location, using the example of new light rail stations in Pasadena that provide transportation from Pasadena to Los Angeles. Karp (2008) lastly discusses how many US cities are starting to look at building multi-residential and retail complexes at or next to transit stations, using the example of a new 449-unit apartment building with 36,000 square feet of retail space atop a subway station in central Los Angeles, opened in 2007.

Munoz-Raskin (2010) presents us with a case study of Bogota, where the value of residential property within walking distance around the newly constructed bus rapid transit system is examined. The findings of the case study are that the residents living in middle-income housing positively valued living within close proximity of the new system. It was concluded that this was because affordable ticket prices, time savings and quality of the service made it highly attractive relative to current systems. However, although the results suggestive that these are drivers of public transport use, the authors caution against interpreting their results as definitively proving a causal relationship.

For lower income residents of Bogota, the effects of the new bus rapid transit system were the opposite in that property values near the new system did not rise. This is seen to be caused by the fact that the new system is not as affordable and so other forms of public transport are used by lower income residents even though they are slower and lower quality.

Ascari (2010) highlights the economic benefits from better accessibility to public transport systems and the relationship between better access and property values. This paper provides us with empirical evidence that proves that there is a positive link between improved accessibility to a public transport system and the increased value of property. This report uses evidence taken from case studies undertaken in North America and the United Kingdom as well as New Zealand to determine this link.

⁴ An evaluation of BART is reviewed on page 23.

Banister and Thurstain-Goodwin (2005) discusses the local level impact of non-transport benefits of transport investments on the property markets. The key findings for us are the conclusions around the fact that there are increases in property values caused by transport investments.

Diaz (1999) tells us about the positive impacts on the property values due to rail investment in the US, as well as what the potential negative impacts are from such investment. The findings tell us that rail investments make the properties around the rail investment much more attractive for development and therefore this pushes up the value of the property. This paper also tells us that these positive impacts can be improved on by making sure that such rail investments also offer high levels of access to the stations and high speed or express services. The negative impacts of such rail investment are covered though these tend to be factors such as noise and visual intrusion of the rail network on nearby properties.

Keall et al (2009) looked at New Zealand travel survey data according to city size. Their analysis shows a reduction in children's walking and cycling, and this is greatest in the bigger cities, but no such reduction in small towns and rural areas. They hypothesise that these results are associated with changes in the urban form of the larger cities over the time period studied, but do not test this hypothesis in this piece of research.

6.1.1 Transit oriented developments

A subset of literature considers how urban developments can be shaped around, and successfully integrated with, transport systems. This subset of literature focuses on urban form and transport systems, but does not explore the effect of TODs on public transport use and real estate values, and how they are linked.

These developments include, for example, the planned community of Orenco in Portland, Oregon, which has been formed around a light rail station in Hillsboro (Arrington 2000). This initiative has also developed a 'pedestrian environment factor' to capture the complex relationship between individual influences, such as pedestrian accessibility and traffic volume, on overall transit behaviour.

A 20 year follow-up evaluation of the San Francisco Bay Area Rapid Transit (BART) system found land-use changes associated with BART have been largely localised (Cervero and Landis 1997). Local redevelopment authorities helped leverage the addition of multi-family housing near several suburban stations, by providing various financial incentives and assistance with land assemblage. The evaluation also points to the importance of the availability of vacant and developable land as a predictor of land-use changes near stations.

Cervero et al's (2002) review (see section 4.3) points to the importance of both physical-design principles and human elements for TODs and TJDs to be successful. This success is

measured in terms of both the commercial and residential success of the development as well as supporting or increasing transit system patronage. The physical-design principles involve some combination of:

- intensifying commercial development around stations
- inter-mixing land uses
- layering in public amenities (e.g., civic spaces, landscaping)
- improving the quality of walking and bicycling.

The human elements of successful TODs and TJDs that the review reflects on include:

- personal security
- economic and community development
- cultural history
- building social and human capital
- strengthening the bond between transit and the neighbourhoods it serves.

The review concludes that experience shows that “TODs must be proactively championed by the public sector” to have a chance to succeed. They argue that the evidence shows that public sector encouragement in the form of proactive commitment to development is critical to attracting transit-oriented land uses to cluster around the development.

Although Cervero et al’s (2002) addresses the benefits of TODs, it highlights a number of findings that are relevant to this review. One aspect of a successful TOD is the creation of a valuable urban development and another aspect is a well patronised transport system. It is precisely the drivers of these aspects that we are interested in.

Cervero et al (1991) and Landis et al (1991) argue that “the accessibility advantages of being near a transit station” can be “capitalized into higher rents or greater occupancy”. Some of the advantages that are relevant to this project are that TODs may:

- free-up disposable income by reducing the need for more than one car and reducing driving costs
- consume less land than low-density, auto-oriented growth, it reduces the need to convert farmland and open spaces to development
- add to the supply of affordable housing as housing costs for land, structures and infrastructure can be significantly reduced through more compact growth patterns.

Creating “enhanced real estate development potential or market potential” (Cervero et al. 1991) is likely to support increased land values, although the review does not explicitly draw this conclusion. Furthermore, by designing the transit system to link “activity nodes”, TODs can increase the use of the transit system.

CTOD (2009) analyses predictors for ridership and economic development benefits of rail transit investments. CTOD's analysis shows that transit corridors that link multiple regional destinations and housing opportunities appear critical to achieving promised ridership and economic returns. It points to the accuracy of the location of population and employment growth forecasts as important factors in the success of new transit infrastructure.

Another important consideration they draw out is the alignment of lines to employment districts. They find that the Houston light rail line has the highest passenger density per mile of any new light rail line in the United States and does so by going through the centre of employment districts rather than skirting them. However, a rail alignment such as this can disrupt businesses during construction and may have expensive land acquisition costs.

A third consideration is the range of destinations, such as routine commuting, special events, and universities, and network connectivity with regional destinations such as airports and other modes of travel. It notes that facilities such as stadia, major entertainment venues and airlines located along main rail lines are "special events trip generators", which can generate a surge in public transport demand with appropriate connectivity.

CTOD also notes that, although they provide little detail, employed people and students may have quite different travel patterns and incentives, with students having "irregular travel patterns and extra incentives to not drive".

The Victoria Transport Policy Institute reports that TODs tends to increase property values by 5 to 15 percent. They suggest that this reflects the direct benefits to residents and businesses of having diverse transportation options, and resulting automobile and parking cost savings (Diaz 1999; Weinberger 2001; RICS 2002). Smith and Gihring (2009) suggest that TODs can often be funded through 'value capture' strategies, in which the costs of improvements are paid through the additional tax revenue or a special tax in the affected area.

6.2 *Are these links multi-directional? Or do they go in one direction?*

The literature supports the conclusion that there are links between passenger transport and land values.

We begin by noting that there is limited evidence that the links between land value and passenger transport are multi-directional. A report by BERL in 2007 investigates the likely economic impact of the Auckland Manukau Eastern Transport Initiative (AMETI) project on Auckland's transport and urban development, and examined the household and employment densities required to make various public transport systems economically viable. The report concludes that the creation of strong town centres and mixed use development can internalise some of the land use and economic development externalities that are generated

by the transport and transit infrastructure investments. High value, high density land uses would provide resident and working populations that represent a market for public transport.

This result is mirrored in Glaeser et al's (2008) paper on why the poor tend to live in dense, inner city areas. The paper argues that public transportation is a more economic choice than cars, and as such the proximity to public transportation predicts the location of the poor within a city. However, as public transportation relies on high densities, it can be associated with the urbanisation of the poor. An implication of Glaeser et al's work is that areas with lower land values and lower densities lack the market size to support public transport.

There is a substantial body of literature which supports the conclusion that there is a link going from public transport to land value, and the link is positive. This means that improvements in the public transport system increase the value of the land near the improved system.

Some studies have examined the relationship between urban density and vehicle miles travelled (VMT), although they do not separately consider public transport use. Previous studies have shown weak, negative effects between residential density and VMT (Cervero and Murakami 2010). One explanation for this result may be that "density is treated as a single, all-encompassing predictor or as a proxy for other built-environment variables": Ewing et al (2008), Ewing and Nelson (2008), and Marshall (2008) argue that density serves as a stand-in for smart growth, soaking up the influences of three other 'Ds': diversity (of land uses), designs (which are pedestrian friendly), and destination accessibility.

Ewing and Cervero (2001) find that total household vehicular travel is primarily a function of regional accessibility rather than land use patterns. However, local land-use patterns are the strongest influence for mode choice. Overall trip frequencies depend mainly upon household socio-economic characteristics, and travel demand is inelastic with respect to accessibility and land use. Collectively, however, they find a substantial, negative relationship between VMT and the 4 Ds with an additive elasticity was around -0.3.

Cervero and Murakami (2010) note that a big factor that appears to account for different estimates of the relationship between density and VMTs across studies is the assumed share of future housing stock that is new or redevelopment.

Cervero and Murakami (2010) examine how much urban form and, in particular, urban densities, influence vehicle miles travelled (VMT). They find that the strongest predictors of VMT per capita are population densities, automobile commuting modal shares, and roadway density, followed by household income. The effects of local retail density and accessibility are fairly modest, as is the effect of urban area size. They note, however, that high retail

accessibility and density are likely to induce travel because of greater levels of shopping but also because of factors such as site designs that promote access by private car.

Cervero and Murakami (2010) find that urban railway supply and ridership had weak and indirect effects on VMT, that is, these forms of public transport affect other variables which in turn affected VMT. Other researchers have found stronger effects between public transport and VMT (Bailey et al 2008, Brown et al 2008). Bailey et al (2008), for example, found that public transport in the United States influenced VMT directly, as well as secondarily through land-use effects.

6.3 Gaps in the literature

The literature available in New Zealand as well as internationally provides a wealth of information on the linkages between passenger transport and land value. The focus is more on public transport (bus and rail), then on passenger transport in general, which includes taxis as well.

The literature also provides us with a good evidence base on the the links from public transport to urban land value. We are confident that the literature from New Zealand and overseas provides a solid foundation on which to build.

The literature reviewed suggests that land values may potentially be a driver of public transport systems. That is, investing in public transport links between areas with high residential, commercial, or industrial values may be beneficial. However, investments in a public transport infrastructure tend to have 'external benefits' that cannot be commercialised by private operators without some form of public intervention. It is possible that this distortion leads to underinvestment in public transport infrastructure in private market settings that are not supported by public policy.

We believe that this insight explains the lack of a separate literature exploring how high value land might influence the transport infrastructure and in particular the supply and use of public transport. Rather, such considerations tend to be subsumed into the sub-literatures that examine land management policies and initiatives, and urban development.

BERL's (2007) findings are consistent with the subset of literature on transport oriented developments. Thus, although we find that passenger transport affects land value, there is a thinner evidence base that land value, as a factor in and of itself, affects passenger transport.

The evidence suggests that increased urban density can lift land values and this is associated with better public transport systems and public transport use. However, the

literature indicates development planning and public sector support are critical to this relationship. Thus, it appears that a sophisticated understanding of the drivers of land value increases is required to understand the knock-on effect to the provision and use of public transport.

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