Transport interventions – towards value for money over time

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1 Background

This paper reports on a survey, conducted in the first half of 2009, of the international literature on transport policy and strategy. The survey is the first stage of a more extensive study aimed at informing transport strategy in New Zealand.

The context for transport strategy in New Zealand has changed rapidly in the last year. First, the international recession means that, for at least the next five years, public spending will be much more constrained than in the preceding period. Second, the current administration has set priorities for transport which differ markedly from those of the previous regime.

The government's priority is for land transport investment to support national economic growth and productivity. The GPS will ensure the use of land transport funding does so by directing investment into high quality infrastructure projects and transport services that encourage the efficient movement of freight and people. Of particular importance to this priority are:

- *investing in the State highway network, as a key to the efficient movement of freight and people*
- *generating better value for money from the government's investment across all land transport activity classes and enhancing the economic efficiency of individual projects.*

(Government Policy Statement on Land Transport Funding 2009/10 – 2018/19, May 2009.)

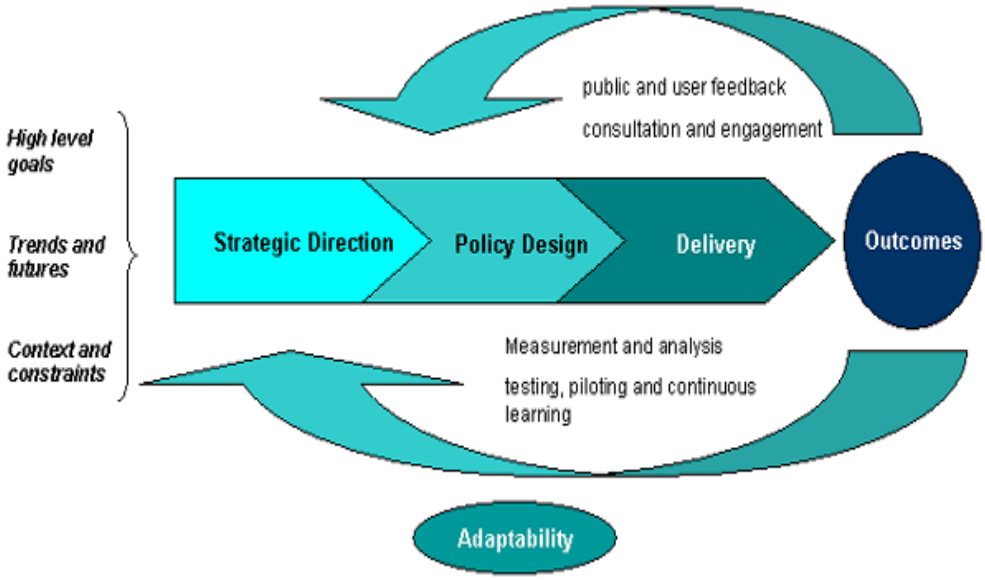
1.1 Introduction

This study centres on one of the core questions facing transport policy makers, within the overarching theme of 'value for money' in government. Broadly, how should policy reflect the government's objectives of using transport infrastructure spending to stimulate economic activity in the next few years, while enhancing the contribution of transport to New Zealand's productivity growth in the longer term?

This study explores the proposition that, in designing and prioritising government interventions in transport, it is important to have a coherent intertemporal (and spatial) framework for assessing the aggregate economic impacts of these interventions.

Our overall goal is to contribute to policy thinking at a strategic level but also to make appropriate connections between those high-level principles and approaches to evaluation at an operational level. So the intention is to inform the evolution of policy design and delivery within a longer-term framework, for example as indicated in the following diagram.

Figure 1: Strategy and policy



Source: Strategy Survival Guide, UK Cabinet Office

Strategy is the overall process of deciding on objectives and processes. **Strategic direction** provides the guiding principles that give context and coherence to action. It describes the desired futures and sets out what needs to be achieved in order to bring it about. Implicitly, the need for strategy arises from the existence of a gap between where we are now and where we should be.

This raises questions about feasible time-frames for closing this gap, or preventing it widening, and hence the quantum of resources required.

Policy provides the means of moving in that direction – and often a number of policies need to work together to deliver particular strategic outcomes. Policy design work is concerned with identifying how to achieve strategic objectives, selecting the most suitable policy instruments for doing this, and detailing how these instruments will work in practice.

1.2 Overview

The central assumption underlying this topic is that a core role of government, through its various policy levers, is to facilitate economic efficiency over time.[1]

The government has had its disposal a portfolio of levers to influence outcomes. Some interventions are quite specific in their objectives (e.g. speed limits are closely targeted to safety improvements), while others such as roading projects may have multiple transport objectives e.g. reductions in congestion, travel times and vehicle wear, as well as safety benefits.

Designing and implementing policies, and building infrastructure, generate benefits for society but also impose major costs. So the ways in which these levers are designed or modified over time, need to be subject to rigorous 'value for money' appraisal.

Most of the study of economics is about the allocation of scarce resources among competing ends i.e. allocative efficiency. But Douglass North (1993) concludes that it is adaptive efficiency, rather than allocative efficiency, which is the key to long-term growth.

At the heart of adaptive efficiency (also referred to as dynamic efficiency) is the impact of product and process innovation by suppliers in the market place. Transport and transport infrastructure can be an important influence on dynamic efficiency in this sense.

Because of the role of transport and transport infrastructure, the spatial aspects of economic efficiency are critical. Local and regional preferences have an inherently vital part in shaping national priorities and there are strong feedback loops (for example through the transport funding process) between national and regional outcomes.

The primary focus of this study is on transport policy; how it influences transport services and broader economic outcomes in New Zealand, and how we should assess 'value for money' from such policies.

To narrow the scope down to some degree we concentrate here on land transport (i.e. road and rail) in New Zealand, rather than on domestic or international maritime or air transport. This is not intended to understate the importance of these transport links, which have an important bearing on New Zealand's economic fortunes. But, in practice, the government here has most influence on domestic transport, and this is where most public resources are concentrated.

We have drawn on the international transport policy literature, on the assumption that many of the challenges in transport and policy options are generic, albeit that New Zealand has its own peculiarities.

The main topics outlined and the sequence followed in this paper are:

- The economic role of transport
- Transport infrastructure
- Spatial effects of transport
- Government and transport in New Zealand
- Evaluation issues.

[1] Economic efficiency may or may not be synonymous with GDP growth. Economic growth is an important objective, but in a 21st Century policy environment, economic development may be a better touchstone, because it encompasses a broader spectrum of societal objectives and constraints (such as environmental effects) than economic growth as such.

2 The Economic Role of Transport

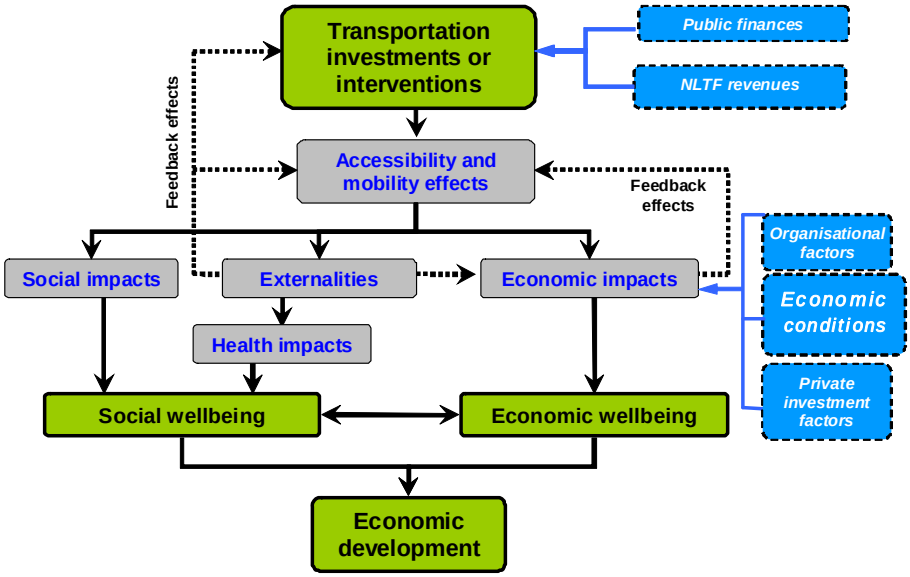
2.1 Overview

The principal role of transport is to facilitate transactions between spatially-separated businesses and households i.e. to enhance accessibility and mobility. And the contribution of transport and transport policy can be measured or observed from various perspectives. These include:

- effects on aggregate economic welfare (i.e. the sum of consumer and producer surplus), which is the focus of cost benefit analysis, as applied to policies or projects
- microeconomic (e.g. enterprise or household) level productivity effects
- macroeconomic (e.g. contributions to GDP, investment or employment), and the spatial patterns of economic activity.

The following chart suggests the broad relationships between funding, transportation interventions, and economic development.

Figure 2: Transport and economic development – key connections



Source: Leung (2006)

As part of economic development, transport infrastructure, by its very nature, has important spatial impacts i.e. on intraregional and interregional transport time and costs, and thus potentially on the location of people and businesses.

Transport services are jointly produced and consumed with transport infrastructure, a major component of the fixed capital of the transport sector.

A distinguishing feature of transportation is that it is valued primarily as an input to many other activities. Firms ship products to distribution centres and retail outlets; businesses send their

employees to meet with customers, suppliers, regulators and co-workers; ordinary people travel to work and for leisure pursuits.

However, the demand for transport cannot be treated simply as derived demand. Increased mobility is a precondition for increased productivity, and growth and improvements in transport may themselves promote growth. The UK Standing Advisory Committee on Trunk Road Assessment (SACTRA)[2] notes various ways in which transport can affect economic growth e.g. through reorganisation and rationalisation of production, distribution and land use, and reducing labour costs by expanding catchment areas.

As discussed later the link between roads and the economy depends crucially on whether firms are primarily consumers of roading services, or whether firms use transportation to change their production processes.[3]

2.2 Demand for transport

Transport demand is characterised by the following three features:

- Transportation encompasses many interrelated decisions such as mode, destination, shipment characteristics, vehicle ownership, residential and industrial location.
- Transportation consists of a large number of distinct services differentiated by location and time. Understanding the spatial and temporal details of these transportation decisions is essential for facility planning and management.
- Travellers and shippers are sensitive to service quality. So demand models must incorporate quality indicators, some of which – travel time, service frequency and route coverage – are readily measurable, whereas others – comfort, crowding, reliability – are somewhat amorphous.

Economic growth implies greater division of labour and spatial specialisation, the development of new technologies requiring transport such as just-in-time, growth in commuting and business travel, and growth in the quantity of goods and services to be transported. At the same time, rising household incomes generate increased demand for travel, for both leisure activities and shopping.

2.3 Production/supply of transport services

The production of all goods and services can be described using the concepts of inputs, outputs, and technology. Inputs have to be acquired by the firm and combined in order to produce and supply outputs. In the case of transport, the firm has to use vehicles, terminals, rights-of-way, energy, labour and so on, to produce movements of freight or passengers, from many different origins to many destinations in various periods and at various frequencies.

The supply of transport services occurs through a combination of providing and using infrastructure across a range of modes. Provision of infrastructure incurs capital costs and covers, for example, roads, railway lines, airports and ports, while usage is made possible through vehicles (e.g. cars,

[2] SACTRA, 1999
[3] Boarnet, 1999, p. 291.

trucks, trains, aeroplanes and boats) and management systems (e.g. traffic lights, signals, air traffic control, navigational aids).

From the traveller's point of view, a key aspect of supply is its price, i.e. the cost of using the transport system. The cost of transport to the user is conventionally discussed in terms of generalised cost, which includes operating costs, fares or tolls paid, incidental costs, such as parking fees, and also the (often sizeable) costs of time involved in making the journey.

The generalised cost of a journey will clearly depend on, among other things, the amount of congestion on the network, and may therefore vary by time of day and location. It can be expected that the demand for transport will be inversely related to its costs as perceived by the users (not always the same as the full costs actually paid).

For business users of transport, deterioration in the supply of transport, leading to a rise in its cost, will tend to raise the price at which they can supply the market. Similarly, an improvement in transport supply, leading to a fall in costs, will tend to lower the price. To the extent that these transport costs are passed on, the impact of changes in the cost of transport is felt by the purchaser of the final goods and services to which transport is an input. Given that different areas have varying transport requirements for the distribution of sales and/or the sourcing of inputs, the level of transport costs can influence the location of economic activity between towns, regions or even countries.

SACTRA (1999) notes that the supply of transport can be altered in a number of ways, including decisions relating to the following:

- investment in, additions to, or improvements in, quality in the infrastructure stock (e.g. new roads or railway lines or rail electrification)
- replacement of existing infrastructure assets (resurfacing a road or renewing railway track)
- reductions in road capacity
- better management of the asset base (clearing breakdowns faster, better management of traffic flows, new services making fuller use of existing infrastructure), and
- changes in money costs (e.g. tolls, parking charges, fuel prices).

2.4 Transport markets

In economics, 'the market' is an abstract concept. It is the interface between supply of, and demand for, a particular good, where the prices and quantities to be bought and sold are determined.

In New Zealand, with the exception of rail services, most freight and passenger services are provided by the private sector, although public subsidies are common for urban bus services.

Transport is characterised by a profusion of markets e.g. in terms of mode, localities, routes, service frequency and cost. For passengers and freight, there are varying degrees of substitutability between transport modes e.g. according to the distance between origin and destination. And a large part of transport activity is transport for own account. This is the case for car passenger transport, and also for a significant part of road haulage and inland waterway transport.

The operating environment in those markets has an important bearing on conduct and performance of the transport sector, and in turn on outcomes such as affordability and safety. The government has a major role in shaping the operating environment, both through its dominant role in infrastructure funding and through regulation and other policy settings.

Transport infrastructure funding and investment is a major part of government's involvement in transport and a major lever applied to transport policy objectives and broader economic objectives. Government, both central and local, is the major funder of transport and other infrastructure, so at the margin all these are competing for political support with all other publicly-funded programmes and projects. This includes social infrastructure such as schools and hospitals.

3 Transport infrastructure

3.1 Overview

There are many possible definitions of infrastructure capital. From an economic standpoint, the term consists of large capital-intensive natural monopolies, such as roads, other transportation facilities, water and sewer lines, and communications systems.[4] One of the debates about infrastructure is whether there is a shortfall or deficit of particular forms of infrastructure, and how this might be determined. Four main ways have been used:[5]

- Engineering assessments of infrastructure needs
- Political measures based on voting outcomes
- Economic measures of rates of return
- Econometric estimates of productivity estimates.

Eddington (2006) reports that there is little consensus about how much, at an aggregate level, should be invested in transport, or what an 'adequate' national transport system looks like.

3.2 Infrastructure as the fixed capital of the transport system

Transport infrastructure is a major component of the fixed capital of the transport system. With the main exception of traditional railway companies, transport firms do not own the fixed capital used in the production process. They acquire transport infrastructure services on a 'pay-as-you-go' basis e.g. in New Zealand through road user charges.

Eddington (2006) reports that, although it is evident from the academic literature that the transport system can impact on the performance of the economy, it is equally evident that this impact will be of different magnitude at different times and in different places.

What is clear, however, is that a 'one-size-fits-all' approach to transport policy – in terms of types of intervention, modal solution or indeed level of expenditure – is not appropriate. Shaped by their

[4] Refer for example NZIER (2004) "Sustainable infrastructure – a policy framework." Report to the Ministry of Economic Development.
[5] Gramlich (1994, p. 1181)

different social, economic, environmental and geographic characteristics, different countries and regions have different transport needs.

The contribution that transport investments make to the rate of economic growth depends on a number of factors. These include:

- the maturity of the economy and the quality of the existing transport network
- the degree to which the transport network is managed efficiently, and
- the presence of other external factors material to productivity and growth.

The physical elements of transport infrastructure projects can vary widely e.g. from new highways to widening of existing roads or changing the height of rail tunnels, to specific design changes e.g. construction of safety barriers. In turn, the effects on the capacity and operation of networks, and on transport benefits, will vary from project to project.

3.3 Transport infrastructure and economic growth

Boarnet (1999, p. 291) states that infrastructure investments, like private investments, provide services and can potentially influence a firm's production process. The link between highways and the economy depends crucially on whether firms are primarily consumers of highway services or whether they use transportation to change their production processes.

- If firms simply use highways to ship their inputs and outputs, then transportation is a cost. Economic benefits from better roads are then strictly user benefits due to reductions in travel costs.
- If transportation changes the nature of the production process, for example by facilitating just-in-time manufacturing, then highways might produce economic benefits beyond the value of user benefits.

Straub (2008) provides a comprehensive review of the literature on the relationship between infrastructure and economic growth. The work reviewed is mainly focused on developing countries but many of the principles referred to apply to higher-income countries such as New Zealand.

This literature breaks the contribution of infrastructure to productivity into direct and indirect channels. The direct effects arise from complementarities between infrastructure and other factors of production. For example, by providing access to certain remote or uncommunicated areas, roads or bridges make private investment possible. Amongst the indirect channels are:

- Maintenance of the existing capital stock and private capital durability. It is often argued that infrastructure policy is biased towards the realisation of new investments, to the detriment of the existing stock. Where maintenance is lower than optimal, it reduces the life of the infrastructure. It also increases operating costs and reduces the life of capital, such as trucks, using the infrastructure.
- Reduction in private capital adjustment costs: For example, better public infrastructure reduces the need for private capital investment to hedge against service interruptions.
- Economies of scale and scope: For example, better transport infrastructure, by lowering transport costs, leads to economies of scale, better inventory management; changes in the

The marginal product of network capital depends on where in the system the incremental investment is made, not just how much capital is already in place. The payoff from the investment will depend on the degree of development of the network, and whether the investment is relieving existing constraints (e.g. congestion) or building in advance of need. Additional links may have little direct effect on output, because they may substitute for other links and mainly relocate activity, rather than adding to it.

Public provision is often, in the absence of market-pricing mechanisms, decided using cost–benefit analysis (CBA) with benefits proxied by time savings, reductions in accidents etc. Only parts of these are directly related to output in national accounting terms. And CBA may miss important benefits of infrastructure if these occur in the form of externalities. For example, transportation infrastructure may have a profound impact on the extent of the market and the ability of producers to exploit economies of scale and specialisation. However, as noted in OECD/ECMT (2007, p. 34) it is difficult to know how to measure these effects and how they should influence infrastructure policy.

In order to estimate rates of return on roads, Canning and Bennathan (2004) use a production function to calculate the impact of infrastructure investment on output (GDP), as well as data on roading construction costs.

The table below sets out data for a selection of countries, showing rates of return are highest for middle-income countries and low for most developed countries, including New Zealand. This is because, relative to developing countries, middle-income countries have fairly well-developed road networks i.e. the marginal transport benefits of additional roads are low, and construction costs are relatively high.

Figure 3: Rates of return to paved roads

Country	Rates of return (%)	Unit costs of construction ($US per km 1985)
Argentina	3.85	80,223
Australia	-0.01	869,154
Colombia	9.47	169,987
Indonesia	2.03	200,008
Ireland	0.06	399,348
New Zealand	0.08	456,604
Sweden	0.06	522,244
UK	0.13	777,133
US	0.07	627,580

Source: Adapted from Canning D and E Bennathan (2004) "The rate of return to transportation infrastructure." In: OECD/ECMT (2007) *Transport infrastructure and economic productivity.* Roundtable 132.

The report notes (OECD/ECMT 2007, p. 46) that this is somewhat different from the normal cost-benefit approach, which looks at the rate of return to a project in relation to a threshold level that is set by the cost of funds. Caveats attached to these estimates are as follows:

- GDP as a measure of aggregate output has the potential to capture some of the externalities that CBA might miss, but there are other drawbacks (OECD/ECMT 2007, p. 45). Whereas CBA will pick up all travel-time savings resulting from a project, GDP will only pick up time saved if it is devoted to productive use. Time saved that is spent in leisure activities will not be accounted for.
- The estimate of the effect of infrastructure on output is its long-run steady-state effect. In calculating rates of return, it is assumed that long-run effects occur immediately and last forever. If in fact it takes infrastructure several years to reach its full potential, the approach may over-estimate its rate of return.

4 Spatial effects of transport

Infrastructure has an important influence on the location of economic activity and population centres. As per Straub (2008, p. 9), infrastructure investment is by its nature spatial, since it involves rival choices on the location of services that will serve specific areas.

Infrastructure services are an input in both households' and firms' consumption and investment decisions. Changes in the availability and quality of infrastructure will crucially influence location decisions e.g. migration of households and firms, establishment of new firms, fixed capital investment in different locations.

Economic geography models consider location patterns to be the result of the interplay between agglomeration and dispersion forces.

Agglomeration forces arise as the result of increasing returns that may be either internal or external to firms. Increasing internal returns push firms to locate their activities in regions with bigger markets to be able to serve more consumers or where, through concentration of suppliers, the firm's input costs are lower than otherwise. Agglomeration may also arise for reasons external to the firm, such as knowledge spillovers or access to a more highly trained workforce.

Acting against these agglomeration forces are dispersion forces affecting both the supply and demand side of relevant markets. For example, agglomeration brings with it increasing costs of land and labour, as well as congestion. And locating in urban concentrations may mean neglecting distant markets.

Transport costs are important in determining the balance between agglomeration and dispersion forces, as both diminish as transport and trade costs decline.

One policy trade-off arising from a geography and growth model, is a spatial equity-efficiency trade-off[6]. There are two main consequences of this trade-off:

- First, infrastructure policies that facilitate transport between regions, for example building or improvement of major road corridors, will increase both regional inequality and national growth.

[6] Straub (2008, p. 12)

- On the other hand, infrastructure policies that facilitate transport within poor regions will have the opposite effect of decreasing regional inequality, but also slowing down national growth.

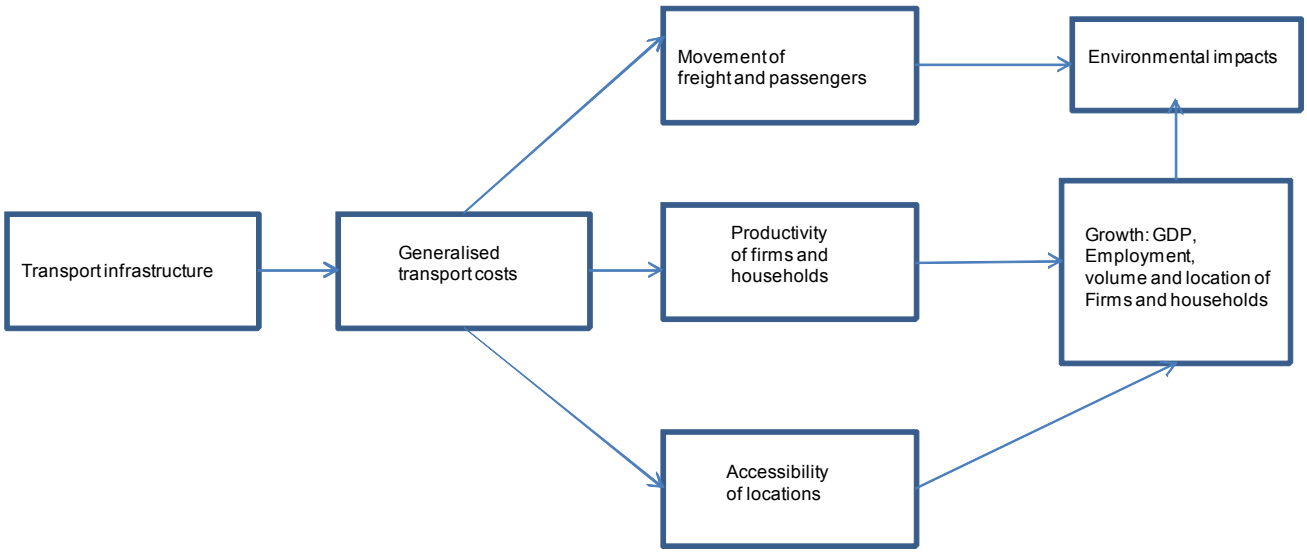
Straub (p. 13) also notes that the new economic geography models help substantiate the claim that active infrastructure policy is a form of industrial policy. Indeed, different types of investment have effects on economic activity that work primarily through their impact on industrial specialisation.

4.1 Modelling transport and its spatial effects

In the following we briefly describe some 'models', shown in diagrammatic form, of the relationship between transport or transport infrastructure and economic outcomes. These models comprise some trigger (e.g. more roads), direct transport impacts, and various economic effects, including positive and negative externalities.

Analysis of the relationship between transport and economic growth is complex, because of the many economic and spatial systems that influence or are influenced by transport. In Figure 4 causality is unidirectional – reductions in transport costs affect firms' productivity and household costs, both of which contribute to regional growth. The model incorporates only one set of externalities i.e. environmental impacts.

Figure 4: Transport infrastructure and its economic effects



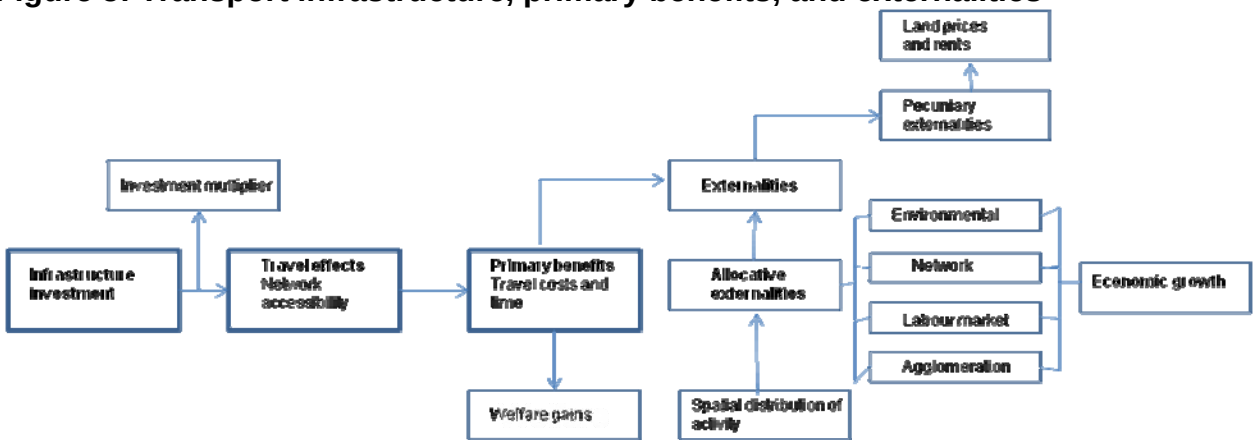
Source: Rietveld, 1996, as cited by Jensen-Butler and Madsen (2005, p. 195)

Some analysts argue that the traditional approaches are inadequate because of the pervasive effects of externalities. This is reflected in Figure 5 where, in addition to the primary benefits which result in welfare gains through cost reductions and productivity increases, there are allocative (cost reducing, technological) externalities affecting growth, but which do not operate through the price system. These are:

- agglomeration economies, or inter-firm externalities, arising from increased accessibility
- a reduction of labour market imperfections

- network externalities, where an improvement to a part of the network raises transport activity in the network as a whole
- congestion and environmental externalities.

Figure 5: Transport infrastructure, primary benefits, and externalities



Source: Banister and Berechman, 2000, as cited by Jensen-Butler and Madsen (2005, p. 197)

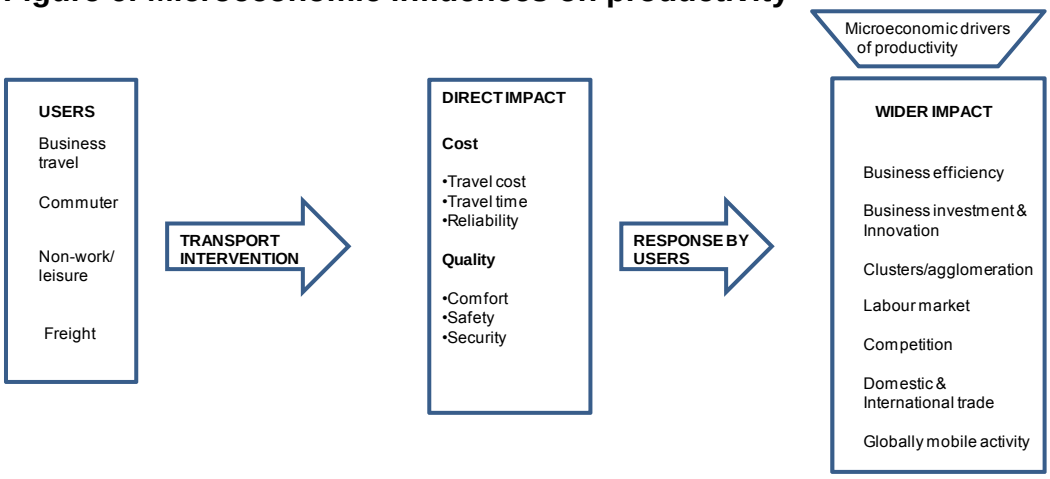
Both the above approaches are unidirectional, there being no explicit feedback effects. In addition there is no real basis for assessing the time taken for the various effects to work through.

4.2 Macroeconomic and microeconomic frameworks

Microeconomic approaches (including cost-benefit analysis) are based on modelling of the behaviour of firms and households, given changes in the transport system.

Eddington (2006) notes that the key characteristics that transport users value are: journey times, reliability, cost, connectivity, comfort, and safety and security, and indicates the possible relationship to microeconomic drivers of productivity in the following figure. Note that some of the items in the 'Wider Impact' box extend into the macroeconomic realm discussed below.

Figure 6: Microeconomic influences on productivity



Source: The Eddington Transport Study, Main Report, Volume 1, p. 24

Macroeconomic approaches deal with the way in which transport contributes to overall economic growth. There are three basic ways in which transport can fit into a typical growth model:[7]

- through the enhancement of investment and productivity
- as a contributor to market integration, working through expansion of demand and dynamic scale economies
- increased efficiency as an endogenous contribution to total factor productivity, including greater openness to trade and ease of technology transfer.

5 Government and transport in New Zealand

5.1 Overview

Transport markets are subject to numerous interventions for economic, environmental and political reasons. Internationally, there are two main perspectives on the appropriate role for government. In the first, the operation of private markets is seen as most likely to lead to improvements over time in economic and social outcomes. This does not preclude government intervention to address specific cases of "market failure". But market failures as such do not justify regulation and controls; they are only desirable if they demonstrably bring about improved outcomes.

The second view, in contrast, sees transport as part of a larger process that requires government oversight. Transport is seen as an input into meeting regional development objectives, or bringing about changes in income distribution. Markets do not necessarily achieve this, so there is a need for government interventions to steer the transportation sector in the desired direction.

These are two extremes of the spectrum, with New Zealand policy having traversed much of the middle ground since the 1980s.

Despite deregulation in the last three decades in New Zealand and elsewhere, government still has a considerable role in the transport sector. This is because transport is seen, not just as an economic issue but also as a subset of other policy areas, such as environmental protection.

Since 2008, in response to the 'credit crunch', transport infrastructure has been seen as a priority area for government spending to stimulate the economy in New Zealand, Australia, and other OECD countries.

Internationally, as transport policy has become more integrated with policy designed to promote economic growth, questions are being raised about the nature of this relationship:

- Do transport system improvements always generate positive net benefits?
- What is the spatial distribution of such benefits?
- What can be done to maximise the benefits of investment in transport?
- How should such investments be financed?

[7] Vickerman (2002) as cited in Jensen-Butler and Madsen (2005, p. 211)

- What are the appropriate methods for assessing the benefits of investment in transport infrastructure or changes in transport pricing?

5.2 Market failures and externalities in transport

The principal economic rationale for government involvement is to address so-called market failures, meaning that the market produces too little of some goods and too much of others. For example, the economic features of transport infrastructure mean that the market, left to itself, would not provide adequate infrastructure. On the other hand, left unregulated, transport produces too many negative 'externalities' such as noise, accidents and pollution.

The boundary between 'market failure' and 'government failure' is in fact quite blurred, because the latter has an important influence on the former. Government failure may reflect inadequate policy design, or inertia in the system which means that today's interventions address the transport problems of the past, not the emerging challenges.

Market failures are thought to occur when the market fails to produce public goods, or inadvertently produces externalities, gives rise to natural monopolies, disenfranchises parties through information asymmetries, or creates undesirable income distributions.[8]

All of these forms are types of externality, since each consists of non-monetary effects not taken into account in the decision-making process.

Externalities come into being because the transaction costs of resolving them are too high. Property rights are important because, the more extensive and complete they are, the lower are the transaction costs and hence the scope for externalities and allocative inefficiencies. Similarly, as transaction costs decline, property rights become more complete as it is cheaper to defend them or transfer property.

As discussed later, the debate about the scale and scope of externalities, both positive and negative, is central to judgements about the contribution of transport and transport infrastructure to economic growth, and to the debate about evaluation methods.

5.3 Market failure and infrastructure

The reasons for state involvement in both provision and management of infrastructure derive from their economic characteristics. There are three main elements:[9]

1. Public good characteristics: Infrastructure consists essentially of large, lumpy investments characterised by a high degree of asset specificity. This makes decisions on the appropriate levels of investment difficult, since it is frequently necessary to choose between investments that are smaller or larger than the apparent optimal capacity to serve revealed demand. Since capacity is fixed, at levels of use below full capacity (or when there is little or no congestion), the marginal cost of infrastructure use is zero. Hence a private market will find it difficult to finance and provide an optimal level of capacity. This 'market failure' provides the basic argument for public sector provision.

[8] Zerbe and McCurdy (2005, p. 6)
[9] Vickerman (2005, p. 224)

2. Lumpiness and asset specificity mean that, in many circumstances, there will be only one provider of infrastructure on any one route i.e. natural monopoly conditions apply. The state can regulate the infrastructure provider, to avoid exploitation of its monopoly power. But problems with regulation can lead to direct provision or nationalisation of the service.
3. In addition to these market failure arguments, there is an externality rationale for state interest in infrastructure provision. It is argued that infrastructure may lead to wider economic benefits than those captured by any charge that a provider can impose on direct users. This may justify the provision of infrastructure out of general taxation rather than through direct charging for use.

These arguments imply that infrastructure should be provided, or at least strictly regulated, by the state. But questions arising are:

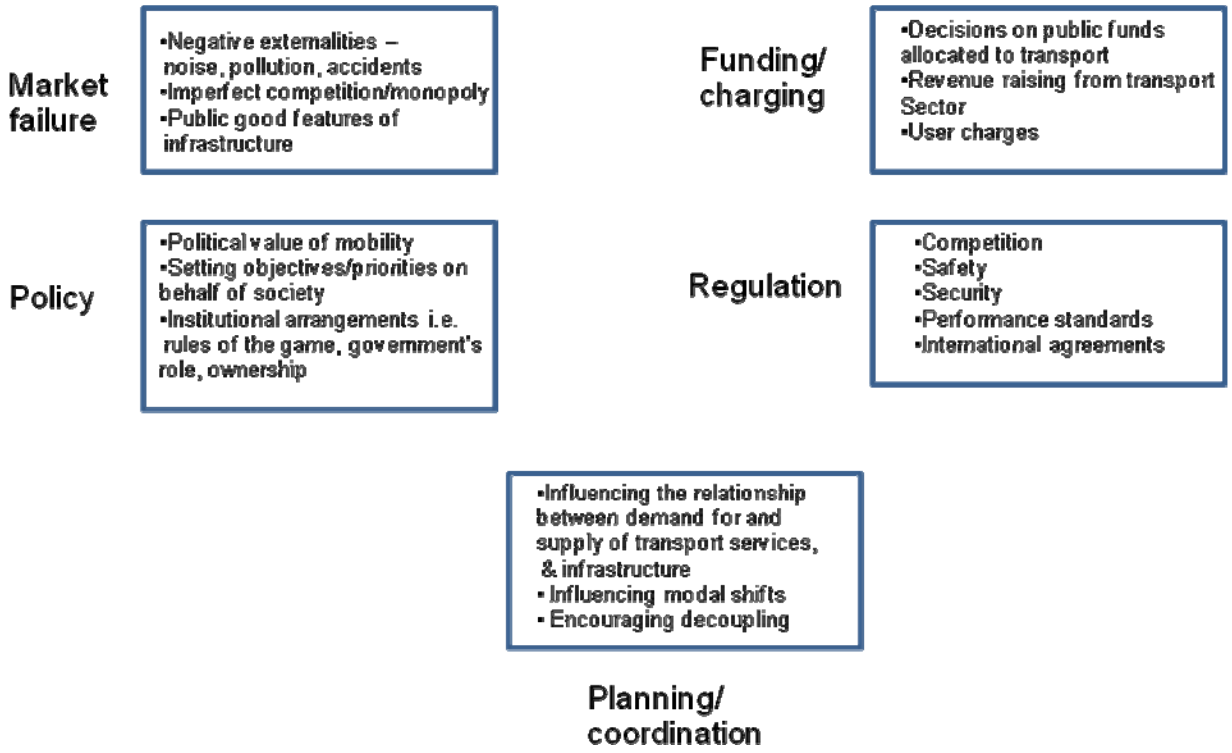
- How does the state determine the level of capacity to be provided?
- How should it be allocated between competing users, whether these are individual final consumers, such as on roads, or transport service providers, as with airports or rail infrastructure?

According to Vickerman (2005, p. 228), infrastructure has largely been seen as an instrument for achieving wider policy goals rather than been the subject of policy in its own right. This has tended to reduce the effectiveness with which infrastructure has been integrated into overall transport planning.

5.4 Policy objectives and instruments in transport

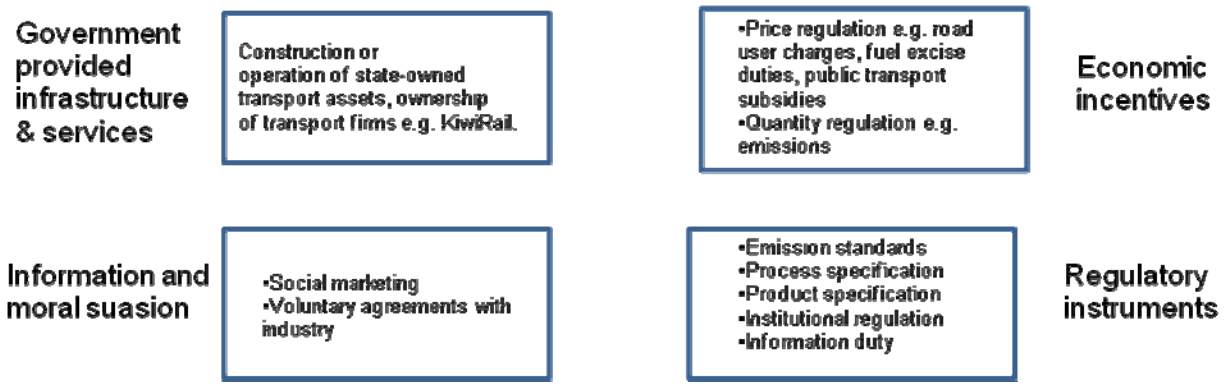
The flow chart below sets out further details on the rationale for, and objectives of, government involvement in transport.

Figure 7: Government involvement in transport



And the next chart sets out the main policy instruments available to, or applied by, government.

Figure 8: Government policy levers



The alignment between transport strategy and the levers available to government, and especially the budgets available, has an important bearing on what is achievable and on the feasible time frames for significant change.

6 Evaluation issues

6.1 Overview

Implementation of a strategy boils down to the identification of potential initiatives, decisions on priorities, and appropriate sequencing of these subject to budget constraints. This in turn calls for

evaluation approaches which align with the choice of levers (e.g. infrastructure spending) and objectives (e.g. economic growth).

Earlier we listed various perspectives on the relationship between transport policy and the economy e.g. Boarnet 1999, who made a distinction between transport as a cost to firms, and transport as an integral component of production processes. We also showed in diagrammatic form various 'models' attempting to summarise the effects of transport and transport infrastructure on:

- microeconomic effects (firms, households). As per Figure 4 (above) the key direct effects relate to cost of travel i.e. transport as an input into business operations.
- aggregate economic welfare effects (benefits less costs) of improved roads with principal benefits assumed to be savings in the time and cost of travel, but also reductions in negative externalities such as road accidents and emissions. Refer 'Welfare gains' in Figure 5.
- macroeconomic effects on regional or aggregate growth. These incorporate, not just travel cost reductions (as in the microeconomic model), but also changes in economic structures (spatial and other changes in production structures referred to as 'allocative externalities' in Figure 5), leading to enhanced rates of economic growth.

The effects referred to in the third of these are much broader than those encompassed in the other two. Implicitly, they call for large-scale initiatives to trigger the economic adjustments envisaged, and extensive periods (e.g. five years or more) for these adjustments to take place. This in turn suggests an approach to evaluation of projects or programmes that goes beyond traditional cost-benefit analysis.

CBA provides the appropriate toolkit for evaluating projects from a mainly static efficiency perspective i.e. focusing mainly on transport cost reductions. But in the context of New Zealand's transport strategy, there are interesting questions about the breadth of effects that should be considered.

At what point and for what size of project, does it become meaningful to consider, not just these static efficiency effects, but also the broader dynamic effects related to network and other externalities from expanded transport infrastructure?

6.2 Roads of National Significance

6.2.1 New Zealand

In addition to setting out an amended funding allocation, the GPS (May, 2009) includes seven initial Roads of National Significance as a statement of national road development priorities. *These are seven of New Zealand's most essential routes that require significant development to reduce congestion, improve safety and support economic growth. The purpose of listing roads as nationally significant is to ensure these priority roading developments are taken fully into account when the NZTA develops the National Land Transport Programme.*

These are seen as strategic priorities because they involve, by New Zealand standards, large movements of freight and people, either in urban areas or between big urban concentrations. There

are some real challenges in establishing priorities. There is not only a need to decide between corridors, but also within corridors, because in practice they are broken down into a series of projects with different budgets, varying benefit cost ratios, and different completion times.

6.2.2 International examples

Identification of roads of 'national significance' raises questions about what this term implies, and how this should be reflected in appraisals and prioritisation. Inevitably each of the roads listed is primarily located within a specific region or urban area, and hence the primary effects on transport would be concentrated in those localities. So 'national significance' implies network effects that are large and go beyond effects in the primary locality.

Some helpful insights can be gained from examining approaches in other countries[10]. Common elements are:

- In general, these investment programmes are set up within a medium-term timeframe (five to ten years), with most of them aiming to form a long-term plan (more than ten years) beyond the current initiatives.
- Nearly all the jurisdictions reviewed have taken an integrated approach (typically an integrated corridor approach) to planning and determining their National Transport Network (NTN), which includes roads, rails and inter-modal facilities.
- All of the programmes examined indicated that one of the main reasons for putting in place a NTN was to improve coordination, decision-making and funding of nationally important transport infrastructure.
- They seek to provide good connections to the following strategic points: major urban centres with the largest population; core economic or commercial hubs; international gateways, and key intermodal facilities.

Even if a corridor or route has been identified as being of national significance and included within the National Transport Network, this does not mean that any proposed projects or initiatives related to that corridor would be automatically approved for national funding. In general, the eligibility of a proposed project for funding is determined through a contestable assessment process. The proposed transport projects have to be appraised both by benefit-cost analysis (BCA) and by their consistency with government's strategic objectives and policy priorities.

[10] AusLink's National Land Transport Network, the UK National Strategic Transport Infrastructure Programme, Scotland's National Strategic Transport Network, and broadly similar programmes in other countries.

7 Short glossary

Allocative efficiency: refers to the allocation of scarce resources among competing uses. Allocative efficiency is synonymous with economic efficiency. Cost benefit analysis is the relevant evaluation framework here.

Dynamic efficiency refers to the outcomes from the sequence of decision-making relating to the allocation of resources, production technologies of firms, and investment in new knowledge. Dynamic efficiency is sometimes referred to as innovation efficiency or adaptive efficiency.

Economic efficiency: Synonymous with allocative efficiency

Externalities: Externalities are costs and benefits that affect people who are not parties to a transaction. They are external to the price mechanism and come about because of an inadequate allocation of property rights within markets. With externalities, the social costs of additional traffic are above the private costs. Traffic volumes are higher than they would be if the external costs were taken into account, and a loss of social welfare results. So-called 'technological externalities' involve real resource costs and ignoring them in decisions leads to societal costs.

- Traffic congestion is a user-on-user external cost, because one motor vehicle on the road affects the speed and travel costs of other road users, without individual users taking full account of these costs.

- Exhaust emissions, noise, visual intrusion etc are user-on-non-user technological externalities, in that many of those affected are not travelling.

Generalised transport costs (SACTRA, 1999, p. 151) Generalised cost varies by mode and is usually a linear combination of the various components of a journey.

- For cars, generalised cost is a combination of: in-vehicle travel time; operating costs (related to distance travelled); parking 'costs' (which notionally include time spent searching and queuing for a space and walking to the final destination); and tolls or congestion charges. Money costs are usually converted to time units using a value of time.
- For goods vehicles, the components are similar, except that different vehicle operating costs and values of time are used.
- For public transport users, generalised cost is a combination of: walking time from the origin to a stop or station (usually weighted relative to in-vehicle time by a factor of about two); waiting time for the service (again, usually weighted relative to in-vehicle time by a factor of about two); fare; in-vehicle time; penalty representing the inconvenience of changing between services; and walking time to the destination (again, usually weighted relative to in-vehicle time by a factor of about two). Again, money costs are converted to time units using a value of time.

Government failure: The distinction between market failures and government intervention failures is rather blurred i.e. the two types of failure are inherently interrelated. Individual government interventions are the exception rather than the rule, with policy normally involving the use of a portfolio of interacting measures.

Market failure: Market failure refers to those situations in which the conditions necessary to achieve 'economically efficient' solutions fail to exist or are contravened in one way or another (Brown and Jackson). Market failure is the obverse to market success. Success is the 'nirvana' of *allocative efficiency,* which is achieved when there are enough markets and when all consumers and producers behave competitively. When these conditions do not hold, the result is market failure i.e. the production of too many or too few goods relative to society's preferences/willingness to pay.

Market power: Considerable effort in government goes into legislation aimed at limiting the exploitation of market power. This has often been the motivating factor for state provision of transport infrastructure. At an operational level, various forms of competition law have emerged to control such practices as predatory pricing, as well as rules to deal with cartel-style arrangements such as shipping conferences and airport alliances.

Market power translates into higher prices and lower output than would result from a competitive market, and reduced economic welfare. While interventions aim to mitigate this allocative efficiency, there are two other aspects relevant to the 'value for money' theme of this study. These are:

- X-inefficiency: Market power reduces the incentives for managers to minimise their costs of production, especially where management is separated from ownership e.g. in the case of public companies or SOEs. The lack of incentive is a particular feature of the principal-agent problem when, because of limited information or ineffective incentives, owners cannot ensure management drive for maximum profits.
- Potential effects on the dynamics of transportation industries: It is argued that monopoly power breeds pressure to use profits to fortify monopoly position through lobbying or acquiring competitors, rather than using it for productive investment or exploiting and developing new technologies.

"Public good" features of infrastructure: Many aspects of transport infrastructure have the features of public goods and will therefore be undersupplied if left to the market. Pure public goods are non-excludable and thus technically difficult to price. They are also non-rival in consumption i.e. have zero scarcity. So they would be undersupplied, because an investor has no way of extracting revenue. In practice hardly any examples of infrastructure are pure public goods. It is feasible to limit the use of roads (i.e. to exclude some potential road users) and roads often suffer from congestion i.e. are demonstrably rival in consumption. The 'market failure' is a matter of degree.

Static analysis: Allocative and productive efficiency are static concepts in the sense that they relate to the welfare outcomes, estimated at a point in time, of resource allocation and production decisions.

Sunk costs: Costs that cannot be recovered once they have been incurred. Most of the costs of building infrastructure are 'sunk' because there is no alternative use or market.

Transport is the function which allows movement of goods or persons from one physical location to another. *Traffic* is the measure of the extent of such movement definition for example, as measured in vehicle-kilometres. *Travel* is the use made of the transport system in terms of the number of trips. (SACTRA, 1999, p.36)

Value for money: In general the term efficiency refers to some relationship between outputs and inputs. In economics, the usual notion is some ratio of the value of outputs to the cost of inputs. So allocative, dynamic, and productive efficiency can each be seen as a versions of ‘value for money.’

8 References

Banister, D and J Berechman (2000) “Transport investment and economic development.” University College of London Press.

Bartle, John R (2003) “Dynamic efficiency and transportation infrastructure investment.” Annual Conference, Transportation Research Forum, March 23, 2003.

Boarnet, Marlon G (1999) “Road infrastructure, economic productivity, and the need for highway finance reform.” Public Works Management Policy 1999; 3; 289.

Boarnet, Marlon G (2000) “Do highways matter? Evidence and policy implications of highways’ influence on metropolitan development.” A Discussion Paper prepared for The Brookings Institution Centre on Urban and Metropolitan Policy.” August.

Budget 2009. http://www.treasury.govt.nz/budget/2009

Button K.J. and D.A. Hensher (2005) “Market and government failures in transportation.” Chapter 2 in *Handbook of Transport Strategy, Policy and Institutions.* Elsevier Ltd.

Canning D and E Bennathan (2004) “The rate of return to transportation infrastructure.” In OECD/ ECMT 2007 *Transport infrastructure and economic productivity.* Roundtable 132.

Cornes, Richard and Todd Sandler (1996) *The Theory of Externalities, Public Goods and Club Goods. Cambridge University Press.*

Department for Transport (2009) *NATA Refresh: Appraisal for a Sustainable Transport System*. April.

De Rus, Gines (2006) "Economic evaluation and incentives in transport infrastructure investment.” Fifth Milan European Economy Workshop, October.

Eddington, Sir Rod (2006) *The Eddington Transport Study – The case for action*. Sir Rod Eddington’s advice to Government. December 2006. HM Treasury.

Égert, B., T. Koźluk and D. Sutherland (2009), Infrastructure Investment: Links to Growth and the Role of Public Policies. OECD Economics Department Working Papers, No. 686, OECD, Paris.

Evans, Lewis, Neil Quigley and Jie Zhang (2000) “An Essay on the Concept of Dynamic Efficiency and its Implications for Assessments of the Benefits from Regulation and Price Control.” New Zealand Institute for the Study of Competition and Regulation.

Garrison, William L and David M Levinson (2006) *The Transportation Experience – Policy, Planning, and Employment.* Oxford University Press.

Gramlich, Edward M (1994) “Infrastructure investment: a review essay.” Journal of Economic Literature, Vol. XXXII (September 1994) pp.1176-1196.

Gwilliam, Kenneth (2001) “Regulation and ownership” (pp 274, 275) and “The new economics of sustainable transport in developing countries: incentives and institutions.” Chapter 13 in Polak, Jacob B and Arnold Heertje (Eds.) *Analytical Transport Economics – An International Perspective.* Edward Elgar, 2000.

Jansson, Jan Owen (2001) “Transport infrastructure: the investment problem.” Chapter 6 in Polak, Jacob B and Arnold Heertje (Eds.) *Analytical Transport Economics – An International Perspective*. Edward Elgar, 2000.

Jensen-Butler, Chris and Bjarne Madsen (2005) “Transport and regional growth.” Chapter 12 in *Handbook of Transport Strategy, Policy and Institutions*, Edited by K.J. Button and D.A. Hensher, 2005, Elsevier Ltd.

Leung, Joanne (2006) “A review of the literature on transportation and economic development.” Ministry of Transport. Paper presented to New Zealand Association of Economists Conference, 2006.

Littman, Todd (2009) “Smart transportation economic stimulation: Infrastructure investments that support strategic planning objectives provide true economic development.” Victoria Transport Policy Institute.

McCartney, Matthew (2004) “Dynamic versus Static Efficiency: The Case of Textile Exports from Bangladesh and the Development State. *Post-Autistic Economics Review*. Issue no.26, August 2004.

Ministry of Transport (2008) *Guide on transport planning and funding in New Zealand: The Land Transport Management Act 2003*. December 2008. http://www.transport.govt.nz/assets/Katrina-09/5991-2-LGT-Transport-07-WEB-2.pdf

Minister of Transport (2008) *The New Zealand Transport Strategy 2008.*

Minister of Transport (2009) *Government policy statement on land transport funding*. 2009/10 – 2018/19. May.

New Zealand Transport Agency (2008) *Economic Evaluation Manual, Volume 1*. Amended September 2008.

New Zealand Transport Agency (2009) *Economic Evaluation Manual, Volume 2.* Amended January 2009.

NZIER (2006) “Implementing the New Zealand Transport Strategy: An evaluation framework.” For Ministry of Transport. October

North, Douglass C. (1993) “Economic performance through time.” The 1993 Economics Nobel Prize lecture.

OECD/ITF (2008) *Transport infrastructure investment – Options for efficiency.*

OECD/ECMT (2007) "Transport infrastructure investment and economic productivity." ECMT. Roundtable 132.

OECD (2008) "Dynamic efficiencies in merger analysis." Directorate for Financial and Enterprise Affairs. DAF/COMP (2007)41, May 2008.

OECD (2009) *Economic Survey of New Zealand.* April.

Rietveld P. (1996) "Transport infrastructure, productivity and employment" in B Madsen, CN Jensen Butler, JB Mortensen and AMB Christensen eds. *Modeling the economy and the environment*. Heidelberg: Springer-Verlag.

Rothengatter, Werner "External effects of Transport" Chapter 4 in: Polak, Jacob B and Arnold Heertje (Eds.) *Analytical Transport Economics – An International Perspective.* Edward Elgar, 2000.

Roy, Rana (2008) "Mind-Forg'd Manacles – the Constraints to Optimising Urban Transport Policy." Paper for OECD/ITF Global Forum on Transport and the Environment. In a Globalising World, November 2008. Guadalajara, Mexico. ENV/EPOC/WPNEP/T(2008)10/Final.

Schumpeter, J A (1942) *Capitalism, Socialism and Democracy*. Unwin, London, 1987.

Small, Kenneth A. and Erik T. Verhoef (2007) *The Economics of Urban Transportation.* Routledge.

Standing Advisory Committee on Trunk Road Assessment (SACTRA, 1999) *Transport and the economy.* London: SACTRA, UK Department of the Environment, Transport and the Regions.

Statistics New Zealand (2000) 'Measuring capital stock in the New Zealand economy.' December, 2000.

Stavins, Robert N., Alexander F. Wagner and Gernot Wagner (2002) "Interpreting Sustainability in Economic Terms: Dynamic Efficiency plus Intergenerational Equity." John F. Kennedy School of Government Harvard University. Faculty Research Working Papers RWP 02-018.

Straub, Stephane (2008) "Infrastructure and growth in developing countries: Recent advances and research challenges." The World Bank, Policy Research Working Paper (4460), Development Research Department, January 2008.

The Treasury (2008) Financial Statements of the Government of New Zealand for the year ended June 2008.

UK Cabinet Office Strategy Unit (2004) *Strategy Survival Guide.* May.

Vickerman R (2002) "Introductory report" in Transport and economic development. Report of the 119th Round Table on Transport and Economics. Paris: ECMT/OECD.

Vickerman, Roger (2005) “Infrastructure policy.” Chapter 13 in Button K J and D A Hensher (eds.) *Transport Strategy Policy and Institutions.* 2005. Elsevier Ltd.

Winston, Clifford and Ashley Langer (2006) “The Effect of Government Highway Spending on Road Users’ Congestion Costs.” AEI Brookings Joint Centre for Regulatory Studies, Working Paper 06-11, May.

Zerbe, Richard O and Howard E McCurdy (2005) “The failure of market failure.” University of Washington, Graduate School of Public Affairs. February.