LINKAGES BETWEEN INFRASTRUCTURE AND ECONOMIC GROWTH

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Executive Summary

The purpose of this note is to highlight what is understood (and what is not understood) about the linkage between infrastructure and economic growth and the implications about this for the management of infrastructure services in New Zealand. It is intended to provide a "high level" view of the subject, and does not attempt to explain any of the theoretical underpinnings of the debate. The focus is largely on exploring World Bank and OECD publications around the subject area. In addition, there is a brief discussion of the Infometrics report, *Generating Growth: Infrastructure* (2003), in terms of the implications for infrastructure management in New Zealand.

The definition of infrastructure adopted for this paper is consistent with the focus of the "infrastructure stocktake" currently being undertaken by the Ministry of Economic Development and the New Zealand Government, covering the (services provided by the) physical networks associated with energy (gas, thermal, and water-based), water supply, transport, telecommunications, sanitation and waste facilities, and flood protection and drainage.

While we can conclude that there is a definite link between infrastructure investment and economic growth, particularly in the longer-term[1], it has not been confirmed that the link is a causal one (in either direction). Instead, physical infrastructure and the services provided can be regarded as form of "complementary capital" that requires the existence of available productive capital (whether physical or human) for investment (and innovation) in order to realise the economic growth potential. Thus, it should be understood that infrastructure investment on its own could not create economic potential, only develop it where appropriate conditions exist.

Inadequate supply of infrastructure or unreliability in services may inhibit the investment of productive capital or restrict /reduce output.

The macroeconomic evidence of a link between infrastructure and economic growth is not in itself helpful to policy development for a variety of reasons as, for example, the nature and type of infrastructure involved, the financial arrangements for the investment, organisational / institutional arrangements, the nature of private capital available, and so on, will influence the action(s) to be taken. However, the available literature does provide limited guidance for facilitating the ability of infrastructure services to enhance economic growth through increased (private sector) productivity:

- Ensure that the macroeconomic policy climate is conducive to efficient resource allocation Such macroeconomic policies include price stability / inflation control, structure of tax system, facilitation of international trade and growth, pro-competitive regulations, facilitating the entry of innovative firms, facilitating the skilling and education of the existing and potential workforce, encouraging R&D investment, and removing barriers to network access
- Improve the efficient use of infrastructure services through demand management and the implementation of user charges reflecting supply & demand conditions and non-market

[1] Nijkamp and Poot (forthcoming) find that studies coving a longer period of time are more likely to find positive effects of infrastructure, suggesting that there is a lag between when the infrastructure investment occurs and the productivity gains becoming apparent. This is consistent with the notion that productivity gains may take time to emerge, as it may require re-organisation or development of complementary private sector investments.

externalities. Additional infrastructure capacity may not address productivity if existing infrastructure is not effectively utilised. Efficient infrastructure use and management has the possibility of greatly affecting economic productivity.

- Recognise that the *reliability* of infrastructure is particularly important vis-à-vis its impact on international trade and production costs for small enterprises. Poor quality or unreliable infrastructure service provision may mean that firms are reluctant to invest productive capital, or have to reduce such investment in favour of "complementary" capital to compensate for the lack of infrastructure
- Care should be taken not to get into a situation of oversupply of infrastructure, which can have a negative impact on the economy as it draws scarce resources away from maintenance and operation of existing stocks.
- Investment in infrastructure projects should be done on the basis of national benefits and on a case-by-case basis. This implies the use of benefit-cost analysis.[2] Some authors have suggested trade-offs should include those between different kinds of infrastructure investment.
- It is worthwhile maintaining the processes NZ has established to limit infrastructure decisions being based on political influence (i.e. through pork barrelling or lobbying and coalition agreements) as such decisions may lead to distortion in infrastructure provision, particularly in the longer term.

Information and communication technology (ICT) is perhaps better thought of as a technological innovation that is "transforming" economic productivity by shifting economic growth onto a higher level, although the overall slope of the path is expected to remain the same. In some countries, the ICT producing sector has had an impact on the economy-wide average growth, influencing "capital deepening" (increased the intensity of physical capital per unit of labour) and assisting in more efficient work organisation outside of the ICT sector, creating "spillover" gains in productivity in these other sectors. The OECD is proposing to continue to monitor ICT development and its effects. The key action for governments in respect of ICT is to ensure that the macroeconomic policy climate is functioning well to encourage further investment and innovation.

The "infrastructure stocktake" has an important function to identify whether or not New Zealand's infrastructure is currently at or below its optimal level, as well as whether or not it is being efficiently or effectively utilised. It should, thus, provide guidance as to the direction of further investment in infrastructure.

[2] It must be recognised that the more "conventional" forms of cost-benefit analysis often have significant limitations, insofar as they may not take into account the full range of potential benefits from investment (i.e. spillover benefits); nor account for economic financing costs; may be based on historical evidence that has little or no relevance to the current situation; and may run into difficulty in measuring all of the benefits, even if they are included. In recognition of these limitations with respect to transport investment in New Zealand, Transfund has recently (2003/04) funded a research project to appraise the national, regional and local economic development benefits of land transport investment with the purpose of identifying how to model and assess these impacts for potential transport investment projects. While the analysis is focused on land transport investment, it may have a broader application for other types of infrastructure framework.

Linkages between infrastructure and economic growth

The purpose of this note is to highlight what is understood (and what is not understood) about the linkage between infrastructure and economic growth and the implications about this for the management of infrastructure services in New Zealand. To do this, an overview of some of the (rather large amount of) available literature has been completed, with a focus on the work produced by the World Bank and OECD in the last 15 years. The implications for infrastructure management in New Zealand take account of the findings from the report *Generating Growth: Infrastructure* (Infometrics, 2003) which involved interviews with 50 of the largest businesses / business organisations and considered current / potential infrastructure constraints and their implications.

This paper does not delve into or otherwise explain in any details the different theoretical / empirical approaches (and their various shortcomings or strengths) used to analyse the link between infrastructure and economic growth. Other work, including papers by Ahn and Hemmings (2000), De la Fuente (2000) and Button (1998), cover these details and issues quite thoroughly.. Rather, the results of these studies and their implications for the NZ situation have been highlighted and discussed.

Definition of infrastructure

It is perhaps helpful from the outset to clarify what is being considered as "infrastructure" in the context of this note, as the definitions used in the available literature vary widely. The definition adopted here focuses on the *services* provided by the physical networks or "infrastructure systems" associated with energy (gas, thermal, and water-based), water supply, transport, telecommunications, sanitation and waste facilities, and flood protection and drainage. This is consistent with the focus of the 2003 "infrastructure stocktake" being undertaken by MED/the NZ Government. The energy, transport and telecommunication infrastructure systems generally consist of a trunk or bulk supply installation and local distribution or collection networks, while the remainder are largely regionally or locally based.

Within the literature, "infrastructure" has various descriptions, and a very good discussion of these is found in the draft paper on the development of an infrastructure policy framework prepared by NZIER (October 2003).

"The sources of economic growth in the OECD countries": an OECD position

The OECD has recently (2003) published its final documents (a report and executive summary) of a large multiple-year study, "The OECD Growth Project", on the determinants of economic growth in the OECD countries. In an earlier report, *The new economy: beyond the hype* (OECD, 2001), it was found that disparities in growth between different OECD countries was linked to new capital – particularly ICT, increased use of labour, increased "quality" of labour, greater efficiency in how capital and labour are combined (multi-factor productivity). The 2001 report also noted that "inadequate infrastructure" (undefined, but excluding education) was identified as a "major impediment to entrepreneurial activity" in the OECD by 11% of entrepreneurs in 14 OECD countries.[3] Public investment in "R&D, transport, communication and infrastructure" was

[3] N.B. beyond stating that entrepreneurs in 14 countries were included in the survey, no details are provided.

highlighted as enhancing private sector innovation and productivity, so long as it is of high quality and generates high economic and social returns.

The primary finding of the 2003 report could be summarised in the following statement: "sound macroeconomic policy setting is a key ingredient for sustainable, long-term growth". Investment in human, physical and knowledge capital is identified as the key driver of economic growth and macroeconomic policies (including price stability / inflation control, structure of tax system, facilitation of international trade and growth, pro-competitive regulations, facilitating the entry of innovative firms, facilitating the skilling and education of the existing and potential workforce, encouraging R&D investment, removing barriers to network access) are found to facilitate this investment.

Thus, the focus of the report is on macroeconomic policy settings rather than micro-economic detail: the word "infrastructure" appears seven times in 248 pages (twice in references) and "electricity" and "transport" are only discussed as industry sectors. It is noted that expenditure on infrastructure (including education and research and development as well as the elements discussed above) generally are one-fifth of GDP – and this share has been declining in most OECD countries in the past decade.

The stance on the linkages between infrastructure and economic growth are found in one paragraph stating that most types of government expenditure probably have some impact on growth, either directly (through provision of infrastructure) or indirectly. Much of impact depends on the overall size of government expenditure in the economy, how it is financed and the composition of expenditure (i.e. direct v. indirect). The authors observe that impact of the expenditures on growth is difficult to determine and causation could go either way.

One particular type of infrastructure, information and communication technology (ICT) *may* have led to an "upward shift" in the growth path of economies where ICT is well-developed. This assumes that most countries have some sort of steady-state output growth path, which ICT has shifted upward to a new level, although the overall slope of the path is expected to remain the same. In *The new economy: beyond the hype* (OECD, 2001), ICT is considered to be "transforming economic activity, as the steam engine, railways and electricity have done in the past" – it is thought to be too soon to say how important ICT is compared with previous new technologies, though it is clearly important as a "transformational technology" in this time period.

The 2003 report finds that ICT has definitely influenced "capital deepening" (increased the intensity of physical capital per unit of labour) and shown additional gains in assisting more efficient work organisation outside of ICT sector, creating "spill over" or "network" gains in productivity for these other sectors. Where productivity gains have been significant, both inside and outside of the ICT sector, it is proposed that this is the result of policy and institutional settings conducive to innovation and adoption of new technologies. The OECD proposes to continue to monitor the economic impact of the ICT industry on productivity growth.

There are several background papers related to the OECD Growth Project available on the internet covering a range of factors thought to contribute to economic growth. Apart from several papers specifically addressing the ICT issue, however, very few (I only found one) are addressing the issue of infrastructure and economic growth. Ahn and Hemmings (2000) discuss the key developments of economic growth, noting the difficulty in controlling for endogeneity in

attempting to establish causality. With respect to ICT, they note that the productivity gains in the ICT producing sector have been large enough to affect the economy-wide average, although the production of significant spill over effects and the potential boost to the long-term growth of TFP in other sectors is more tentative, partly due to the uncertainties surrounding measurement of the effect. They agree with a conclusion by Sturm et al (1996, quoted in Ahn and Hemmings, 2000): "public capital probably enhances economic growth, but the magnitude of the effect is highly uncertain" and recommend a cautious approach: "decisions on public capital spending should be based on cost-benefit analysis for each individual project, rather than based on alleged growth enhancing effects of public investment".

One other paper, specifically addressing infrastructure and private sector productivity is available from the OECD. Ford and Poret (1991) provide two definitions of infrastructure, a narrow one – the capital stock of producers of government services and a broad definition which includes in addition equipment and structures in electricity, gas and water, transport and communication. Their focus is on testing Aschauer's hypothesis that the slowdown of private sector TFP in the US in the 1970s was caused by a slowdown in infrastructure investment. Their results propose that the relationship between infrastructure and productivity is a longer-term rather than cyclical one, and that when the longer time series is taken into account, there is evidence that the decline in public capital stock lags TFP, implying reverse causation. Ford and Poret also suggest that private sector inputs have a more important role than infrastructure in economic productivity.

The World Bank "position"

The World Bank has extensive publications in the two topic areas of "infrastructure" and "economic growth", largely focused on issues associated with developing countries, as opposed to developed or industrialised countries. However, there are still some relevant lessons for New Zealand.

Kessides (1993) provides an overview of the issues in her paper, *The contributions of infrastructure to economic development – A review of experience and policy implications.* Her definition of infrastructure matches the one used by the MED. Kessides (1993) examines a wide range of evidence on the impacts of infrastructure on economic development, drawing the following conclusions:

- Infrastructure contributes to economic growth, both through supply and demand channels by reducing costs of production, contributing to the diversification of the economy and providing access to the application of modern technology, raising the economic returns to labour (by reducing workers' time in non-productive activities or improving health)
- Infrastructure contributes to raising the quality of life by creating amenities, providing consumption goods (transport and communication services) and contributing to macroeconomic stability.
- Infrastructure does not create economic potential; only develop it where appropriate conditions (i.e. other inputs such as labour and private capital) exist.

Kessides (1993) then offers four conditions necessary to realise the positive impacts of infrastructure on economic development:

- A macro-economic climate conducive to efficient resource allocation, avoiding distortions in service provision, inflationary funding arrangements and "crowd-out" of other more rewarding investment.
- The presence of sufficient other input factors (such as labour) to raise factor productivity in the presence of infrastructure, because infrastructure cannot create economic potential, only develop it where appropriate conditions exist.
- An orientation to economic demand considerations such as service prices and demand elasticity, not just projections of physical capacities and consumer needs, because infrastructure with the most enduring benefits is that which provides the reliability and quality of services that users need.
- Application of user charges that reflect supply and demand conditions and non-market externalities as far as possible, to ensure infrastructure will be more economically efficient and favourable to the environment.

The above four conditions lead Kessides (1993) to provide comment on their implications for investment planning and policy appraisal:

- Planning of supply should consider all possible alternatives, including demand management, to generate the services demanded – as opposed to "quantitative projections of physical 'need'" (including shifts at the margin between large-scale infrastructure services and smaller scale alternatives).
- Choosing between options for national benefit requires a cost benefit analysis.
- In practice, a demand orientation in both evaluation and operation of infrastructure investments requires performance indicators that reflect the quality of service and user satisfaction, not just measures of physical assets and financial performance.

The annual *World Development Report* for 1994 was entitled *Infrastructure and Development*[4] - defined to include transport, telecommunications, water and sanitation, power and gas, and major water works – and focused on quantity v. quality of infrastructure. While their analysis provides a wide range of results for the effect of infrastructure on economic growth (from no effect to rates of return in excess of 100% per annum), they provide a substantiated argument that many countries, particularly developing ones, do not have shortages, but need to improve the effective use of infrastructure stocks and services. The report recommends implementing commercial management, competition and stakeholder involvement as means of improving this performance (as NZ has done – with the exception of rail services – over the past nearly two decades). It also identifies global trends, including technological innovation, regulatory management, and increasing concerns about social and environmental sustainability, that the World Bank believes will facilitate improvements in the performance of infrastructure.

Later papers published by the World Bank, such as Alexander and Estache (1999), Reinikka and Svensson (1999), and Canning and Bennathan (2000) confirm the conclusions that the link between infrastructure investment and economic growth is "at best ambiguous" (Reinikka and Svensson 1999), the direction of causality is unclear, and that physical infrastructure investment is a form of "complementary capital" that supports services necessary for the operation of productive private capital. Reinikka and Svensson (1999) posit that poor quality or unreliable infrastructure services, or insufficient infrastructure service provision, means that firms may be

[4] Unfortunately, this report was only available for "snail mail" purchase on the internet, and time constraints did not permit waiting for it to arrive. Hence, discussion about it is based on other authors' interpretation and information available off the World Bank website.

reluctant to invest, or where established, may invest in "complementary capital" (i.e. provide their own infrastructure services) rather than "productive" capital, thereby lessening the rate of return on private investment.[5] They conclude that macroeconomic policy reform needs to be accompanied by adequate levels and quality of infrastructure services to be effective in enhancing economic growth.

Canning and Bennathan (2000) add support to Kessides (1993) earlier work by presenting an argument for public provision of infrastructure, suggesting that rural roads are a non-rival public good and electricity distribution and the landline telephone networks are natural monopolies. Public provision is warranted due to the positive externality benefits. Using a trans log specification to model aggregate production functions, Canning and Bennathan find that each of roading and electricity generating capacity, on their own, have diminishing returns as well as having returns in line with or lower than those found for physical capital as a whole, implying little support for a policy of purely infrastructure-led growth. Instead, they discover that roading and electricity generating capacity investment is strongly complementary with both physical and human capital investment, giving it an important role in a process of balanced growth. They postulate that the effectiveness of infrastructure *may* depend "crucially" on its quality, both in its initial provision and ongoing maintenance.

Alexander and Estache (1999) hypothesise that establishing an environment in which infrastructure provision (i.e. through macroeconomic policy reform) becomes more efficient should create conditions leading to more sustainable economic growth.

Other sources

It must be stressed that the preparation of this note has not entailed a full and thorough reconnaissance of the available literature addressing the issue of infrastructure and its relationship to / with economic growth. Rather, the focal point has been the available OECD and World Bank material along with the Infometrics report on infrastructure, which has then been complemented with other material to either support or deepen the understanding of ideas found therein.

Modelling the link between infrastructure and economic growth

To quote Stephan (1997), the "published results on the productivity effects of infrastructure so far are rather ambiguous", particularly when considering "infrastructure" as a generic input in production. Button (1998) echoes this opinion. Early studies, such as Aschauer's several papers, used relatively simplistic econometric techniques to study the productivity effect of infrastructure, which later, more suitable, econometric techniques proved to be "spurious".

There is generally thought to be sufficient trustworthy evidence available now to indicate a positive and statistically significant effect of "infrastructure" on long-run economic growth (see for example, the meta-analysis by Nijkamp and Poot, forthcoming). The direction of causality, and the extent and nature of the contribution, however, is still largely unsettled (Cadot et al, 2002).

Work by Fernald (1997) provides evidence that increasing the roading stock induces faster productivity growth in those industries that use roading more intensively, implying that the

[5] This assumption appears to presume that the private sector companies do not fully capture the benefits from the support services provided. Reinikka and Svensson (1999) do not address the issue of user charges for services provided either, despite the earlier example of Kessides (1993).

causation is more likely to be from infrastructure investment to output growth, rather than the other way around. Based on his cross-regional study comparing infrastructure provision in Spain and the US, De la Fuente (2000) also concludes that causality flows from infrastructure investment to economic growth, but posits that, as a "saturation point" is reached, the returns on such investment declines. He observes that:

> "Appropriate infrastructure investment provision is probably a key input for development policy, even if it does not hold the key to rapid productivity growth in advanced countries where transportation and communication needs are already adequately served."

With respect to the issue of the extent or magnitude of the contribution of infrastructure investment to productivity improvements, Gramlich (1994) makes the following point:

> "If public investment really were as profitable as claimed, would not private investors be clamouring to have the public sector impose taxes or float bonds to build roads, highways, and sewers to generate these high net benefits?"

On a more technical level, Gramlich (1994) also notes, as do Nijkamp and Poot (forthcoming), that the omission of relevant variables from the analysis, among other things can lead to biased estimates of the impact of infrastructure investment on output.

Eberts and McMillen (1999) suggest that the theory on agglomeration economies "inextricably" links such economies with infrastructure by virtue of the suggestion that agglomeration economies occur when businesses / organisations in an urban locale share a public good as a production input:

> "Urban public infrastructure is one such shareable input that directly affects the efficient operation of cities, particularly large cities, and thus promotes the realization of agglomeration economies. Without an efficient highway system and adequate water and sewer capacity, for example, the positive gains achieved from the close proximity of people and businesses could be completely offset by the gridlock of the movement of people and goods and the inability to meet the basic needs of densely populated areas. Therefore, cities of identical size may experience different levels of productivity from agglomeration economies because of differences in the size and quality of their public infrastructure."

They examine the results of several studies, which generally focus either on the contribution of agglomeration economies or of infrastructure to productivity, and find that manufacturing firms are generally more productive in larger cities as opposed to smaller ones and in cities with a bigger stock of public infrastructure. This supplies evidence of the close relationship between the two, with Eberts and McMillen (1999) suggesting that infrastructure "provides the means by which the close spatial proximity of economic activities can lead to increased productivity for all parties." They make a plea for further studies to consider the two effects simultaneously and to examine the dynamics of the relationship.

Politics, infrastructure investment and productivity

In the last few years, economists have started to explore the nature of the policy decision-making process as an exogenous variable affecting public infrastructure and, consequently, production output. For example, Cadot et al (2002) and Stephan (1997) find that "pork barrelling" –

especially lobbying by larger businesses and "swing-vote" political parties – has an effect on the decision to invest in infrastructure and on its distribution / location. It is assumed that large firms have sunk investments, giving them a vested interest in maintaining or upgrading the quality of infrastructure in areas where they are located. By virtue of their size, they are more likely to take action to ensure that the improvements to infrastructure occur. The outcome of such influence could mean that there are "political distortions" in the spatial allocation of infrastructure investment, ultimately economically disadvantaging some regions or areas.

Haughwout (2002), in an analysis of the effects of infrastructure investment in 33 large US cities, found that households derive more benefits from marginal infrastructure investment than firms. He suggests that public investment decisions may reflect political processes that may not be designed to maximise private sector returns – harkening back to the building of roads to get re-elected (which still occurs overseas, see for example Cadot et al, 2002).

NZ has taken clear steps in the past to avoid the politically driven allocation of major infrastructure works. In the area of electricity, splitting up ECNZ, privatising Contact Energy and establishing a wholesale market for electricity with private sector incumbents accomplished this. With respect to transport infrastructure, the establishment of a national benefit-cost framework and competitive tendering requirements was, in part, done to eliminate political influence in road construction.

Efficient use of infrastructure and its effect on productivity

Another focus in the literature is on contribution of *efficient use* of infrastructure to economic growth. Supporting the view posited by the *World Development Report 1994,* work by Willoughby (2002), Hulten (1997) and Canning and Pedroni (1999) stresses the efficiency of infrastructure utilisation is important. All three posit that there may be an optimal level of infrastructure maximising the growth rate (i.e. if infrastructure levels are too high, it diverts investment away from other productive uses to the point where income growth is reduced). Hulten (1997) takes this further by conjecturing that new infrastructure construction may not only have a limited effect on economic growth, it may have a perverse effect if it draws scarce resources away from maintenance and operation of existing stocks.

Hulten (1997) attempts to document the magnitude of the penalty of inefficiency on economic growth and finds that a 1% increase in the infrastructure effectiveness parameter generates an impact on growth seven times greater than the impact of a 1% increase in rate of public investment. He notes that this result raises the issue of whether it is the efficiency of infrastructure use or issue of *general* productive efficiency (i.e. in use of *all* inputs to production) that is required.

Taking a different tack, Canning and Pedroni (1999) examine 100 developing and developed countries, using physical measures of infrastructure (i.e. length of paved roads, kilowatt hours of electricity generating capacity), and find that there is no evidence of worldwide infrastructure shortage of telephones or paved roads (though some under- or over-provision occurs in less developed countries). They do find that there is an under provision of electricity *on average* across the countries and individually for various countries. Based on their analysis, Canning and Pedroni (1999) argue that the "policy relevant" question for infrastructure investment is not "what is the effect of extra infrastructure, holding everything else constant?" but "what is the net effect of more infrastructure taking into account that infrastructure construction diverts resources from other uses?" This would imply a national benefit-cost framework that makes explicit trade-

offs between different types of infrastructure investment, not just the different options for a given type of infrastructure.

Stephan (1997) found that other exogenous factors are more relevant than the growth of road stock (measured in length of paved road) in explaining TFP growth differences between eastern and western parts of Germany. Also, he postulated that increasing the road stock does not necessarily correspond to *effective* capacity growth, implying that the *capacity utilisation* of roads should be taken into account as well in assessing contribution to TFP growth.

Murillo-Zamorano (2003) decomposes productivity growth into technological progress and technical/economic efficiency change in order to analyse the relationship between energy consumption, both sources of change, and productivity. She finds that technical efficiency in energy use seems to explain a significant part of temporal evolution and cross-country variability of aggregated productivity growth, suggesting that reliance on the "identification of productivity growth with technological progress" may not provide appropriate results in an analysis of factors affecting productivity.

Infometrics report & implications

The report *Generating Growth: Infrastructure* (Infometrics, 2003) is based on interviews with 50 businesses and organisations, with an average of 1725 employees per business (note that 96.8% of NZ businesses have 19 or fewer employees) and 73% of whom had some export sales. The focus of the interviews was infrastructure bottlenecks. The most common constraints identified, in order, were:

- Availability/cost/timeliness of transport
- Accessibility/cost of skills/labour
- Demand for output or sales
- Compliance costs/regulations/RMA
- Exchange rate volatility
- Energy (cost & supply).

Transport concerns have very little to do with domestic transport infrastructure *per se*, rather to do with costs, availability of air cargo, rail wagons, and the speed and frequency of services. Some points were raised about the reliability due to congestion of the roading network. Changes in market demands (i.e. to "just-in-time" delivery and demand for "fresh" produce) have created new pressures on transport delivery services, which may be affecting perceptions of reliability, speed and frequency of services. It is worth commenting on the issue of air cargo and rail transport availability, insofar as these are privately provided services that have been reduced over recent years, probably because they have not been financially viable. The level of service provided is not (currently) a reflection of a physical infrastructure constraint. If there was adequate demand and they were perceived as being profitable, there is no *readily apparent* reason why the operators would not provide more air and rail services.

Infometrics notes the further concern that commuter congestion increases business costs when a wider range of business hours mean higher operating costs. A matter not mentioned, but surely related, is the potential for a decrease in the productivity of labour, if increasing amounts of time are spent in travelling to and from work. It may be worth putting the congestion issue into some kind of perspective: first, the report notes that congestion in Auckland less severe than Sydney, Melbourne, Brisbane, and comparable to Perth, Adelaide and Canberra. No comparisons are

made with urban areas elsewhere internationally. At the same time, however, average daily traffic flows have been increasing by about 4% pa – a rate considerably higher than the annual growth in GDP in NZ. In addition, there are several major transport infrastructure projects proposed for the Auckland area with an assessment including benefit:cost ratios above 4.0, implying that current infrastructure service levels may be sub-optimal.

The (perceived) uncertainty about energy prices (where sufficient contracts have not been negotiated) and the effect of spot prices (where output can be affected) was also raised. NZ electricity costs were the 4th lowest of 48 countries in 2001/02, although recent energy cost rises are expected to shift this position – for example, Australia is reported to now have lower energy costs than NZ. However, Infometrics (2003) noted that there is WIDE variation about whether or not this is an issue within individual industry sectors, being largely dependent on whether or a business has been able to derive a suitable contract. They posit that the problem could be poor management of energy supply to and within the firm. A potentially more serious matter is associated with the perceived security of supply – power cuts and brown outs – are believed to affect international reputation, particular with respect to the ability to deliver goods in sufficient quantity in a timely fashion.

Other types of infrastructure, namely telecommunications / broadband, ICT, water and waste, were only raised as issues in a very limited way. The level of access and cost of ICT services is comparable to other OECD countries and an IMD survey rated adequacy of services rated quite highly.

The report concludes that the executives interviewed stated that they could no longer rely on infrastructure, particularly transport and energy, although Infometrics acknowledged that infrastructure was only one of many factors affecting growth. If the level of risk associated with these uncertainties increases, they suggest that a firm will be less likely to increase their investment, thus inhibiting growth and innovation. While there is certainly cause to take note of the views of these, the largest businesses and organisations within in NZ and hence the ones with the potential for the greatest impact on NZ productivity levels, it is worth considering that:

- In the Small-Medium Enterprise Survey sponsored by the National Bank, infrastructure service issues do not feature as business operating constraints at all. Identifying infrastructure constraints was the primary purpose of the Infometrics report, meaning that there is a definite bias towards such issues
- This may be a case of "pork barrelling": the size of these businesses and the extent of their investment in NZ gives them a particular, vested interest in ensuring that the infrastructure they use is maintained and/or upgraded
- In the report, Infometrics notes that some of the issues about energy infrastructure services could be the result of poor management. It is quite possible that this is also true of some transport-related concerns, insofar as businesses may not have sufficiently developed systems to address the changing market demands. Increased capacity in transport infrastructure may not be the only, or most effective means, of addressing the issues raised.
- NZ's distance from markets probably means that the efficient operation of the transport and electricity networks is more important than in other regions internationally and that maintaining an image of "reliability" is also necessary.

Issues for further investigation

Clearly this note has not begun to address a number of issues, which may or may not be of further interest to the MED at present. A few possibilities are listed below:

- What are the implications of private v. public provision of infrastructure services for economic productivity? (This may have been tackled elsewhere, but was not evident in the research just completed).
- Has the changing nature of market demands (as identified in the Infometrics report) created new pressures on available infrastructure services that require new approaches (some of which may be simply management-related) to resolve?
- The plaint of the larger businesses in the Infometrics study regarding transport and electricity, focused more often than not on complementary service issues (i.e. access to suitable freight cartage mechanisms, spot pricing, etc) rather than being directly related to the infrastructure system itself. Are there macro- or micro-economic policy reasons for the apparent lack of adequate transport services (air cargo, rail wagons) or related to the inability of some firms to negotiate suitable power contracts?
- Haughwout (2002) provides evidence that the price of land embodies improvements to geographically localised infrastructure services and, thus, that the benefits of such services are privately captured. Are there any externalities that are not assigned in this process? What are the implications for infrastructure services provision? Eberts and McMillen (1999) provide an introductory examination of the relationship between agglomeration economies and infrastructure provision and their effects on productivity, which could be improved by an examination of more recent literature on agglomeration economies, as well as reference to the "new economic geography," to further clarify the nature and dynamics of this relationship.

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