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Paper title: **Economic development and investment in transportation infrastructure – an analysis of Wellington's predicament**

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Abstract (200 words):
This paper investigates the relationship between economic development and transportation infrastructure development. The urban region of Wellington, New Zealand is used as a case study as for some time New Zealand has been under investing in its transportation infrastructure compared to average OECD investment levels. The structure of the Wellington regional economy is examined. A sector by sector analysis of the dependency of the economy on transportation services is undertaken. This enables key sectors to be identified so the impact of investment in transportation infrastructure can be considered. This investigation is characterised by the linking of a conventional four stage strategic transportation model with an input-output model for the Wellington region. This enables the impact of investments or lack of investment in transportation infrastructure to be studied. The use of this modelling suite gives insights into the response of key sectors and the economy as a whole to transportation infrastructure investment. This enables current investment profiles to be examined in terms of their adequacy and which sectors are the winners and losers. Thos sectors that benefit from increased transportation investment can be identified including the extent that Government benefits from increased taxation revenue.

Introduction

Goods have little value unless they can be transported and utilised at locations and times where they provide economic benefit. This is the second in a series of papers concerned with the contribution of transportation infrastructure to economic development in Wellington. The first paper by Brennand (2003) was presented at the 26th ATRF conference in Wellington. This paper surveys the Wellington regional economy and identifies those sectors that make the largest contribution to the region's economy. Empirical data suggest there is a strong correlation between economic activity and the demand for travel.

A sector analysis is undertaken to identify those sectors which are likely to be winners with a transport sector productivity increase or alternatively losers should the transport sector productivity decline. These results are then examined in terms of their significance to the overall contribution to the regional economy. The Wellington regional economy has been sluggish in recent years and there has been some concern that low rates of investment in transport infrastructure has been constraining economic growth in the region.

The movement of goods in the Wellington region is investigated. This provides some useful insights into what are the critical links in the region's transportation network and where are the investment priorities. The demand profile throughout the day is examined to determine whether this is a peak period issue or otherwise.

The likely response in the region's economy to an increase in productivity in the transport sector is identified. This is separately determined for road and rail. This produces an effective output multiplier for each dollar of transport network investment. This enables consideration to be given to the relative merits of strategies for improving transport network performance such as investment and road pricing.

The implications on government revenue through taxation as the result of infrastructure investment are considered. The policy options for transport infrastructure investment are discussed.

Empirical evidence for the link between economic growth and transportation

Research undertaken for the Land Transport Safety Authority (2003) using New Zealand wide data has established a correlation between heavy vehicle travel and change in GDP. For every 1% increase in GDP there has been, historically, a 1.5% increase in heavy vehicle travel. This correlation has an R-squared of 0.72.

The annual monitoring report of Greater Wellington Regional Council (2003) records the National Bank economic activity index for the region. The state highway daily traffic flow index is also recorded against year. These are shown in figure 1. If the National Bank economic activity index is plotted against the state highway daily traffic flow index the pattern in figure 2 arises. Clearly there is a strong correlation between the National Bank economy activity index and the state highway traffic flow index. The R-squared for this correlation is 0.96 which is nearly a perfect correlation. A 1% increase in the National Bank economic activity index leads to a 0.99% increase in the daily state highway traffic flow.

The Wellington regional economy

During the 2000/01 financial year economic activities produced $27.53 billion worth of intersector transactions which employed 190,600 people. All dollar amounts in this paper are New Zealand dollars. If household income and consumption is included the total value of inputs and outputs in the Wellington regional economy for 2000/01 was $52.36 billion. The major contributing activities in order of transaction value are shown in table 1.

These are the top ten sectors with the wholesale sector on its own contributing 7.8% of the region's output and the top four sectors of wholesale, central government, finance and retail contributing 24% of the region's output.

Sector sensitivity to transport costs

Changes in transportation productivity will have different impacts on the productivity of different sectors. This relates to the sensitivity of a sector to transport productivity. Conversely, declines in transport sector productivity will result in differential declines in productivity of the various economic sectors. The top ten sectors listed in table 1 for 2000/01 have been analysed for their response to a ten percent change in transport productivity in the road freight area. By way of clarification a ten percent productivity change is one that yields $28.6 million worth of economic savings.

The four stage regional transportation model can be run with a programme of investments to test whether an annual savings of $28.6 million in travel time and vehicle operating costs is achieved for freight movements throughout the region. If a 10 percent discount rate is used the programme of infrastructure investments will need to produce a net present value of savings of $270 million for freight movements.

To achieve this end it is necessary to have a robust freight vehicle matrix in the transportation model. This requires good knowledge of trip movements to obtain reliable estimates of road user benefits but also a good understanding of the spatial distribution of commodity movements so that the correct sector response can be determined for road freight improvements. Unfortunately, in many transportation models the representation of freight movements is frequently poor and inadequate for the purpose. This sector response is shown in table 2. If the transport sector productivity increases, then the response of the sectors in table 2 is positive. If the transport sector productivity decreases then the response of the above sectors is negative.

Whilst none of the sector responses in percentage terms is large in absolute terms wholesale has a sizeable response and the responses of the central government communications, computer services, air services and ancillary services sectors all exceed $100,000. We can conclude that declining level of service on the region's road network will erode the productivity of the regional economy particularly in those sectors. The absolute change in sector output above is largely due to the size of the sector rather than the sensitivity of the sector to transport inputs. The sectors listed in table 3 are generally smaller in terms of total output but are sensitive to transport inputs.

The absolute and percentage changes in productivity in table 3 are more significant than the previous sectors. This is true even though some of these sectors only have a small base output. This list shows which sectors in the Wellington regional economy are particularly at risk

through a reduction in transport sector productivity due to a decline in level of service. Alternatively these sectors are likely to show the strongest response to an increase in transport infrastructure productivity.

Investment in transport infrastructure to achieve a 10% increase in transport sector productivity will provide a one off stimulation of the construction sector. At current levels of transport funding the value of additional construction could be in the order of $10 million to achieve a ten percent productivity increase in the transport section. The effect of this increased investment will flow through the whole regional economy including some feedback into the construction sector. The main beneficiaries of this investment in terms of output are shown in table 4. The impacts of a ten percent productivity change in the transport sector on the total regional economy are as shown in table 5. Again, if the transport productivity changes are positive then the changes in table 5 will be positive. A decline in transport sector productivity will lead to a decline in overall regional productivity.

Table 5 shows that transport sector productivity changes have the potential to change regional output by many millions of dollars. A ten percent road freight productivity increase will lead to an expanded road freight transport task of 0.16% because of the 0.11% expansion in the regional economy.

Investment in transport infrastructure to achieve a 10% increase in transport sector productivity will provide a one off stimulation of the construction sector. At current levels of transport funding the value of additional construction could be in the order of $90 million (assuming a benefit cost ratio of 3.0 for the investment) to achieve a ten percent productivity increase in the transport sector. The effect of this increased investment will flow through the whole regional economy as shown in table 6. Because of an increased economic output the freight task of the region will grow by 0.50%.

Goods movement around the Wellington region

Daily volumes of Medium Commercial Vehicle (MCV), Heavy Commercial Vehicle Class 1 (HCV1) and Heavy Commercial Vehicle Class 2 (HCV2) on the region's state highway network for 2001 are shown in figures 3 and 4. Heavy vehicle flows in the Petone, Seaview and Gracefield areas are also shown. These are total two way volumes. Splitting the volumes by direction shows that the flows are reasonably balanced. Figures 3 and 4 identify those links that are significant in terms of the volumes of freight vehicles carried. State Highway1 (SH1), Porirua to Ngauranga, State Highway2 (SH2), Lower Hutt to Ngauranga, SH1 Ngauranga to Kilbirnie, and Petone Esplanade are important links.

A key point to note from this analysis is that the majority of freight movements in the region by road are over short to medium length journeys. That is less than 20km. Long distance freight movements are in fact a minority and where they do occur are more likely to be associated with SH1. This illustrates the importance of having an efficient northern access out of Wellington if the region is to be a successful economic hub for the southern north island.

The movement of freight between SH1 and SH2 appears to take place at Ngauranga with only a small number of movements using SH58. This is both a function of the distribution of freight movements and the alignment problems on SH58.

The highest daily freight movements occur on the Ngauranga-Kilbirnie section of SH1. This illustrates the importance of maintaining efficient movement on this part of the highway and highlights the urgency of addressing the efficiency of movement, on the highway through central Wellington and further south.

Some aspects of figures 3 and 4 are not unexpected. Generation of freight volumes are associated with the larger regional CBDs, the Petone-Seaview-Gracefield area, the Port and the Kilbirnie-Rongotai area. This data shows that there is not a large opportunity for freight to be carried by rail instead of road. This is due to the short distances of haulage and the significant volume of trips in the Ngauranga-Kilbirnie area.

Figure 5 shows how the total freight vehicle movements on the region's state highway network distributed by time of day. This distribution is subdivided by direction (to Wellington and from Wellington). The distribution of car traffic by time of day is shown for comparison.

The profile by time of day for freight vehicles is different from the general traffic profile in several respects. There are far more pronounced peaks with the general traffic profile with a greater dip between peaks. There is also a much higher level of general traffic trips than the freight vehicle trips in the post afternoon peak period. This is shown in table 7. The freight vehicle profile shows a distinguishable morning peak and only a slight decline in the interpeak period. Approximately 54 percent freight vehicle trips are made in the period between peaks whereas the corresponding number for general traffic is about 40 percent. This situation has benefits for freight trips as a significant proportion of freight vehicle trips are made when general traffic volumes at interpeak times are on average about 65 percent of peak period flows. When it is understood that interpeak growth rates for general traffic are high this raises concern about the future.

The general traffic afternoon peak has a sharp peak that fortunately occurs when freight vehicle numbers are rapidly declining. The general traffic profile shows a significant tail after the afternoon peak where there is low use of the off peak (outside peak and interpeak) periods by freight traffic. For example, as a proportion of total trips the post afternoon peak period has twice the volume of general traffic trips as compared to freight vehicle trips. The other interesting feature is that inbound to Wellington freight vehicle trips occur in greater numbers than outbound freight vehicle numbers in the morning. The reverse is true in the afternoon with the cross over point about midday.

This information needs to be carefully reflected in the freight matrix used in four stage regional transportation model. This, along with a spatial appreciation of commodity movements enables the correct sector response to be determined. The intensity of the freight flows in the Hutt-Porirua-Wellington area makes this a priority area for infrastructure investment.

The region's economic response to increased transportation productivity

The 2000/01 Wellington regional input-output model can assess the impact of transport sector productivity gains. The region wide productivity gain can be estimated in table 8 from the Wellington regional input output model, 2001.

Type I multipliers include the impacts of one productive sector upon another. Type II multipliers include all the intersector impacts accounted for by type I multipliers plus it includes the impact of increased household income and consumption.

This means, for example, for every one dollar productivity gain in the road freight sector this will lead to a $1.63 gain for the regional economy as the effects on every other sector in the regional economy are accounted for. If the impacts on households are included this will lead to a $1.94 gain for the regional economy. This productivity gain will be distributed across every sector in amounts related to their relative transport sensitivity as discussed above. In terms of the analysis above, the principal beneficiaries will be the wholesale, road freight, forestry, air services, meat processing, central government and paper product sectors. Similar arguments can be raised for road passenger movement and rail/sea productivity gains. The corresponding benefiting sectors will be retail, central government and wholesale sectors respectively.

These multiplier effects are very important. If a road improvement project is put forward with a benefit cost ratio of 3, for example. This represents an increase in national economic benefits of three dollars for every dollar invested. If the benefit cost ratio is correctly calculated this is a measure of transport sector productivity gain through travel time savings, accident savings and vehicle operating cost savings. There may be economic benefits that are not productivity related such as CO_2 reductions but these will normally be small.

It is worth noting here that Transfund, the national transport infrastructure funding agency, calculates the value of time for work travel using the marginal cost for labour. This value of time is provided as a national average figure. Using the 2001 census data it was found that the Wellington regional median income was 21 percent higher than the national median. This leads to the conclusion that Transfund's procedures significantly undervalue the benefits of Wellington projects.

Assuming that the economic benefits do translate into transport sector productivity gains we can assess the impact on the regional economy. This assumption can have some problems particularly for small projects which might generate time savings of just a few seconds. There are problems with the country using a national average value of time, as this is likely to undervalue the true economic benefits in Wellington as it has the country's highest per capita income levels.

Most road improvements are dominated by benefits accrued to moving people. Freight movements typically amount to less than ten percent of total traffic volumes although in the rural parts of the region freight movements can make up a much higher proportion of total traffic volume.

Recognising the above qualifications, a road improvement project with a benefit cost ratio of 3 (with a discount rate of 10%) could provide a $0.513 per annum gain to the region's economic sectors and a total gain of $0.611 per annum to the regional economy for every dollar invested. Similarly a rail improvement with a benefit cost ratio of 3 could provide $0.451 per annum for the region's economic sectors and $0.534 per annum to the regional economy for every dollar invested. These are healthy returns for the regional economy.

To understand what this means in terms of a contribution to the Wellington regional economy, the total value of intersector transactions for the 2000/01 was $27.53 billion and total regional output was $52.36 billion. Average per annum expenditure on the region's

roads for the 1997-2002 period was $18.8 million for state highways and $7.9 million for local roads making a total of $26.7 million per annum.

This means our investment rate in new road infrastructure was 0.097% of the total intersector transaction value and 0.036% of the total regional output. If we assume that all these projects achieved a benefit-cost ratio of 4 which was the funding cut off at the time (which may not be the case for unsubsidised local roads) this may have contributed $21.8 million per annum in productivity gains to the regional economy or a 0.04% per annum growth rate. This assumes everything else remains the same. To get a 1.0% per annum productivity gain an investment of about $641 million per annum in the region's road network is required.

In addition there will be a one off return to the regional economy due to increased construction. The type I construction multiplier is 1.61 and the type II construction multiplier is 1.91. This means for every dollar invested in building projects there is a $1.61 increase in intersector activity and the $1.91 increase in total regional output.

Taxation implications for increased productivity

An argument that is sometimes mounted for not increasing the investment in transport infrastructure is that it will either reduce the size of budget surpluses or reduce the availability of funds for expenditure in other areas where government believes greater priority exists for expenditure.

Investment in road infrastructure increases the intersector productivity and total regional output. This will in turn increase the size of government's taxation take. Consider the investment of an additional dollar on road projects that has a benefit cost ratio of b. This will lead to an increase of intersector productivity of $1.53b and a total increase in regional output of $1.92b distributed over the life of the project. In addition there is a one off increase in intersector productivity of $1.61 and total output of $1.91 due to construction. These estimates are low as they are based on road passenger multipliers. Road freight contributions are ignored as typically they make up a small percentage of the trips on the road network.

Each of these contributions to the regional economy will be subject to tax. The intersector productivity increase will lead to an increase in the Goods and Services tax of 12½ percent. Profit margins will attract 33 percent but these are ignored for the purposes of the calculation. The difference between the total regional output increase and the intersector productivity increase will be made up in increased household income, savings and other. These will be taxed at a variety of rates, but a rate of 19 percent is used as a conservative proxy because it is the lowest income tax rate.

Hence, over 25years the increased tax take due to the extra dollar invested is

$$\$0.125 \times 1.53b + 0.19 \times (1.92 - 1.53)b + 0.125 \times 1.61 + 0.19 \times (1.91\text{-}1.61) = \$0.266b + 0.256$$

The term 0.125 x 1.53b represents the Goods and Services tax revenue increase due to more activity in the economic sectors due to more efficient road freight movement. The term 0.19 x (1.92 – 1.53)b accounts for the increased tax revenue due to household related activity. The term 0.125 x 1.61 is the Goods and Services tax revenue increase due to increased construction activity. The term 0.19 x (1.91 – 1.61) is the increased tax revenue due to household activity stimulated by increased construction.

If we approximate the benefit stream by a uniform stream of benefits then the increase tax take in year one is:

$$\$0.258 + \frac{0.266b}{9.524} = \$0.258 + 0.0279b$$

and each subsequent year the tax take is \$0.0279b.

The time in years to recover that extra \$1 investment is then $\frac{26.6}{b}$

The corresponding time for a rail/sea investment is 30.9/b. This is shown in table 9.

Even with the very conservative assumptions made in this calculation including a low value of time used in Transfund's procedures, government recovers quickly its additional expenditure through an increased tax take on increased productivity provided the benefit cost ratio of the additional expenditure is high. This means that instead of losing the opportunity to spend that additional dollar on other things, expenditure on high benefit cost transport infrastructure increases government's opportunity to spend funding elsewhere or increases its long term surpluses.

This provides a good argument to increase government expenditure on transport infrastructure in Wellington to a level that all projects with a benefit cost ratio of at least three and most probably two are funded.

Policy implications

There are significant policy implications with respect to transport network development. The information provided in previous sections suggests that transport interventions may make a positive contribution to regional productivity.

It should be appreciated that transport interventions are only one of many factors that influence regional productivity and so measuring the consequence of a transport intervention is likely to be difficult.

The other point to note is that transport demand is continually growing as seen by increasing volumes of traffic on our roads. The reasons for this growth are many and not all the trips directly relate to regional productivity activities. This means regional productivity activities are experiencing growing competition for access to the transport network.

This leads to a decline of level of service due to growing demands which if left unchecked will lead to a productivity decline in the region. This means that if the rate of transport infrastructure investment is sufficient to overcome the decline in level of service due to growth there will be a net gain in regional productivity. If the investment rate in transport infrastructure is insufficient to overcome the decline in level of service due to growth there will be a net loss in regional productivity.

Where there is a net decline in regional productivity due to a reduction in the network level of service those sectors that will most be affected will be those that are most sensitive to travel costs. In terms of the observed impact on the regional economy those will be the industries

identified in section 3. The effect on the regional economy will be subject to the multipliers identified in section 5.

The decline in the level of service on the Wellington regional network is estimated to be $135 million per annum where the decline is increasing delay, vehicle operating costs and accidents all expressed in monetary terms. This has been calculated using the regional strategic transport model.

In the section headed "The region's economic response to increased transportation productivity", it was noted that there was an average annual investment of $26.7 million per annum in the road network. This would yield $90.8 million in economic benefits if an average benefit cost ratio of 3.4 was achieved for each project. The 3.4 has been derived by commencing with a benefit cost funding cut off of 4.0 and assuming 5% of expenditure per annum is not actual construction but design and related tasks. This has been confirmed by examination of recent annual programmes. Another 10% allows for average cost increases (during construction) which decrease the effective benefit cost ratio. At the current rate of decline in level of service this amounts to a net $44 million per annum reduction in the road transport productivity. This translates into a $72 million (or 0.26%) decline in regional sector productivity per annum.

The policy response options are either to increase road transport infrastructure investment or to introduce travel demand management tools to overcome the decline in level of service due to traffic growth. Road pricing is required to overcome traffic growth induced level of service decline of the scale we are considering here.

The design of a road pricing scheme is critical. To be beneficial the economic benefits gained in terms of time, vehicle operating and accident savings will need to exceed the additional cost of road charges and overcome the underlying decline in level of service due to traffic growth. This will vary from sector to sector as each sector has a different value of time.

Transfund's Project Evaluation Manual provides an average value of time for commercial vehicles. These are provided in table 10.

Consider a heavy commercial vehicle I and a heavy commercial vehicle II being driven on a congested highway in Wellington. Consider a 15km trip at an average speed of 40km/hr or the alternative to pay a user charge to use a higher level of service lane where average speeds are 70km/hr.

The value of time for the HCV1 and driver in moderately congested conditions (40km/hr) is $39.70/hr and for the HCV2 it is $50.70/hr. The value of time for the HCV1 at 70km/hr is $37.30/hr and the HCV2 at the same speed is $48.20/hr. The travel costs for the 40km/hr and 70km/hr trips over 15km are shown in table 11.

In the case of the HCV1 it is worth paying an additional user charge up to $6.92 or $0.46/km to achieve the level of service offered by the 70km/hr lane over the 40km/hr congested lane. Similarly it is worth paying up to $8.68 (or $0.58/km) in additional user charge for the HCV2 to achieve the same enhanced level of service. As discussed before Transfund's procedures significantly undervalues time in the Wellington region. In reality the willingness to pay tolls is likely to be much higher than the figures presented here.

These figures are based on a global average value of time to transport freight. In reality the different sectors have different values of time dependent on their sensitivity to travel costs. The industries identified in section 3 as sensitive to transport inputs are likely to have a higher willingness to pay tolls than that identified for the global average. Such industries would demonstrate significant net gains in an environment where paying user charges guaranteed higher levels of service.

Conclusions

The Wellington regional economy is dominated by the wholesale, central government, finance and retail with these four sectors making up 71% of the regions output in 2000/01. Changes in the productivity of the transport sector will be highly significant for the wholesale, road freight, forestry and air services and other sectors in Wellington.

Road freight movements in the Wellington region are dominated by trips under 20km in length. On the state highway network the sections from Porirua and Lower Hutt south to Kilbirnie are very important. In particular there is an urgent need to ensure efficient movement of freight south of the Terrace Tunnel on SH1.

Transport sector multipliers vary from 1.70 to 1.94 in the 2000/01 Wellington regional economy. This means transport sector productivity gains will have useful flow on effects for the regional economy. Reduction in transport sector productivity due to declines in the level of service offered by transport infrastructure will adversely impact on regional productivity and could have impacts measured in millions of dollars.

Current investment rates in road infrastructure amount to 0.097% of the total intersector transaction value of the regional economy and 0.036% of total regional output. This investment rate is insufficient to overcome the level of service decline due to traffic growth and represents a decline in economic value of $44 million per annum and a decline of regional productivity of $72 million per annum.

Investment in road infrastructure will not only stimulate the economy through productivity gains but the construction activity itself will increase region wide economic activity. There is some concern, however, that Transfund's procedures significantly undervalue the benefits of infrastructure investment in Wellington.

An understanding of sector economic responses to transport infrastructure investment can be achieved by using a conventional four stage transportation model in tandem with an Input-Output model. To achieve this end the freight trip matrix needs to be robust and a good spatial understanding of the underlying commodity flows is required.

Increased investment in transport infrastructure may not deplete the funds available to Government for public expenditure. Investment in projects with good benefit cost ratios will produce efficiency gains in the Wellington regional economy which in turn will yield increased tax returns to government. This increased taxation is expected to recover the initial investment quickly depending on the benefit cost ratio.

Analysis shows that there is a significant rate of decline in level of service due to inadequate investment in the region's transport network. This decline in level of service is slowing regional productivity and employment growth.

The options for responding to this situation include investing at a higher rate in transport infrastructure, managing travel demand growth or a combination of the two approaches. Road pricing is the only travel demand management tool that can sensibly operate to produce the scale of impact needed. It can also provide a revenue stream to lift investment rates in transport infrastructure. Careful attention to the design of the road pricing scheme is important to ensure the scheme leads to a net gain in productivity. It appears that many Wellington regional commercial interests would receive significant net gains through a user charge – level of service environment. Again these net gains are likely to be significantly underestimated by Transfund's procedures.

References

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Appendix A

Table 1 Major contributing activities in order of transaction value

Sector	Output ($ billion)
Wholesale	2.14
Central government	1.52
Finance	1.48
Retail	1.48
Owner/occupier	1.26
Communications	1.10
Property	0.94
Computer services	0.92
Air services	0.85
Ancillary services	0.69

Table 2 Sector response

Sector	Output ($million)	Road freight elasticity	Change for 10% road freight productivity ($million)	Percentage change
Wholesale	2144	0.02915	0.834	0.039
Central govt	1524	0.00435	0.124	0.008
Finance	1479	0.00286	0.082	0.006
Retail	1475	0.00337	0.096	0.007
Own/occ	1256	0.00146	0.042	0.003
Communications	1099	0.00511	0.146	0.013
Property	936	0.00226	0.065	0.007
Computer	921	0.00365	0.104	0.011
Air services	849	0.00951	0.272	0.032
Ancillary services	685	0.00643	0.184	0.027

Table 3 Sector response

Sector	Output ($million)	Road freight elasticity	Change for 10% road freight productivity ($million)	Percentage change
Road freight	286	0.15815	4.523	1.58
Rail/sea transport	420	0.13060 (rail/sea elasticity)	5.485	1.31
Forestry	80	0.10431	2.983	3.73
Sawmilling	58	0.03868	1.106	1.91
Meat processing	218	0.03470	0.992	0.46
Other non metal	84	0.02945	0.842	1.00
Wholesale	2144	0.02915	0.834	0.039
Seafood	31	0.02892	0.827	2.67
Other food	77	0.02868	0.820	1.07
Paper and products	216	0.02791	0.798	0.37

Table 4 Main beneficiaries of investment in terms of output

Sector	Output ($million)	Construction elasticity	Change for $10 million investment ($million)	Percentage change
Construction	277	1.08399	10.840	3.91
Local government	406	0.13943	1.394	0.34

Table 5 Impacts of 10% productivity change in the transport sector on the total regional economy

	Road freight	Road passenger	Rail/sea freight
Change ($million) on intersector activity	29.231	7.196	14.33
Percentage change	0.11	0.026	0.052
Change ($million) total regional output	55.513	27.662	71.232
Percentage change	0.11	0.053	0.14
Estimated employment change	202	50	99

Table 6 Effect of increased investment through the whole regional economy

	Effect of an additional $90 million in the construction sector
Change ($million) on intersector activity	145.2
Percentage change	0.52
Change ($million) total regional output	171.7
Percentage change	0.33
Estimated employment change	1010

Table 7 Comparison of general trips and freight trips

Time Period	Pre AM peak 12pm-7am	AM peak 7–9am	Interpeak 9am–4pm	PM peak 4–6pm	Post PM peak 6pm–12am
General traffic percentage of daily trips	4.7	17.0	39.5	17.6	21.2
Freight vehicle percentage of daily trips	6.9	15.2	54.4	13.4	10.1

Table 8 Region wide productivity gain

Sector for productivity gain	Road freight	Road passenger movement	Rail/sea freight
Region wide multiplier Type I	1.63	1.53	1.43
Region wide multipler Type II	1.94	1.92	1.70

Table 9 Corresponding time for rail/sea investment

Benefit cost ratio	1	2	3	4	5	6	7
Time required road (years)	26.6	13.3	8.9	6.6	5.3	4.4	3.8
Time required rail/sea (years)	30.9	15.4	10.3	7.7	6.2	5.1	4.4

Table 10 Average value of time for commercial vehicles

Trip	Value of time ($/hr)
Medium/heavy commercial vehicle driver	20.10
Maximum increment for congestion for freight driver	3.15
Heavy commercial vehicle I and freight time	17.10
Heavy commercial vehicle II and freight time	28.10

Table 11 Travel costs for 40 km/hr and 70 km/hr trips over 15 km

	Time taken at 40km/hr	Travel cost at 40km/hr	Time taken at 70km/hr	Travel cost at 70km/hr	Travel cost saving
HCVI	0.375 hr	$14.89	0.214 hr	$7.97	$6.92
HCVII	0.375 hr	$19.01	0.214 hr	$10.33	$8.68

Appendix B

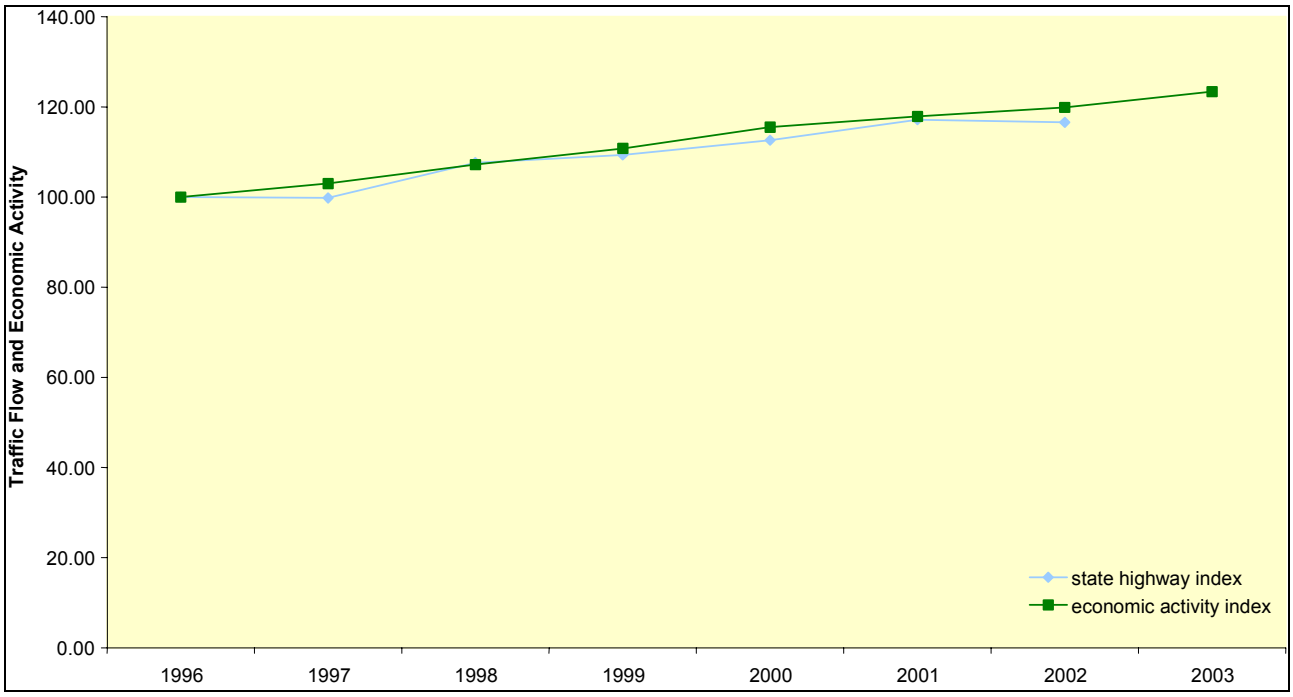

Figure 1 Traffic flow and economic activity indexes versus year

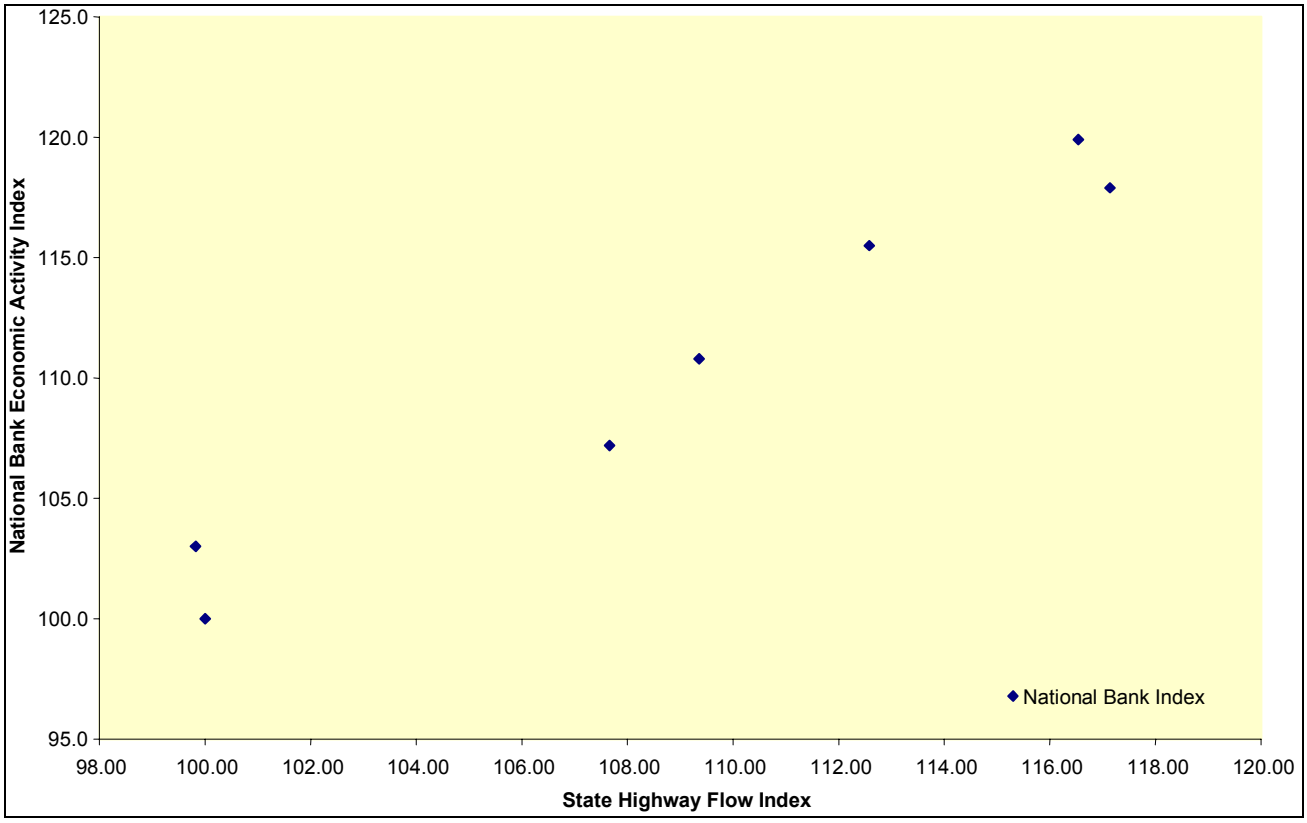

Figure 2 National Bank index versus state highway flows

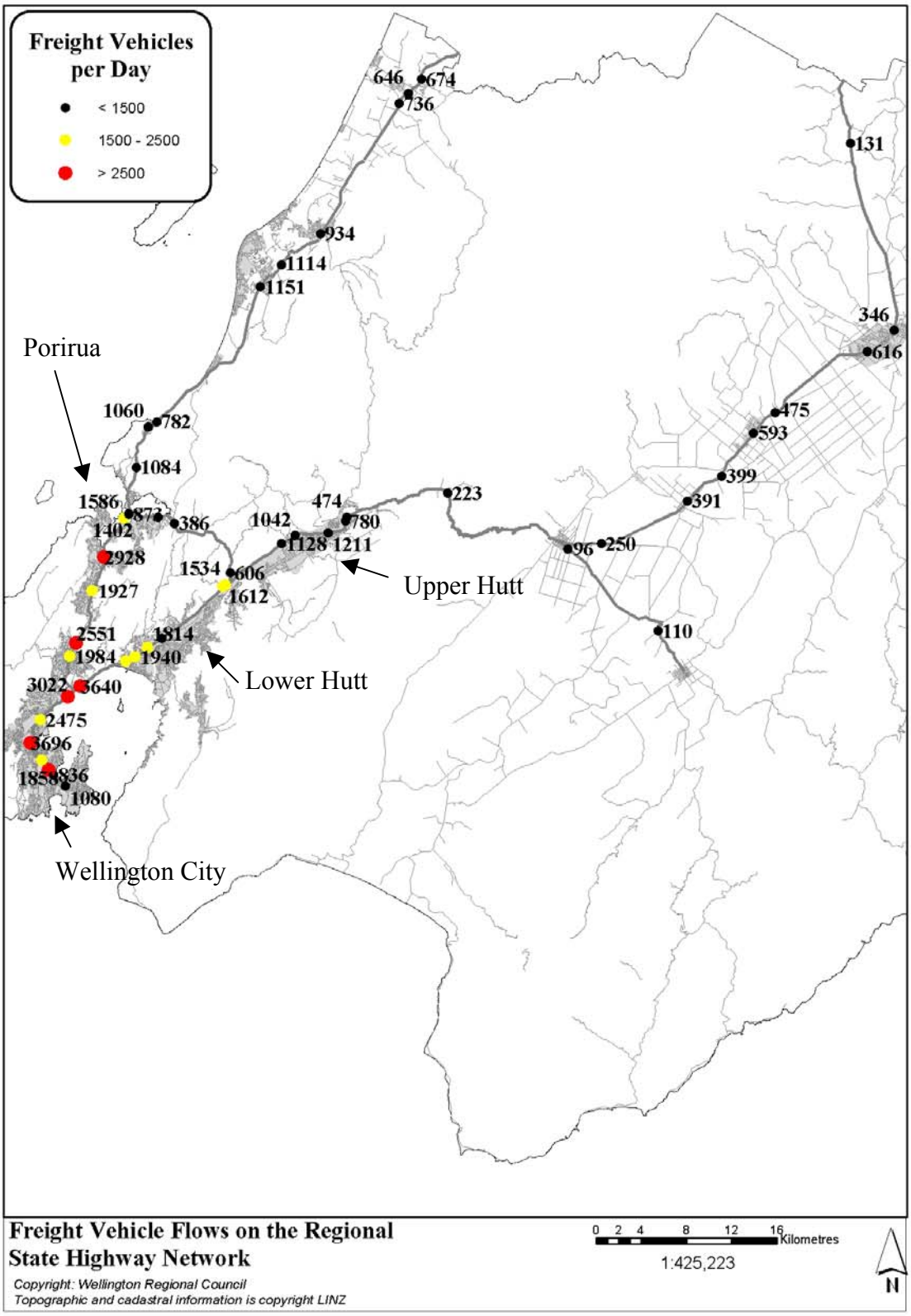

Figure 3 Freight vehicle flows on the regional state highway network

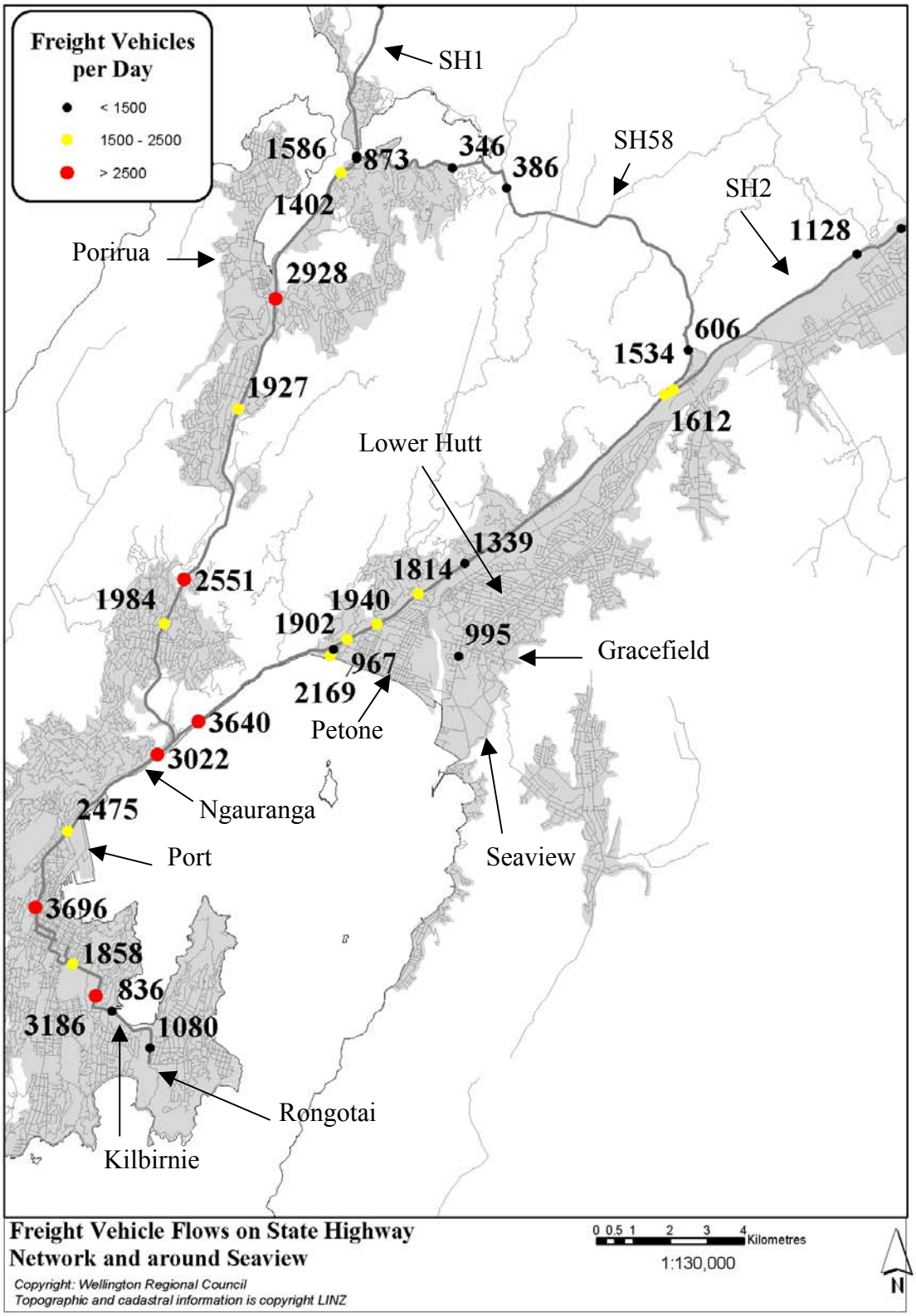

Figure 4 Freight vehicle flows on state highway network and around Seaview

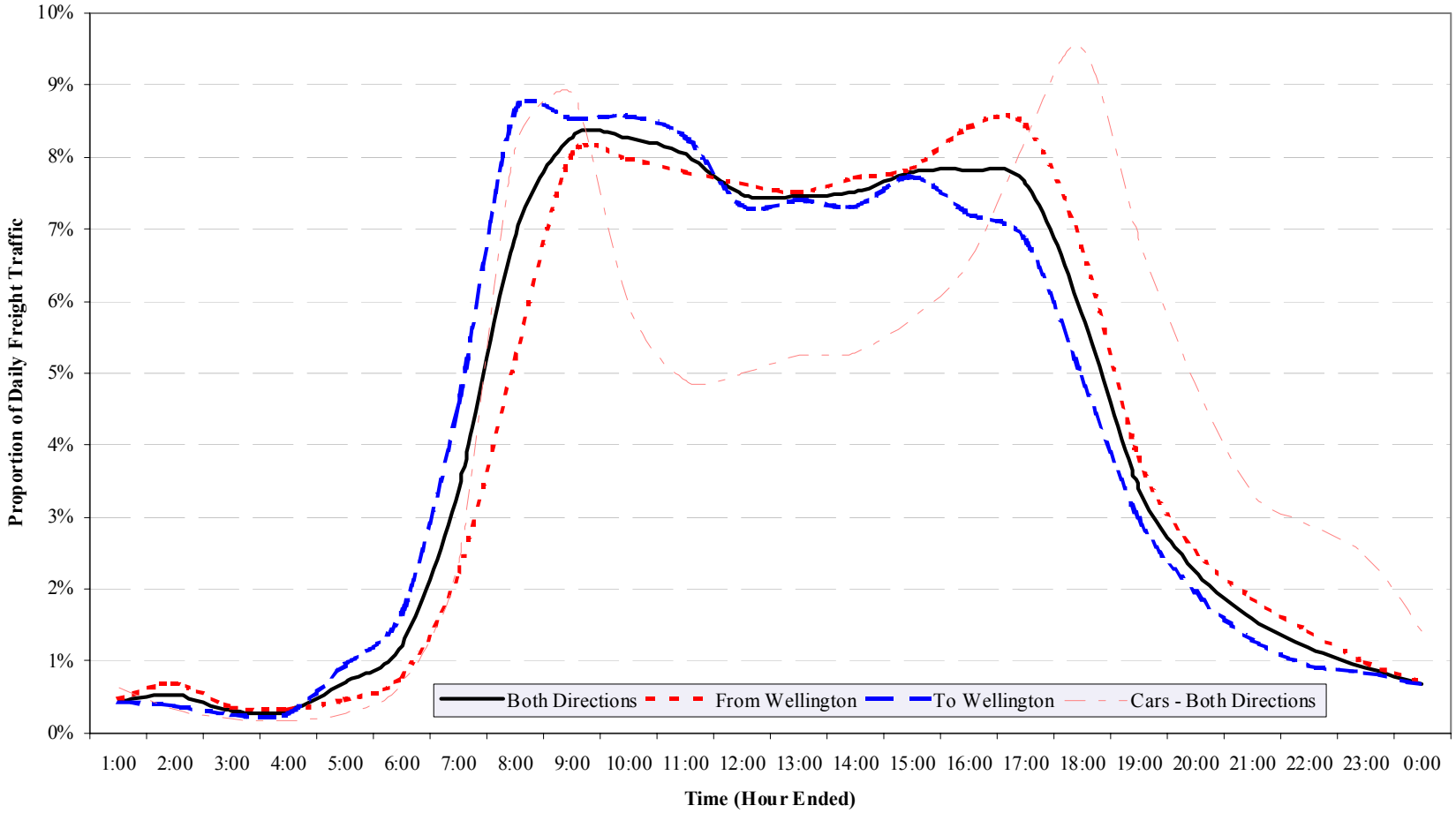

Figure 5 Freight vehicle proportions by time of day