Report to:

Rail and Maritime Transport Union and Dunedin City Council

BUSINESS CASE FOR
BUILDING ROLLING STOCK IN NEW ZEALAND

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Business case for building rolling stock in New Zealand

1 Business case

This project was commissioned by the Rail and Maritime Transport Union (RMTU) and Dunedin City Council (DCC). The purpose of the project was to estimate the likely economic benefit of New Zealand building new rolling stock for the Auckland rail network. Kiwirail has plans to purchase 38 three-car Electric Multiple Units (114 cars), and 13 electric locomotives. This new rolling stock is likely to cost NZ$375 million to produce in New Zealand.

Some stakeholders question whether New Zealand has the capacity to build the rolling stock in the timeframe suggested in Kiwirail's Industry Engagement Document. We have therefore estimated impacts for two scenarios: a "mandated" scenario and a "constrained" scenario.

The key benefits of producing the rolling stock in New Zealand, at a national level, include:

- an average of 1,270 full-time equivalents (FTEs) employed across New Zealand over a period of 45 months (mandated scenario) or 770 FTEs across New Zealand over a period of 69 months (constrained)
- NZ$250 million (mandated) or NZ$232 million (constrained) added to total GDP, including NZ$117 million (mandated) or NZ$108 million (constrained) in direct GDP.

Our research suggests that overseas manufacturers would need to produce the rolling stock at between ***29 percent and 62 percent less*** than the price of manufacture in New Zealand to offset the benefits to New Zealand GDP of producing the trains here. The range is dependent on whether we consider only the ***direct*** benefits (29 percent) or ***total*** benefits (62 percent) to New Zealand GDP of building the rolling stock here.

Our research suggests that at these prices, the rolling stock is unlikely to be sourced from quality western suppliers. It may be possible for Asian sources to supply at prices close to these. However, the quality and expected life could be less than those from Europe and North America, and we suspect from New Zealand. It is possible also that total operating costs could thus be higher. It therefore makes business sense to produce the trains here, not only from a ***national*** perspective, but also from a ***commercial*** (Kiwirail) perspective.

There are a number of further economic benefits of building the rolling stock in New Zealand that are discussed in this report. These include developing and maintaining skills in New Zealand; the opportunity to capture part of a NZ$15 billion rolling stock industry; opportunities for innovation and technology spill-overs to other industries; ongoing maintenance contracts with associated jobs and contribution to GDP; reduced exchange rate risk or risk-minimisation costs; and Crown revenue and trade balance benefits.

2 Introduction

This project was commissioned by the RMTU and DCC. The purpose of the project is to estimate the likely economic benefits of New Zealand building the new rolling stock required by Kiwirail. These benefits include those that are quantifiable in terms of employment, GDP and output generated, and the wider benefits that are not as easily quantified, such as building and maintaining skills in New Zealand, developing export capability, or technology and innovation spill-overs.

2.1 Background and definition

Kiwirail has announced plans to purchase 38 three-car EMUs (114 cars), along with 13 electric locomotives, as detailed in *Auckland Metro EMU Procurement: EMU Industry engagement document* (IED). Throughout this report, reference to "rolling stock" refers to this planned purchase.

The Government has announced a budget of up to NZ$500 million for the purchase of rolling stock for Auckland, with a proposed delivery schedule to begin in the first quarter of 2013.

The immediate question arises as to what, if any, advantages there are to manufacturing the rolling stock here, rather than having them fully imported. This question is the focus of this report.

2.2 Outline of the report

Section 3 presents the quantifiable impacts in terms of employment, GDP and output estimated by Computable General Equilibrium (CGE) modelling and multiplier analysis.

Section 4 discusses the wider economic benefits of building the rolling stock in New Zealand.

Section 5 outlines the methodology used to reach the results presented in section 3. Both CGE modelling and multiplier analysis were used to estimate impacts, with CGE modelling used at the national level and multiplier analysis used at the Regional level.

3 Core economic analysis

This chapter presents the context of the project, and the expected impacts on employment, GDP and output of building the rolling stock in New Zealand.

Throughout this chapter we present two scenarios. The production timeline as laid out in the IED calls for delivery of all rolling stock within 45 months ("mandated" scenario). Some stakeholders believe a 69-month timeline would be more realistic in terms of capacity constraints ("constrained" scenario). We thus present results for both scenarios.

3.1 Context: pricing, skills and capital

The cost of manufacturing the rolling stock is expected to be around NZ$375 million. This includes the cost of 38 three-car EMUs at a cost of NZ$6.9 million each, 13 locomotives at NZ$8 million each, and around NZ$8.5 million in constructing a test-track, dedicated EMU assembly workshop, and semi-automated welding stations.

Around 31 percent, or NZ$115 million, of this figure will almost certainly be captured by overseas providers. The key question is whether or not it makes sense, from a business case point of view, for New Zealand to do as much as it can of the production in New Zealand (i.e. the other NZ$260 million).

Analysis elsewhere in this report shows the size of the international rolling stock market. Our analysis also provides an insight into the typical cost of building EMUs overseas. Figures on contracts for EMUs are replicated in Table 3.1.

Table 3.1 Unit cost of EMU vehicles, March 2010

Purchaser	Description	Quoted currency	NZ$m	Cost/EMU
New Zealand (proposed)	38 three-car EMUs	NZ$271m	$270.8	$7.1
Germany	26 three-car and 22 five-car EMUs	€200m	$390.2	$8.1
Poland	5 four-car EMUs	91 m zoty	$45.5	$9.1

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Our analysis of contracts being finalised internationally raised several important points:

- The cost of producing EMUs in New Zealand is very much in line with international trends. The figure for the New Zealand EMUs of NZ$271 million is based on the unit cost of NZ$6.9 million plus the further NZ$8.5 million to be spent on plant. This results in a total unit cost of NZ$7.1 million, below the cost of the EMUs being produced for Germany and Poland, which are slightly larger (four-car units for instance).

- The vast bulk of most large-scale projects are still being completed by major Europe and North America-based train manufacturers, rather than the stereotypical low-cost Asian manufacturer. The idea that we could get the trains built cheaper elsewhere may be true, but almost all rolling stock purchases being made elsewhere are sticking with companies that have established quality and safety records.

- The NZ$ is currently at a level above its long-term average. The figures given for EMU production overseas are thus likely to be underestimated in NZ$ terms. The comparative cost of building in New Zealand is thus likely to be even lower over the long-term.

The benefits of building the rolling stock in New Zealand go well beyond the possibility that we may be able to build them as cheaply here as major international manufacturers could build them. The benefits we would gain by developing and maintaining skills in New Zealand would include export potential, the possibility for spill-overs into other industries, and capacity-building that will allow us to undertake similar or associated future projects here.

In addition, there is the need to consider "whole-of-life" costs, rather than just initial manufacturing costs. Even if an overseas supplier can produce the rolling stock at a lower price than that of producing in New Zealand, there may be substantially lower whole-of-life costs in making the trains here, with better access to ongoing maintenance facilities here.

Work currently underway by the Industry Capability Network (ICN) suggests that costs for major system acquisitions overseas are often far higher when seen from a whole-of-life perspective. In particular, costs such as whole-of-life repair costs; long lead and down time costs; spare parts delivery time costs; lack of control over design changes; and ongoing maintenance and operator training costs tend to be far higher with offshore purchases. The fact that New Zealand is often a small player in a large market also means that we may not be a priority to an overseas supplier once the original manufacturing has been completed.

3.2 National impacts

CGE modelling, explained in detail in section 5.2, was used to estimate the expected national impacts of the project. We look at the national impacts at two levels – direct, and indirect and induced. Direct impacts refer to the employment, GDP and output generated in direct spending on the manufacture of the rolling stock. Indirect and induced impacts refer to spending by suppliers to the project (indirect or upstream impacts) and by those employed in the manufacturing process (induced, or downstream impacts).

3.2.1 *Direct impacts*

Table 3.2 summarises the direct impacts for both scenarios.

Table 3.2 Direct employment, GDP and output impacts, National

CGE impacts: Mandated	Direct
Employment (one-year FTEs)	2,093
average across years	558
GDP (NZ$2009m)	$117
Output (NZ$2009m)	$289
CGE impacts: Constrained	**Direct**
Employment (one-year FTEs)	1,940
average across years	337
GDP (NZ$2009m)	$108
Output (NZ$2009m)	$269

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Under the ***mandated*** scenario, the project is expected to result in the equivalent of around 2,090 new one-year full-time equivalents (FTEs). One must be careful in interpreting this figure. It does not mean that more than 2,000 new workers will be employed at any one time. It means that over the 45 months of the project, a total of around 2,090 ***one-year*** FTEs will be employed. In other words, ***on average***, around 560 new FTEs will be employed across the 45 months.

The mandated scenario sees direct GDP increase by NZ$117 million as direct output increases by NZ$289 million.

Should production take place over the longer, ***constrained***, period, the equivalent of around 1,940 new one-year FTEs will be created, or nearly 340 ***on average*** across the 69 months.

Under the constrained scenario, direct GDP would rise by NZ$108 million. Direct output would rise by NZ$269 million.

3.2.2 *Indirect and induced; and total impacts*

The total impact on the national economy is far larger than the direct impact on job and GDP creation in direct production of the rolling stock. This fact is highlighted in Table 3.3.

Table 3.3 Indirect and induced employment, GDP and output impacts, National

CGE impacts: Mandated	Indirect & induced	Total
Employment (one-year FTEs)	2,678	4,771
average across years	714	1,272
GDP (NZ$2009m)	$134	$250
Output (NZ$2009m)	$284	$573
CGE impacts: Constrained		**Total**
Employment (one-year FTEs)	2,485	4,425
average across years	432	770
GDP (NZ$2009m)	$124	$232
Output (NZ$2009m)	$262	$531

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In the ***mandated*** scenario, a further 2,680 one-year FTEs, or 714 on average across the 45 months, are created in supplier industries and in industries where workers building the trains spend their incomes. This suggests that there will be large gains in employment upstream and downstream. Exactly what sorts of occupations these new workers will be employed in is discussed further in section 4.1.

Indirect and induced gains to GDP reach NZ$134 million in the mandated scenario, on output gains of NZ$284 million.

Similarly, in the ***constrained*** scenario, the 2,490 new one-year equivalent FTEs created through indirect and induced impacts equate to an ***average*** of 432 new FTEs across the country for the 69-month period.

Indirect and induced GDP add a further NZ$124 million, while output rises by NZ$262 million.

Summing direct impacts presented in section 3.2.1 with indirect and induced impacts yields the total impact on the New Zealand economy. Depending on the scenario, this equates to between 4,430 and 4,770 one-year FTEs, NZ$232 million to NZ$250 million in GDP, and NZ$531 million to NZ$573 million in extra output.

3.2.3 Resource allocation

One major advantage of CGE modelling over multiplier analysis, which is discussed later, is its ability to model how a change in spending in one industry may result in the re-allocation of resources such as labour and capital from another. A more detailed look at the results of the CGE modelling shows that there is increased employment in transport equipment manufacturing, but also some declines in employment in other industries, most notably other manufacturing industries. These industries include textile manufacturing, paper product manufacturing, and residential construction, with workers attracted to the increase in opportunities in transport equipment manufacturing. Overall, however, the shifts are small, with large net gains in national employment.

We also see a shift in capital stock across industries, with an overall slight reduction in capital stock in transport equipment manufacturing as the shift in resource prices changes the structure of the industry slightly in favour of labour. Other industries see small shifts in capital stock in both directions.

3.3 Regional impacts

Multiplier analysis, rather than CGE modelling, was used to estimate what the impact could be at a Regional level. This is because Regional CGE models do not exist for New Zealand. Multiplier analysis is explained in section 5.3.

If the rolling stock is manufactured in New Zealand, it is likely to be done at Dunedin or Woburn (Wellington). Production may be split across the two sites or captured completely by one site.

The analysis in this section is based on Otago Region multipliers. Our research found that the multipliers for the Otago Region and for the Wellington Region are almost identical. For instance, the unadjusted Type II multipliers for employment in the machinery and other equipment manufacturing industry for the two Regions are 1.73 and 1.75 respectively. For output the gap is even narrower, at 1.70 and 1.71 respectively. This indicates that the Regional impacts would be similar whether part or all of the project were completed in both Woburn and Dunedin.

Table 3.4 summarises the impacts for both scenarios.

Table 3.4 Employment, GDP and output impacts of the project, Regional

Multiplier impacts: Mandated	Direct	Indirect & induced	Total
Employment (one-year FTEs)	1,476	1,085	2,561
average across years	394	289	683
GDP (NZ$2009m)	$141	$121	$263
Output (NZ$2009m)	$342	$239	$582
Multiplier impacts: Constrained	**Direct**	**Indirect & induced**	**Total**
Employment (one-year FTEs)	1,380	1,014	2,394
average across years	240	176	416
GDP (NZ$2009m)	$132	$113	$246
Output (NZ$2009m)	$320	$232	$552

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Under the ***mandated*** scenario, the project is likely to create around 1,480 direct one-year FTEs at the Regional level over the 45 months of the project. Taking upstream and downstream impacts into account, multiplier analysis suggests around 2,560 one-year FTEs will be created. These figures equate to an ***average*** of 394 direct FTEs a year over the project, or a total of 683 FTEs on ***average*** at a Regional level across the 45 months.

Multiplier analysis suggests that under the mandated scenario, direct GDP added will be NZ$141 million, while total GDP added will be NZ$263 million. In net present value terms, direct output is calculated at NZ$342 million. An explanation of how this figure was calculated can be found in section 5.1.2. This direct output leads to total output of NZ$582 million being generated at a Regional level.

Under the ***constrained*** scenario, around 1,380 direct one-year FTEs are expected to be created across the 69 months, equivalent to an ***average*** of 240 FTEs across the time period. Taking into account indirect and induced impacts, total employment in the Region is expected to rise by 2,390 one-year FTEs, or an ***average*** of 416 FTEs across the 69 months.

Under the constrained scenario, a further NZ$132 million in direct GDP is expected to be created, and NZ$246 million in total. Direct output is equal to the net present value of the cost of the project spread over the 69 months, at NZ$320 million (calculated in section 5.1.2). Multiplier analysis suggests that total output would rise by NZ$552 million.

The table also shows that an average of 176 to 289 new indirect and induced FTEs would be created for a 69-month or 45-month period respectively. These workers would be in industries linked to the project, whether as suppliers, or in industries in which employees of the manufacturing process spend their incomes.

3.4 Comparison of CGE and multiplier analysis results

There are significant differences in the estimates of impacts produced by CGE modelling and multiplier analysis, as summarised in Table 3.5.

Table 3.5 Comparison of CGE and multiplier analysis result

Comparison: CGE minus multiplier figures	Difference: Mandated	Difference: Constrained
Employment (one-year FTEs)	2,210	2,031
average across years	589	353
GDP (NZ$2009m)	-$12.6	-$13.6
Output (NZ$2009m)	-$8.7	-$21.0

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The CGE results produce significantly higher employment figures than the multiplier analysis – 2,210 in the mandated scenario, and 2,030 in the constrained scenario. There are two main reasons for this:

- The CGE model runs at a national level, so it takes into account additional employment created beyond the Regional boundaries. For instance, the Type II Multiplier for employment at the Regional level is 1.73, while at a national level it is 2.25. This allows for the fact that many more jobs will be created outside the Region, a fact captured by the CGE model but not the Regional multipliers.

- Multiplier analysis does not allow for a change in resource prices. The CGE model suggests that in the case of rolling stock being produced in New Zealand, there will be a shift toward greater use of labour (as opposed to capital) given the relative prices of capital and labour in the industries concerned.

On the other hand, CGE modelling produces slightly lower GDP and total output figures across both scenarios. This is as the CGE model allows for the fact that spending on new rolling stock will draw some production away from other industries. In other words, the model overcomes the unrealistic multiplier assumption that all the spending will be additional.

3.5 What the results mean

We discuss the implications of these estimations from a national point of view (the benefits to New Zealand) and the perspective of Kiwirail (the benefits to the specific business in question).

3.5.1 The national business case

The results of the CGE analysis are clear. There are large quantitative economic benefits of building the rolling stock in New Zealand. Building the rolling stock here results in at least NZ$108 million in direct benefit to GDP, or NZ$232 million in total GDP that would otherwise not occur. These figures are summarised in Table 3.6.

Table 3.6 GDP benefits as a percentage of total project cost

Cost / Benefit	NZ$m	*Benefit as % of build cost*
New Zealand build cost	$374.8	
Direct benefit (GDP)	$108.4	*29%*
Total benefit (GDP)	$232.0	*62%*

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The ***direct*** benefit in GDP terms is around 29 percent of the project cost of NZ$375 million. In other words, the cost of purchasing from overseas would need to be at least 29 percent (NZ$108 million) ***less*** to justify buying from overseas, if we take into account direct impacts only. This would mean a unit cost of NZ$4.9 million per EMU and NZ$5.7 million per locomotive. As Table 3.1 and Table 4.1 point out, it is unlikely that the rolling stock could be sourced from quality western suppliers at these prices.

The ***total*** benefit in GDP terms is around 62 percent of the project cost of NZ$375 million. In other words, the cost of purchasing from overseas would need to be at least 62 percent (NZ$232 million) ***less*** to justify buying from overseas, if we take into account total impacts. This would mean a unit cost of NZ$2.6 million per EMU and NZ$3.1 million per locomotive. It ***may*** be possible for Asian sources to supply at prices close to these. However, the quality and expected life could be less than those from Europe and North America, and we suspect from New Zealand.

It is probable also that total operating costs could thus be higher, as suggested by work currently underway by the ICN. Considering a 'whole-of-life' costing this analysis indicates that there will be significant benefits sourcing this rolling stock from New Zealand.

In addition, New Zealand has significant unemployment of labour and productive capacity at present. Hence, since all our resources are not employed, we can produce more goods by employing some unemployed and re-arranging some of the skilled workforce and production capacity to produce the additional goods and generate additional GDP. The kinds of jobs created by building the rolling stock in New Zealand is summarised in section 4.1.

3.5.2 The Kiwirail business case

Market information presented in Table 3.1 and Table 4.1 indicates that EMUs purchased from European and North American sources with three to five cars would cost NZ$8 million to NZ$9 million a set. Our information is that three-car EMUs produced locally would cost NZ$7.1 million a set (including costs to upgrade plant in advance of manufacturing). This indicates that unless there are significant differences in quality, operating costs or expected life, the commercial decision would be to ***buy locally***, even without considering the broader economic impact.

Further incentives to Kiwirail of building the rolling stock here would include the potential to capture a share of the international rolling stock market, valued at NZ$15 to NZ$20 billion a year (see section 4.2). Given that the figures suggest New Zealand would be competitive internationally in terms of the production of rolling stock, there would be the opportunity to use the skills and capacity built up during the project to develop export markets.

Developing and maintaining the skills required for the project within New Zealand in general, and specifically at Kiwirail, would also make any future need for rolling stock, or for urgent maintenance, easier to service (see also section 4.1).

4 Wider economic benefits

There are several other benefits that will accrue to New Zealand should the rolling stock be built here, in addition to the quantifiable benefits already outlined.

4.1 Skills development and maintenance

Building the rolling stock in New Zealand will offer significant potential for developing and maintaining a skills base in the country. The figures presented in this report show that there will be significant numbers of jobs created over a period of several years, many of them highly-skilled.

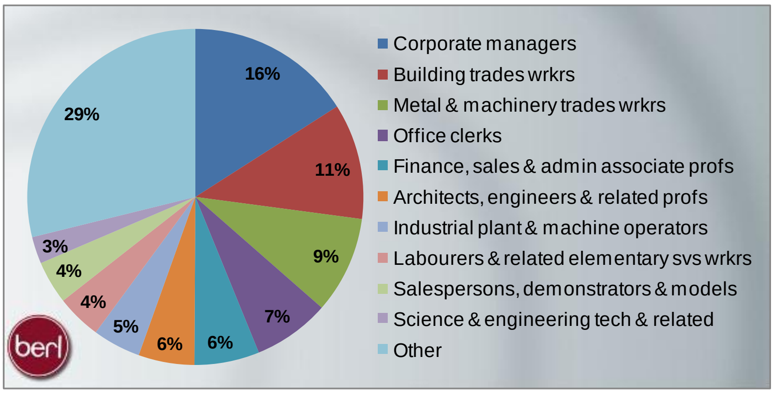
The likely composition of staff to complete the project would include a large number of workers employed in design, fabrication, and finishing. Fabrication workers would mostly be welders, assemblers, and boiler-makers. There would also be a range of workers in finishing, including fitters, electricians, and painters.

The length of the programme, whether 45 months or 69 months, should provide sufficient opportunity for skills transfer and development of ongoing capability within the industry.

This project also provides an opportunity to keep skilled workers in New Zealand, further develop their skills, and possibly even to attract skilled workers from overseas to build up the knowledge base in New Zealand. For instance, should much of the project be completed in Dunedin, it may be able to draw on the skills of workers affected by the reduction in Fisher and Paykel operations there.

The project would also strengthen engineering industry networks, and maintain and support supply and service industries, as highlighted in Figure 4.1. The figure shows what occupation groups are expected to benefit most from new employment generated by the project, as estimated by the CGE model.

Figure 4.1 FTE creation by occupation



One in six new FTEs will be for corporate managers. This is because these positions occur in all industries, and will thus be affected by both direct, and indirect/induced output generated.

Several occupations are specific to the kinds of work being done in the project, however. These include building trades workers such as electricians and fitters; metal and machinery trades workers; architects and engineers; industrial plant and machine operators; and science and engineering technicians.

Occupations such as office clerks and salespeople would be employed across the range of upstream and downstream industries, while each industry affected would also require more financial and other goods and services.

4.2 Export potential

Leading directly on from the benefits to skills development and maintenance highlighted above is the potential for New Zealand to capture a share of the huge global train design, build and maintenance market. An indication of the size of the market for rolling stock is shown in Table 4.1. When considering these figures, it is important to bear in mind that:

- a similar list of orders is produced each month
- dollar figures are not provided for each itemised order, such as the 200 diesel locomotives being purchased by Germany
- there are numerous other purchases not included on the list.

Table 4.1 Rolling stock orders, reported March 2010[1]

Purchaser	Quoted currency	NZ$m	Description
Australia	A$126m	$164.7	15 diesel locomotives, 160 coal wagons
Canada	C$34m	$47.3	3-year maintetnace contract for commuter locomotives and coaches
China	JPY3.6bn	$56.8	Traction equipment for 27 six-car metro trains for Beijing
Germany	€29m	$56.6	9 low-floor trams
Germany	NA	NA	200 diesel locomotives to run in Austria, France, Switzerland, Denmark, the Czech Republic and Poland.
Germany	€77m	$150.2	20 LRVs
Germany	€200m	$390.2	26 three-car and 22 five-car EMUs
Germany	€45m	$87.8	18 low-floor trams
Italy	€58m	$113.2	5 DMUs + maintenance for 5 years
Netherlands	€200m	$390.2	23 six-car metro trainsets
Pakistan	760RMB	$158.8	Passenger coaches to Pakistan Railways
Poland	50m zoty	$25.0	6 DMUs
Poland	91 m zoty	$45.5	5 four-car EMUs
Poland	149m zoty	$74.5	10 DMUs
Russia	NA	NA	650 coal wagons
Switzerland	NA	NA	5-year contract to maintain 5 locomotives
Total		**$1,761.0**	

Railway Gazette International

The figure of NZ$1.76 billion in orders for the month of March 2010 is a conservative one. This suggests that the world-wide rolling stock and maintenance contracts put in place each year exceed NZ$15 to NZ$20 billion (eight to 11 percent of New Zealand's annual GDP).

The table shows that many of the largest purchasers of rolling stock and maintenance contracts are in Europe. Also worth noting (but not shown on the table) is that the vast majority of these contracts were won by companies located outside East Asia. In other words, the idea that China or other Asia-based manufacturers, being price-competitive in terms of labour at least, have become dominant players, is a misconception. Even the traction equipment being purchased for Beijing trains is being produced as a joint-venture between a Chinese company and Mitsubishi. A rough estimate would be that under 20 percent of all rolling stock featured in Railway Gazette International rolling stock market data is being produced outside Europe, North America, or Japan.

A more in-depth look at the table shows that the price of the varying types of rolling stock range between $4.2 million for a DMU set for Poland, and $23 million for a DMU set for Italy, which includes five years' maintenance. Most prices, however, whether for LRVs, trams, or EMUs, range between $5 million and $9.1 million. This suggests that, at the price at which New Zealand could build the rolling stock required here, we would be quite competitive internationally.

[1] LRVs are Light Rail Vehicles; DMUs are Diesel Multiple Units.

Significant opportunity thus exists for New Zealand to compete for market share in Europe, Australia, and the Americas.

In addition, as we expand upon in section 4.3, there will be spill-overs of technology and innovation into other industries, meaning export potential in other industries (such as bus, aircraft, or boat-building) may also develop.

4.3 Innovation and technology spill-overs

A project of this size and duration will offer an excellent opportunity for innovation and technology development and spill-over into other industries. Our CGE analysis shows that small numbers of workers from other manufacturing industries including paper product manufacturing; and textile and clothing manufacturing would move into the transport equipment manufacturing industry to support the project. In the same way, we could expect some people with skills developed on the rolling stock project to move into other industries as the rolling stock project winds down.

A pool of highly-skilled people will be available to support export capability as already discussed, or to move into associated industries, such as machinery and electronics manufacturing, or other transport manufacturing (such as bus and boat-building).

New Zealand may also develop various innovative technologies in producing the rolling stock that can be transferred to other industries. The scale of the project may see a range of support businesses spring up that form a cluster of transport and design-related businesses around the train-manufacturing site(s).

4.4 Ongoing maintenance costs

Our analysis of the quantitative impacts of building the rolling stock in New Zealand does not include the ongoing maintenance of the rolling stock, for two reasons. First, the scope of the project is to examine the benefits of building the rolling stock in New Zealand. Second, the scale of the maintenance work relative to the manufacturing stage is small. Nevertheless, the maintenance contract would result in ongoing jobs, with additional GDP and output advantages for New Zealand.

Stakeholders suggest that maintenance would likely average around NZ$10 million a year expressed in 2009$ with less spent in earlier years and more in later years. The annual Regional impact of this expenditure is presented in Table 4.2.

Table 4.2 Economic impact of maintenance being completed in New Zealand

Maintenance	Direct	Total
Employment (FTEs)	43.1	74.8
GDP (NZ$2009m)	$4.1	$7.7
Output (NZ$2009m)	$10.0	$17.3

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Around 75 FTEs in total would be created on an ongoing basis at a Regional level, generating NZ$7.7 million in total GDP from total output of NZ$17 million. These will be jobs created and maintained in New Zealand, and will continue to build on the skills development and maintenance already discussed.

As mentioned elsewhere in this report, work underway by the (ICN) suggests that costs for major system acquisitions overseas are often higher when seen from a whole-of-life perspective. These costs include whole-of-life repair costs; lead and down time costs; spare parts delivery time costs; lack of control over design changes; and ongoing maintenance and operator training costs.

4.5 Foreign exchange, Crown revenue, and trade balance

The Treasury report *Challenges and Choices: New Zealand's Long-term Fiscal Statement* (October 2009) paints a bleak picture of revenues and spending over the four years to 2013. It expects net debt to rise from the current NZ$17.1bn (9.5 percent of GDP) to NZ$62.6bn (31 percent of GDP) in the next four years.[2] This would assume an average increase in debt of NZ$11.4bn a year, or NZ$220m a week. The Treasury report states that the Government is currently issuing around NZ$250m a week in debt although this figure of NZ$250m a week appears to be a ***gross*** figure, which does not take account of debt being retired. The ***net*** figure appears to be closer to NZ$130 or NZ$140 million.

At a time such as this, it seems prudent for Government to be looking to New Zealand sources to produce the rolling stock, rather than sending a further NZ$260 million (the share of the project that could be captured by New Zealand) offshore.

The CGE analysis indicates that, depending on the scenario, building the rolling stock in New Zealand would raise ***Crown revenue*** by a net NZ$65 million to NZ$70 million over the lifetime of the project.

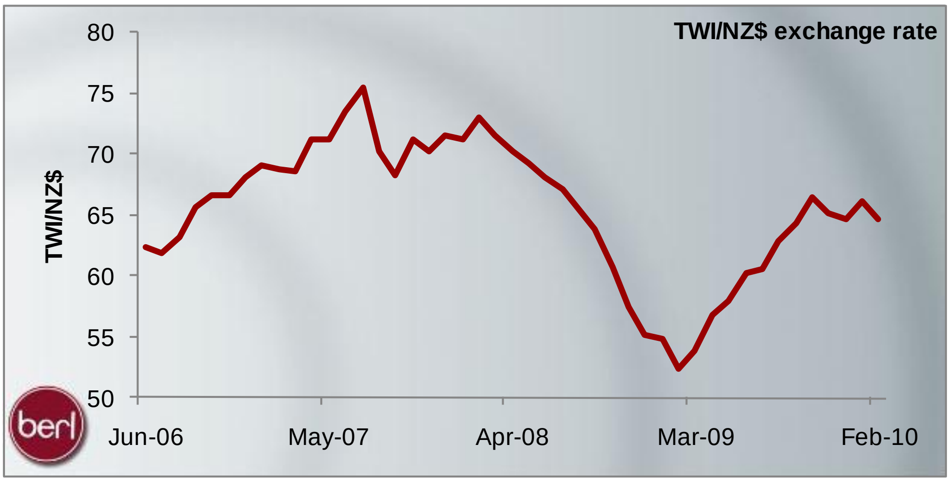
The ***trade balance*** would also benefit, by NZ$114 million to NZ$122 million over the lifetime of the project, compared with not building the rolling stock in New Zealand.

[2] This measure of net debt (NZ$17.1bn) excludes the New Zealand Superannuation Fund, student loans and other advances.

4.6 Exchange rate risk

New Zealand is subject to severe exchange rate fluctuations. Figure 4.2, for instance, shows changes in the NZ$ against the Trade Weighted Index (TWI) over the last 45 months, the length of time required to complete the project under the mandated scenario.

Figure 4.2 NZ$ volatility, 2006 to 2010



Over the 45 months to February 2010, the TWI varied between 52 and 75. In other words, in February 2009 the currency was 31 percent weaker against the basket of major trading partner currencies than it was in July 2007.

The NZ$ is currently above its long-term average, which indicates it is likely to weaken at some point in the next 45 months. As a result, Kiwirail would have to hedge to avoid major cost overruns on the project due to exchange rate volatility, if a significant portion of the spending on rolling stock was to be overseas. As it is, an estimated 31 percent of the spending on the project would be on imports. Adding to this percentage would increase the costs of risk minimisation.

5 Methodology

This chapter explains the process undertaken to estimate the quantitative impacts of building the rolling stock in New Zealand.

5.1 Base numbers and assumptions

There are three stages in production of the new rolling stock:

- construction stage required to build a test track, purpose-built EMU assembly shop, and semi-automated welding stations.
- delivery of the first EMU and the 13 locomotives
- delivery of the remaining EMUs.

The production timeline as laid out in the IED calls for delivery of all rolling stock within 45 months ("mandated" scenario). Some stakeholders believe a 69-month timeline would be more realistic in terms of capacity constraints ("constrained" scenario). We present both scenarios in this report, each in net present value form.

5.1.1 Costs in current dollars and stage duration

Costs for the project are expected to be as shown in Table 5.1.

Table 5.1 Mandated and constrained expenditure by year, NZ$2009m

Mandated (NZ$m)	Capex	Opex	Total	Constrained (NZ$m)	Capex	Opex	Total
Year 1	$3.8	$49.2	$53.0	Year 1	$3.8	$49.2	$53.0
Year 2	$3.8	$59.2	$63.0	Year 2	$3.8	$59.2	$63.0
Year 3	$0.9	$135.1	$136.1	Year 3	$0.9	$64.9	$65.9
Year 4 (9 mths)		$122.8	$122.8	Year 4		$70.2	$70.2
				Year 5		$70.2	$70.2
				Year 6 (9 mths)		$52.6	$52.6
Total	**$8.5**	**$366.3**	**$374.8**	**Total**	**$8.5**	**$366.3**	**$374.8**

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The total cost of the project is estimated at NZ$375 million, spent over a period of either 45 months or 69 months.

Table 5.2 presents the expected timeline and cost of the various components of the project.

Table 5.2 Expected duration and cost of the project, NZ$2009m

Spending ($2009m)	Start month	End month	Duration	NZ$m total
Construction	1	27	27	$8.5
Deposits on equipment	16	20	5	$10.0
First EMU delivery	1	27	27	$6.6
13 electric locomotives delivery	1	27	27	$104.0
Mandated scenario: EMUs 2-38	28	45	18	$245.6
Constrained scenario: EMUs 2-38	28	69	42	$245.6
Total				**$374.8**

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The construction stage is expected to cost NZ$8.5 million. This stage includes building a test track, an EMU assembly shop, and semi-automated welding stations.

The second stage is the production of the first EMU vehicle (three cars) and the 13 electric locomotives. Each three-car EMU is expected to cost around NZ$6.9 million to manufacture, and each locomotive, around NZ$8 million. Deposits on equipment paid out in months 16 to 20 are expected to be around NZ$10 million of the total for all 38 EMU vehicles, and are assumed to be shared equally across the cost of each vehicle. As a result, the figure for the first EMU is slightly less than the NZ$6.9 million unit cost.

The mandated scenario would see a further NZ$246 million spent over 18 months, while the constrained scenario would see the same figure spent over 42 months.

5.1.2 Net present value

To take into account the fact that the spending will take place over a number of years, we apply a discount rate in order to estimate the net present value of the project under each scenario.

We apply a real discount rate of five percent, which we believe is fairly conservative on a project of this scale and type.

The result is a net present value of the project of NZ$342 million in the mandated scenario, and NZ$320 million in the constrained scenario, as summarised in Table 5.3.

Table 5.3 Mandated and constrained expenditure by year, net present value

Mandated	Capex	Opex	Total	Constrained	Capex	Opex	Total
Year 1	$3.8	$49.2	$53.0	Year 1	$3.8	$49.2	$53.0
Year 2	$3.6	$56.2	$59.8	Year 2	$3.6	$56.2	$59.8
Year 3	$0.9	$121.9	$122.8	Year 3	$0.9	$55.7	$56.5
Year 4 (9 mths)		$106.7	$106.7	Year 4		$57.2	$57.2
				Year 5		$54.3	$54.3
				Year 6 (9 mths)		$39.2	$39.2
Total	**$8.2**	**$334.0**	**$342.2**	**Total**	**$8.2**	**$311.7**	**$319.9**

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5.1.3 Imports

A final consideration in estimating how much expenditure could be captured in New Zealand was to estimate what proportion of the project would be completed outside the country even in the best case scenario. Stakeholders suggested that a minimum of 31 percent of the cost of each unit would be spent overseas. In other words, at best, New Zealand could capture 69 percent of the spending on the project, or between NZ$214 million and NZ$237 million in net present value terms, depending on whether we adopt the mandated or constrained scenario.

5.2 CGE modelling

Having estimated the net present value of the project under the two scenarios, we were able to apply CGE modelling to estimate the likely impacts on employment, GDP and output at a national level. This section introduces the BERL CGE model and summarises its advantages over standard multiplier analysis. ***Results of applying the CGE model to the rolling stock project are presented in section 3.2***.

A CGE model is a standard and widely used tool to investigate the impacts of economic shocks or events, or to measure the contribution of sectors or industries to the wider economy. The model captures the inter-relationships within industries, between exports, imports and consumption as well as their combined resource requirements.

The model follows standard neo-classical assumptions of market-clearing prices, profit-maximising firms and utility-maximising consumers. Its equilibrium is determined by the relative prices of production factors (resources) and outputs adjusting to ensure supply equals demand in each of these markets.[3] In addition, embedded in the production structure of firms is the standard assumption of zero pure (economic) profits.

5.2.1 Origins

The model has its origins in the models developed by the Project on Economic Planning at Victoria University of Wellington in the early-1980s. Early applications focussed on trade policy questions, with simulations of tariff removals and GATT outcomes contributing to the “gains to free trade” argument prevalent at that time.

Originally based on the *ORANI* (Dixon *et al.*, 1982) model of the Australian economy, its structural framework is similar, arising from input-output relationships. Since then BERL has maintained and further enhanced the model as well as applied it to investigate numerous

[3] That is, all factor and output markets.

issues.[4] The latest version of the core model is based on the official *Statistics New Zealand* 1995/96 input-output data updated by BERL to a 2004/05 base year.[5] This model can be used to simulate the effect of a policy, world price, world demand, productivity and/or behavioural shock and solves for the equilibrium outcome in a future snapshot year.[6]

Policy simulations or experiments can be undertaken within alternative macroeconomic environments. The assumptions adopted to enforce a particular macroeconomic closure should be interpreted as relevant *ceteris paribus* assumptions.

The detailed model structure closely follows Dixon, *et al*. (1982) and is also noted in Poot *et al*. (1988). A summary of key elements is provided below.

5.2.2 Key model structure

The BERL computable general equilibrium (CGE) model of the New Zealand economy separately identifies 49 industries, 22 export commodities, eight household consumption commodities and 40 different occupation categories. The export commodities and household consumption commodities are listed in Table 5.4. The industries in the model are listed in Table 5.5, along with their relevant ANZSIC codes.[7]

Each industry produces a single output via a production function requiring a fixed combination of intermediate and primary factor inputs. At the secondary level, each intermediate input is a mixture of a domestically produced item and its imported equivalent. Producers can substitute between these two sources for each intermediate input in response to shifts in the relative price of each according to a CES mixing function.[8] Substitution elasticities are less than infinite to reflect, in part, the degree of aggregation as well as technological limits to such substitution. Similarly, the primary factor input comprises a CRESH function, mixing 40 different types of labour and one physical capital resource.[9]

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[4] For examples of the model's application, see BERL and AERU (2003) and BERL (2003). Applications using a variant modelling both the New Zealand and Australian economies are described in Nana and Poot (1996) and Nana et al (1995).

[5] March years.

[6] A dynamic (or inter-temporal) version has also been developed (Nana, 2000), which enables the path of an economy over time to be modelled. Comparing a baseline path to one that incorporates the response to a shock(s) enables comparative dynamic (as opposed to comparative static) analysis to be undertaken. A key assumption within this framework is in incorporating cost(s) involved in the adjustment path as the economy moves towards its general equilibrium. In particular, there are costs (and limits) involved in redirecting investment from one industry to another. The static CGE model implicitly assumes costless transition over time – or that the snapshot year is sufficiently far in the future for these costs to be negligible.

[7] ANZSIC: Australia and New Zealand Standard Industrial Classification 1996 (Rev 2).

[8] CES: Constant Elasticity of Substitution.

[9] CRESH: Constant Ratio of Elasticity of Substitution Homothetic.

Each industry's output is either sold to other industries for use as intermediate inputs, or sold to meet final demand agents. Imports compete with domestically-produced products.

Final demand agents comprise other industries for the production of investment goods, domestic households for consumption, foreign demand for export and government.

Investment good production involves a similar CES mix of imported and domestic inputs. Aggregate investment is exogenous to the model, either as a fixed amount or as a set ratio to GDP. However, investment activity is allocated across industries endogenously, so as to equate expected rates of return.

Households allocate their income according to a LES function across a consumption basket containing eight consumer categories.[10] Again, within each of these categories, consumers can shift between domestically made items and their imported equivalents in response to relative price changes given the constraints of a CES function. Aggregate consumption is linked to household income, which is predominantly determined by employment income.

Government consumption demand is exogenous to the model, either at a set figure, or at a specified ratio of GDP.

Exports are modelled as facing a less than perfectly elastic demand curve. As such, foreigners demand more or less from New Zealand sources depending on the relative price competitiveness of New Zealand-made products *vis-à-vis* products from elsewhere. Differing elasticities amongst the commodities reflect, in part, aggregation as well as non-market barriers to the expansion of export sales. In general, New Zealand exporters of primary commodities such as dairy and meat face steeper demand curves than manufactures and service exporters.

The BERL CGE model is maintained, updated and solved using *GEMPACK* modelling software.[11]

Table 5.4 and Table 5.5 list the various categories of industries, consumption and exports incorporated in the model.

The model results presented in this report should be interpreted in the sense of a set of comparative static experiments. The modelled outcomes are listed as changes in various economic measures caused by the shock under consideration.

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[10] LES: Linear Expenditure System.

[11] Pearson (1988).

Table 5.4 Consumption and export commodity categories, BERL CGE model

Consumption commodities	Export commodities
Food	Dairy
Housing	Meat
Household operation	Wool
Apparel	Horticulture
Transportation	Fish
Tobacco and alcohol	Other food, beverages and tobacco
Other goods	Textiles
Other services	Logs
	Wood
	Paper
	Oil products
	Other chemical products
	Coal
	Minerals
	Ceramics
	Base metals
	Fabricated metal products and machinery
	Other manufactures
	Tourism
	Transportation
	Education
	Other services

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Table 5.5 Industry classifications, BERL CGE model

Industry	Associated ANZSIC codes
Horticulture and fruit growing	A011
Mixed livestock and cropping	A0121, A0122, A01591
Sheep and beef cattle farming	A0123-A0125
Dairy cattle farming	A013
Other farming and services to agriculture, hunting & trapping	rest A01, A02
Forestry & logging	A03
Commercial fishing	A04
Coal mining	B11
Oil & gas extraction and exploration	B12, B1511, B1512
Other mining & quarrying and services to mining	B13, B14, B1514, B1520
Meat processing	C2111
Dairy product manufacturing	C212
Other food processing & mfg	rest C21
Textiles, clothing, footwear & leather mfg	C22
Log sawmilling, timber dressing & other wood product mfg	C231, C232
Paper and paper product mfg	C233, C239
Printing, publishing & recorded media	C24
Petroleum	C251, C252
Chemical and chemical product mfg	C253, C254
Rubber and plastic product mfg	C255, C256
Non-metallic mineral product mfg	C26
Basic metal manufacturing	C271-C273
Structural, sheet and fabricated metal product mfg	C274-C276
Machinery and equipment mfg	C28
Other manufacturing	C29
Electricity generation	D361pt
Electricity transmission & supply	D361pt
Gas supply	D362
Water supply	D3701
Construction	E
Wholesale & retail trade	F, G
Accommodation, cafes & restaurants	H57
Road transport	I61, I661
Water and rail transport	I62, I63, I662
Air transport, services to transport, storage	I64, I65, I663,I664, I67
Communication services	J71
Finance and insurance	K
Ownership of owner-occupied dwellings	L771190pt
Other property services	rest L77
Scientific research & technical services	L781, L782
Computer services	L783
Legal, accounting & other business services	L784-L786 (xL7865-66)
Govt administration & defence	M, Q9631-Q9633
Pre-school, primary, secondary & other education	N84 (xN843) O871
Post-school education	N843
Hospitals, nursing homes, aged accommodation & other community care	O861, O872
Medical, dental and other health services	rest O86
Cultural and recreational services	P
Personal and other services, pest control and cleaning services, waste disposal & sewerage services	D3702, L7865-66, Q (excl Q9631-Q9633)

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5.2.3 Advantages of CGE modelling over multiplier analysis

Specific advantages of CGE modelling are directly linked to the assumptions one is forced to make in multiplier analysis, discussed below.

One chief advantage is that CGE modelling allows for ***constraints on resources*** in the economy. For instance, the model takes into account that an increase in demand for workers in one industry, say transport equipment manufacturing, may draw workers away from other industries, such as residential construction or other forms of manufacturing. The net benefit to the economy may therefore be different from that suggested by multiplier analysis.

As demand for various resources changes, so do their prices. This is not accounted for by multiplier analysis, but is dealt with by the CGE model. The CGE model captures behavioural responses using theory of utility-maximising consumers, cost-minimising producers or profit maximising firms. This framework also allows a more comprehensive analysis of the economy-wide effects.

Unlike multiplier analysis, CGE modelling also allows the ***ratio of capital to labour inputs to change*** in production within industries. For instance, an industry may adopt a more labour-intensive or capital-intensive structure as relative prices of resources change.

5.3 Multipliers

This section explains the uses and limitations of multipliers. ***Results of our multiplier analysis are presented in section 3.3***.

Multipliers are a tool used by economists to estimate the impact of expansion in one industry taking into account indirect impacts on industries that supply inputs (upstream effects) and induced impacts on industries that benefit downstream of the expansion.

Multipliers are a much misunderstood (and, in cases, misused) tool, as their correct interpretation requires acknowledgement of the severely limiting assumptions that form the basis of their derivation.

5.3.1 Assumptions

Critical assumptions implicit in the use of multiplier analysis include:

Availability of resources

- Multipliers can only be interpreted as estimating ***additional*** economic activity (whether indirect or induced) where there are sufficient available unused productive resources (labour and capital) to facilitate an expansion in activity.

- Where resources are already fully employed, any indirect and/or induced activity calculated by multipliers should be interpreted as a ***diversion*** of economic activity, not an increase in activity.

No change in relative prices

- The impacts estimated by multipliers are only valid under the assumption that relative prices (of goods, services and resources) are unchanged. On the contrary, where any such relative price change is expected to occur, behavioural changes will be induced - the impact of which will not be captured by the standard multiplier analysis.

Constant returns to scale production technology

- The calculated multipliers are only valid for the situation where additional production is undertaken given existing production function (technology) coefficients. In other words, units of output are produced using the same inputs of raw materials, labour and capital in the same proportion as has been used in the production of previous units of output.

Therefore, multipliers are appropriate to assess the impact of small, marginal shocks - not large-scale shocks.

Note that to correctly investigate issues where relative prices are expected to alter, a general equilibrium approach is required. Such a general equilibrium modelling framework for analysis explicitly incorporates behavioural responses to relative price changes.[12]

5.3.2 Examples

The underlying logic of multiplier analysis is relatively simple. For example, the construction of a new facility (e.g. a new furniture factory) is initiated by a preliminary flow of expenditures, as designs are drawn, land is acquired and landscaped, labour hired and materials purchased and so on. These initial expenditures (labelled ***initial*** effects) create further flows of expenditures.

[12] General equilibrium models capture such behavioural responses using standard neo-classical theory of utility-maximising consumers, cost-minimising producers or profit maximising firms. This framework also allows a more comprehensive analysis of the economy-wide effects, as discussed elsewhere in this report.

In particular, these initial expenditures are magnified or ***multiplied*** as they flow-on to the wider economy, in two ways:

- the construction firm will purchase materials and services from supplier firms (labelled ***direct*** effects), who in turn make further purchases from their suppliers (labelled ***indirect*** effects). For example, original raw materials will be required, which will then be transported to processing plants, thereafter developed (through various stages into appropriate building materials). These impacts are sometimes referred to as ***upstream*** effects.

- persons employed in the construction and in firms supplying materials and services earn income (mostly from wages & salaries, but also from profits), which, after tax is deducted, is then spent on consumption.[13] These impacts are referred to as ***induced*** effects.

This analysis of the construction phase determines the one-off impact of the development. Thereafter, the annual impact arising from the operation of the furniture factory is similarly divided into two flows of expenditures.

- the furniture factory will purchase raw materials, as well as other goods and services from supplier firms, who in turn make further purchases from their suppliers (eg. legal, accounting, insurance, marketing, transport, communications and distribution services). As before, these impacts – being the ***direct*** and ***indirect*** effects – are sometimes referred to as ***upstream*** effects.

- persons employed in the furniture factory and in firms supplying materials and services earn income (mostly from wages & salaries, but also from profits), which, after tax is deducted, is then spent on consumption.[14] These impacts are referred to as ***induced*** effects.

5.3.3 Input-output table modification

The availability of estimates of how the NZ$375 million to be spent on the rolling stock project would be spent made it possible to modify the input-output tables that form the basis of the multipliers used in multiplier analysis.

The latest available input-output tables for the Otago Region include transport equipment manufacturing under the broader machinery and other equipment manufacturing industry. It

[13] Noting also that a portion will be saved.

[14] Again, noting also that a portion will be saved.

is therefore a valuable exercise to compare the expected expenditure pattern on the rolling stock project with those given in the input-output tables and make appropriate adjustments. Some of the key differences between the input-output tables and data for this particular project are highlighted in Table 5.6.

Table 5.6 Comparison of input proportions, IO tables and Kiwirail project

Proportions of inputs	IO Table	Kiwirail project
Imports	0.357	0.308
Intermediate inputs	0.259	0.279
Value added	0.384	0.413
Including wages	*0.205*	*0.188*
Total	**1.000**	**1.000**

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The table shows that, in the event of New Zealand capturing 69 percent of the expenditure on the project (the total of the intermediate inputs and the value added), proportions spent on different inputs will vary from those suggested by the input-output tables.

We therefore modify the multipliers used to estimate the impact of the project at the Regional level, as summarised in Table 5.7.

Table 5.7 Original and modified multipliers, 2009

Multipliers	IO Table	Kiwirail project
Employment		
Direct employment/$m output	4.70	4.31
Type II multiplier	1.73	1.73
GDP		
Direct GDP/$m output	0.38	0.41
Type II multiplier	1.86	1.86
Output		
Type II multiplier	1.70	1.73

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As the table shows, given the lower proportion of the Kiwirail project funding spent on employment, the direct employment (in FTEs) created per million dollars spent is lower. We have no reason to expect the Type II multiplier of indirect and induced employment to be different for the Kiwirail project compared with the IO table.

The higher GDP to output ratio on the Kiwirail project means it will add more value than a typical project within the machinery and other equipment manufacturing industry in direct terms. The Type II multiplier stays the same.

Because the ratio of intermediate inputs (inputs from inside the Region) to output is slightly higher for the Kiwirail project, the Type II multiplier for output is higher.