ARTC

Melbourne-Brisbane Inland Rail Alignment Study

Final Report July 2010

Appendix M Computable General Equilibrium Analysis

ACIL Tasman
Economics Policy Strategy

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Key points

Computable General Equilibrium (CGE) analysis is a technique for estimating the wider economic and employment impacts of a project. It goes beyond the immediate economic costs and benefits of the project, and traces the aggregate changes in expenditure and employment, positive and negative, at the local, state, national and international level.

The key finding of this CGE analysis of the Melbourne-Brisbane inland rail project is that, although its construction and operation will increase real Australian incomes (especially in the eastern states), this is outweighed by the loss of incomes caused by diverting resources to build it.

This result was the same whether the project was funded domestically or by increasing net foreign debt. In particular, the net present value of the real income of Australians (using a 7 per cent discount rate) is projected to fall by $599 million if the rail line is domestically funded or fall by $2.3 billion if funded by increasing foreign debt.

Executive summary

ACIL Tasman was commissioned by the Australian Rail Track Corporation (ARTC) to undertake an economic impact assessment of the proposed Melbourne to Brisbane inland rail line. This appendix uses CGE modelling to provide insight into the wider economic impacts. It is designed to complement the cost benefit analysis in the main report.

Impact of constructing and operating the inland railway

In the main report, the Inland Rail project was assessed for operations starting at three potential commencement dates (2020, 2030 or 2040). For the analysis in this appendix, operation was assumed to commence in 2020. Based on the economic analysis in the main report, CGE results would be more favourable for later commencement dates.

The inland railway is expected to require a capital investment of $4.7 billion. In the scenarios modelled here, most of this investment ($4.2 billion) is spent over the period 2015 to 2019. The remaining capital expenditure occurs in 2035.

Funding

When considering the impact of the construction of the new inland railway it was necessary to make assumptions about funding. Two funding scenarios were considered. Under the first scenario funding for the capital investment was assumed to have been sourced from foreigners. If the funding is sourced by tapping foreign debt markets then indirectly Australians (as a whole) will be bringing forward future consumption. That is, Australia will increase spending on the items necessary to build the inland rail line but will be required to pay back the accumulated debt over subsequent decades, as the construction will require the purchase of imported items, the total debt incurred during the construction phase will be greater than the amount spent on domestically produced goods and services.

The second funding scenario assumed domestic funding. In this situation Australians will be foregoing current consumption over the construction period to supply the resources necessary to build the inland railway. A reduction in current consumption relative to the reference case can occur in a number of ways, including, hypothetically, an increase in the total tax burden with the proceeds used to fund the construction of the inland railway.

Market impact

It has been assumed that, once the line has been constructed, it begins to operate in 2020. As a consequence some freight that would otherwise have been transported by the east coast railway and by road is diverted to the inland railway. This freight diversion arises as a result of productivity improvements and cost savings associated with the new line. In addition some new freight will be induced onto the new line. The modelling inputs used for this analysis were drawn from the chapter 3 of the main report.

Economic impact

From the perspective of Australia's real economic output (GDP), the foreign funding scenario produces the highest present value return to the economy. Under the foreign debt scenario the construction and operation phases over the period 2015 to 2040 increase Australia's GDP in NPV terms by:

- $202 million – using a 7 per cent discount rate
- $195 million – using a 4 per cent discount rate (see Table ES 1).

Under the domestic funding scenario over the period 2015 to 2040 Australian GDP in NPV terms increases by:

- $26 million – using a 7 per cent discount rate
- $62 million – using a 4 per cent discount rate (Table ES 1).

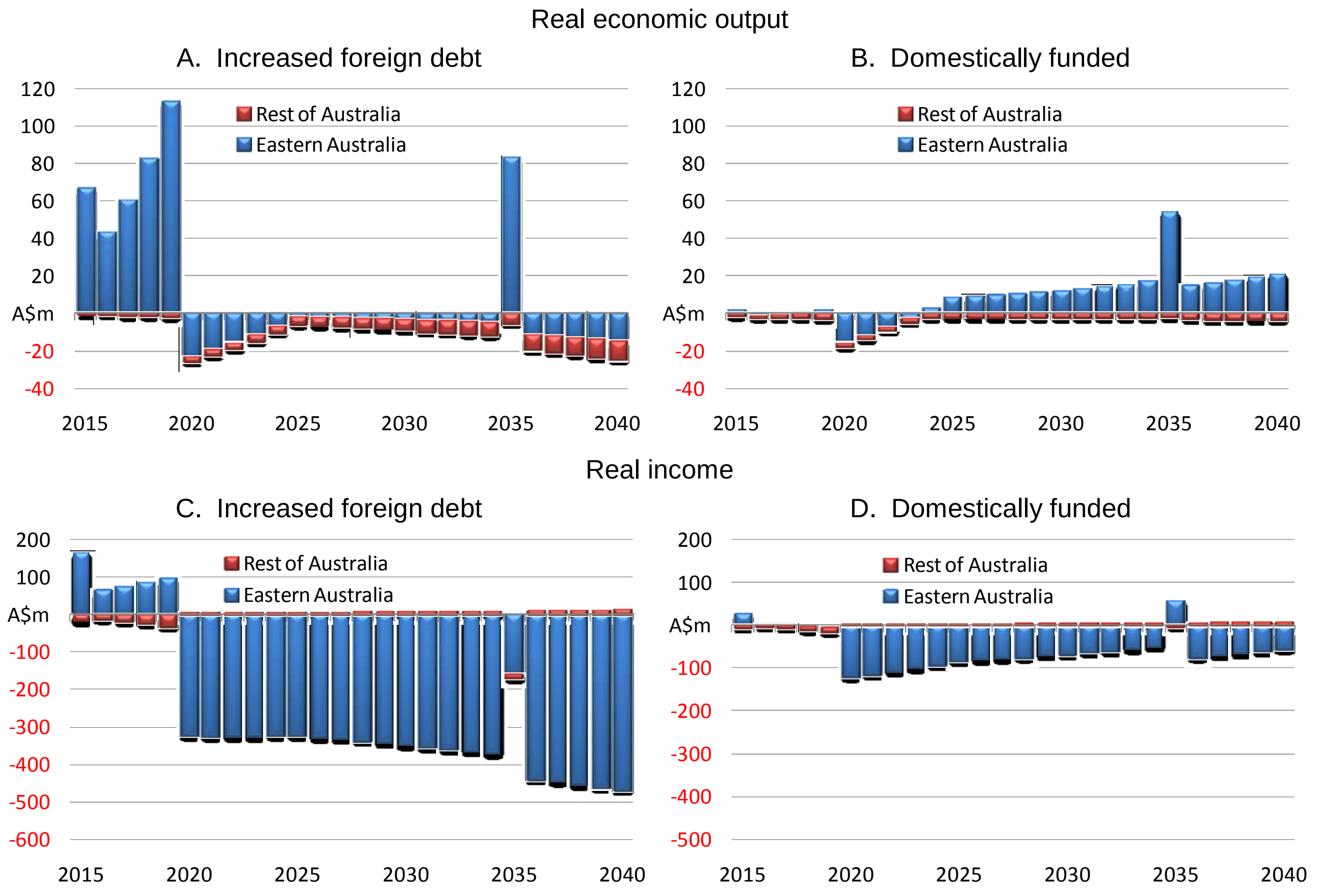
Table ES 1 Inland rail total project (construction and operation) – Cumulative change in selected macroeconomic aggregates under different funding scenarios, relative to the reference case

	Increased foreign debt scenario			Domestically funded scenario		
	Total (2015-2040)	NPV (4% discount rate)	NPV (7% discount rate)	Total (2015-2040)	NPV (4% discount rate)	NPV (7% discount rate)
	2010$m	2010$m	2010$m	2010$m	2010$m	2010$m
Real economic output (GDP)	$153	$195	$202	$170	$62	$26
Real income (RGNDI)	–$6,982	–$3,607	–$2,289	–$1,426	–$848	–$599
Real private consumption	–$4,800	–$2,399	–$1,465	–$5,414	–$3,981	–$3,319

Notes: NPV = Net Present Value. The NPV calculation includes the impacts through to 2040 though the project will continue producing impacts beyond that; a longer period would have only a modest effect on the NPV results because of discounting.

The annual changes in Australia's real economic output, relative to the reference case, that are induced by the project are shown in Figure ES 1. It can be seen that under the foreign funding scenario significant benefits to GDP arise in the construction years. However, these are largely offset during the operation phase as the debt is repaid and the returns from the line's operation are insufficient to fully cover these repayments. Under the domestic funding scenario the annual impacts on GDP are much less pronounced and in most years of the line's operation there is a small positive increase in Australia's GDP.

Figure ES 1 Inland rail total project (construction and operation) – Change in real economic output and real income, relative to the reference case under two alternative funding scenarios



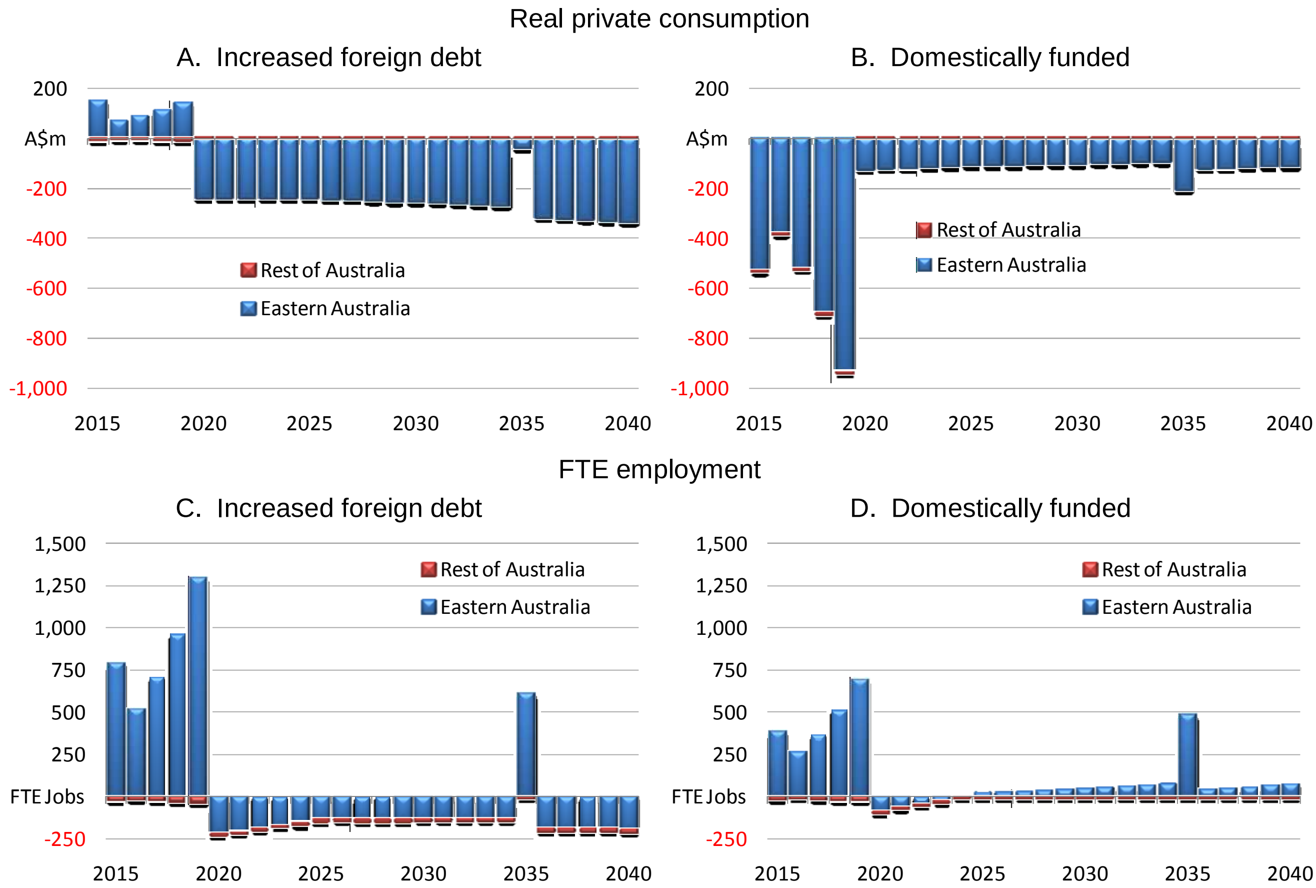
Note: The anticipated construction expenditure for the project is mostly spent over the period 2015-2019 However, further substantial expenditure is assumed to occur in 2035 to cope with anticipated traffic demand, which has a noticeable impact on the projected impacts in that year (in practice it may be smoothed over a longer period).

However, while GDP is a relatively well known macroeconomic aggregate, real income is a better measure of the welfare benefit to Australians. This is because real GDP does not take into account payments to and receipts from foreigners or changes in the terms of trade. (Real income is synonymous with real gross national disposable income (RGNDI) as used by the ABS.) It can be seen from the summary results produced in Table ES 1 that both funding scenarios reduce real income streams.

The magnitude of the cumulative reduction is smaller under the domestic funding scenario than the foreign scenario. This is because under the domestically funded scenario annual real income takes a relatively small 'hit' as the bulk of the cost of funding the project's construction is borne by lost consumption during the construction phase. In contrast, under the foreign debt scenario, the interest on the borrowed debt must be repaid over the operation phase and the annual returns to real income from the operation phase are not sufficient to compensate the economy (see Figure ES 1). It should be borne in mind that income generated by the project for the economy as a whole is not the same as income earned by the owners of individual assets.

Table ES 1 also shows that real private consumption is also negative under both the funding scenarios. The foreign debt funding scenario produces a smaller negative NPV result than the domestic funding scenario (see Figure ES 2). Under the domestic scenario higher levels of real consumption must be foregone during the early construction years.

Figure ES 2 Inland rail total project (construction and operation) – Change in real private consumption and annual employment, relative to the reference case under two alternative funding scenarios



Note: The anticipated construction expenditure for the project is mostly spent over the period 2015-2019 However, further substantial expenditure is assumed to occur in 2035 to cope with anticipated traffic demand, which has a noticeable impact on the projected impacts in that year (in practice it may be smoothed over a longer period).

Employment

Average annual FTE employment is higher than the reference case under both funding scenarios. On average, over the period 2015 to 2040:

- An additional 50 FTE jobs are projected to be created under the foreign debt scenario
- An additional 120 FTE jobs are projected to be created under the domestically funded scenario.

As shown in Figure ES 2, the employment impacts vary markedly between the construction and operation phases under both funding scenarios. Under the foreign debt scenario in most years of the operation of the railway FTE employment across Australia is lower than the reference case by an order of around 130 FTE jobs because the interest on the borrowed debt must be repaid. Under the domestically funded scenario, longer term employment (2020-2040) is projected to be neutral or positive in most years of operation.

1. Introduction

ACIL Tasman was commissioned by the Australian Rail Track Corporation (ARTC) to undertake an economic impact assessment of the proposed Melbourne to Brisbane inland rail line. The analysis in this appendix is designed to complement the cost benefit analysis in the main report to provide insight into the potential wider economic, employment and government finance impacts.

The modelling in this appendix draws on the most recent cost and revenue estimates from the technical consultants. However, a key difference in the modelling approach used here, compared with the main report, is the use of a CGE model to enable the implications of the new line on the wider economy to be estimated.

1.1 Structure of this report

This appendix is made up of the following sections:

- Section 2 considers the range of tools which can be used to undertake economic impacts of a project such as the inland railway project, and explores why CGE analysis is an appropriate tool to undertake such assessments
- Section 3 presents some background on the *Tasman Global* model used in the analysis and details the business -as -usual reference case against which the project impacts are estimated
- Section 4 provides some background information on the macroeconomic aggregates reported in the results chapters
- Section 5 presents the projected impacts of the construction and operation of the inland railway.

2. What is an economic impact assessment?

Any project will have an impact, either positive or negative, on the economic activity in a region. It will directly affect the employment and expenditure levels in different parts of a community.

An economic impact assessment is an attempt to trace the changes in spending through an economy as the result of the subject project or policy change, and to measure the aggregate effects of that spending. Estimating the economic impacts of a project or policy can be a helpful process for understanding the scale of the potential benefits flowing to the local and regional economies. It should be remembered, however, that the economic impacts will need to be considered in the broader context of the likely social and environmental consequences of the project or policy.

The economic impacts of a project are rarely contained within the local economy. Any imported components or labour will result in some of the economic benefits (and/or costs) 'leaking' beyond the local region. For this reason it is important to estimate the proportion of employment and expenditure that will directly occur in the local, state, national and international economies.

2.1 Measuring economic impacts

The economic impacts of a project or other activity can be estimated using a variety of economic analysis tools. The most popular and well known are input-output multiplier analysis and CGE modelling. Choosing the right tool is critical to the accuracy of the estimated effects and depends on the characteristics of the project or industry. Sometimes a range of tools are required. Box 1 provides a brief discussion of input-output multipliers and CGE models.

Box 1 Overview of input-output multipliers and general equilibrium models

Input-output (I-O) tables are at the heart of both multiplier analysis and CGE models. Input-output tables provide a comprehensive picture of the supply and consumption of all commodities within the economy, including detailed information on factor incomes, taxes and the source (domestic or foreign) of every commodity. They are essentially the bottoms-up accounting framework that underlies the calculation of aggregate GDP. Unlike the GDP accounts, however, I-O tables retain all intermediate consumption and therefore provide a detailed picture of the structure and interrelationships of industries. An important feature of I-O tables is that they are fully balanced matrices. For example, production costs (including returns to factors of production) equals sales revenue.

I-O multipliers are summary measures generated from input-output tables that can be used for predicting the total impact on all industries in the economy of changes in demand for the output of any one industry. The tables and multipliers can also be used to measure the relative importance of the product chain linkages to different parts of the economy. In most circumstances, the results of I-O multiplier analysis should be treated as upper level impacts.

CGE models mimic the workings of the economy through a system of interdependent behavioural and accounting equations which are linked to an input-output database. These models provide a representation of the whole economy, set in a national and international trading context, starting with individual markets, producers and consumers and building up the system via demands and production from each component. When an economic shock or disturbance is applied to a model, each of the markets adjusts according to the set of behavioural parameters which are underpinned by economic theory. The generalised nature of CGE models enable a much broader range of analysis to be undertaken (generally in a more robust manner) compared to I-O multiplier techniques.

Limitations of I-O Analysis

The limitations of the I-O analysis relate to four key simplifying assumptions underpinning the model:

- Each industry in the I-O table is assumed to produce a single output
- There can be no substitution between the goods or services of different industry sectors (or their source)
- There are constant returns to scale in production such that the inputs to production of all industry sectors are in fixed proportion to the level of output from that industry

- The total effect of production in several sectors is equal to the sum of the separate effects.

Therefore, particular care should be used when interpreting multiplier impacts, as they represent a linear response from the increase in final demand under implicit assumptions that an economy or industry has no spare capacity and that the productivity of that industry is constant.

The I-O approach ignores the opportunity costs associated with diverting resources from other productive activities as the model has no mechanism whereby the prices of factors (land, labour and capital) adjust in response to changes in demand. As such, I-O analysis does not consider the efficiency of an investment and the wider social implications. I-O analyses are not well suited to the analysis of social or population changes that might arise over the life of a project.

Weaknesses of CGE modelling

One complaint sometimes levelled at CGE modelling is that the models are 'black boxes'. In part this complaint arises because of the computing used to drive the model and the thousands of simultaneous equations which are solved to reach a modelled equilibrium. However, it must be stressed that the equations which underpin the credible models used in Australia are based on rigorous economic theory.

This theory and the use of the models are generally well understood and respected by Australian Government decision makers. Although cost benefit analysis has the central role in evaluating the economics of a project, CGE can be a powerful tool for understanding the implications of a project to a region and the state as it recognises not only the direct and second round impacts but the third and fourth round etc. impacts of a project in a region.

A weakness of CGE is that it can only model market impacts on economic variables such as regional gross product, consumption, production and population. CGE generally does not have the capacity to model wider social or environmental impacts although various modern models have attempted to capture some of these aspects (such as greenhouse gas emissions which are widely modelled using CGE).

Source: ACIL Tasman

Various aspects of a policy or project, such as the number of jobs or the size of the investment expenditure, are relevant to certain stakeholders. However the key aggregate measure of the impact of a project is the extent to which the total wealth of the economy has changed as a result of the policy or project[1]. Typically this is measured by real gross national disposable income, although real gross domestic product (GDP) and consumer surplus (among others) can also be important aggregate measures depending on the nature of the policy or project being analysed.

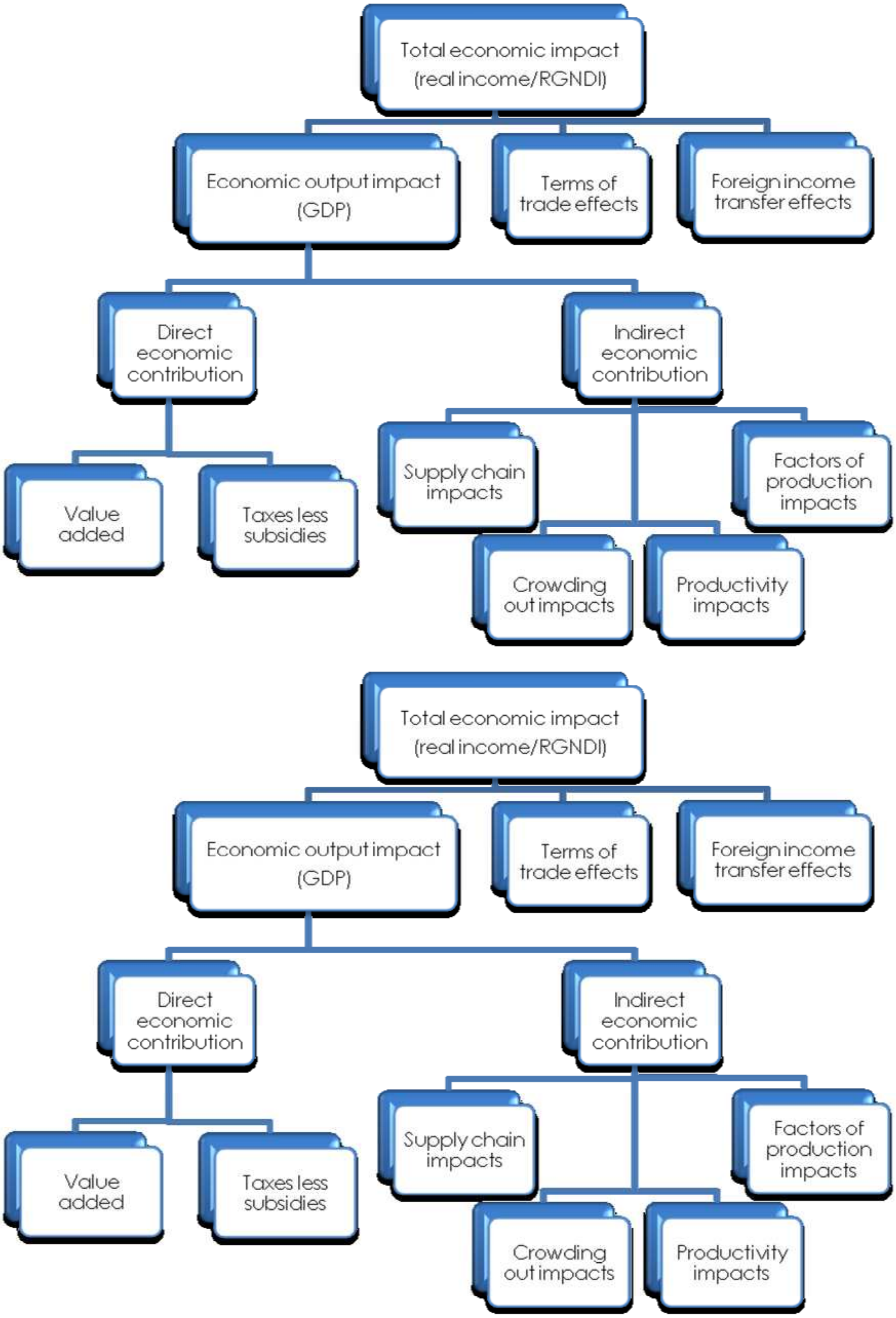
The main factors that need to be considered when analysing the economic impacts of a project or policy include:

- The direct and indirect contribution to the economy as a result of the activities associated with the project
- Any crowding out implications as resources are potentially diverted from other productive activities to undertake the project being analysed
- Any productivity effects generated as a direct result of the policy or project activities – particularly any enduring productivity changes or productivity spillovers to other activities not directly associated with the project or policy
- Any changes to the factors of production in the economy
- Any welfare implications associated with changes in terms of trade or foreign income transfers
- Whether there is a dynamic element to the size of any of the above effects (due to different phases of the project for example).

Figure 1 shows these components graphically. Some of these effects may have negligible impact while others may be very significant and an understanding of the effects helps determine the most appropriate tool(s) for the analysis.

[1] Analysis of any non-market impacts (such as the loss of biodiversity, changes in air quality, and social justice implications) may also be relevant in assessing the full implications of a project or policy.

Figure 1 Estimating the economic impact of a project or policy



Source: ACIL Tasman

For many projects, static estimates of the direct economic contribution and supply chain implications can be obtained through the use of input-output multipliers. Estimating the size of other components using multiplier techniques is either impossible or very complex, as is estimating the economic impacts through time. In contrast, most CGE models are able to estimate all of the components shown in Figure 1 with dynamic CGE models able to estimate the impacts through time. The greater complexity of CGE models generally increases the cost of undertaking analysis compared to using input-output multipliers, but it enables a much broader range of economic impacts to be considered within a single framework and is used in this appendix.

3. Framework of analysis

For this analysis ACIL Tasman's CGE model, *Tasman Global*, was used to estimate the impacts of the construction and operation activities associated with the inland rail project.

Tasman Global is a large scale, dynamic, CGE model of the world economy that has been developed in-house by ACIL Tasman. *Tasman Global* is a powerful tool for undertaking economic analysis at the regional, state, national and global levels.

CGE models such as *Tasman Global* mimic the workings of the economy through a system of interdependent behavioural and accounting equations which are linked to an input-output database. These models provide a representation of the whole economy, set in a national and international trading context, using a 'bottom-up' approach, starting with individual markets, producers and consumers and building up the system via demands and production from each component. When an economic shock or disturbance such as an increase in a sector's rate of growth is applied to the model, each of the markets adjusts to a new equilibrium according to the set of behavioural parameters[2] which are underpinned by economic theory.

In addition to recognising the linkages between industries in an economy, general equilibrium models also recognise economic constraints. For example, increased demand for labour may increase real wages if there is full employment.

A key advantage of CGE models is that they capture both the direct and indirect impacts of economic changes while taking account of economic constraints. For example, *Tasman Global* captures the expansion in economic activity driven by an investment, and at the same time accounts for the constraints faced by an economy in terms of availability of labour, capital and other inputs. Another advantage of CGE models is that they capture a wide range of economic impacts across a wide range of industries in a single consistent framework that enables rigorous assessment of a range of policy scenarios.

3.1 The Tasman Global model

ACIL Tasman's CGE model *Tasman Global* is a powerful tool for undertaking economic impact analysis at the regional, state, national and global level.

There are various types of economic models and modelling techniques. Many of these are based on partial equilibrium analysis that usually considers a single market. However, in economic analysis, linkages between markets and how these linkages develop and change over time can be critical. *Tasman Global* has been developed to meet this need.

Tasman Global is an analytical tool that can capture these linkages on a regional, state, national and global scale. *Tasman Global* is a large-scale CGE model which is designed to account for all sectors in the Australian economy and all economies across the world. ACIL Tasman uses *Tasman Global* to undertake industry, project, scenario and policy analyses. The model is able to analyse issues at the industry, global, national, state and regional levels and to determine the impacts of various economic changes on production, consumption and trade at the macroeconomic and industry levels.

[2] An example of a behavioural parameter is the *price elasticity of demand* – the responsiveness of demand for a commodity to a change in the price of that commodity. Each of these markets – for example the market for a commodity or a factor such as labour or land or the market for capital goods – is then linked through trade and investment flows.

A Dynamic model

Tasman Global is a model that estimates relationships between variables at different points in time. This is in contrast to comparative static models, which compare two equilibriums (one before a policy change and one following). A dynamic model such as *Tasman Global* is beneficial when analysing issues where both the timing of and the adjustment path that economies follow are relevant in the analysis.

In applications of the *Tasman Global* model, a reference case simulation forms a business-as-usual basis with which to compare the results of various simulations. The reference case provides projections of growth in the absence of the changes to be examined. The impact of the change to be examined is then simulated and the results interpreted as deviations from the reference case.

The database

A key advantage of *Tasman Global* is the level of detail in the database underpinning the model. The database is derived from the latest Global Trade Analysis Project (GTAP) database which was released in 2008. This database is a fully documented, publicly available global data base which contains complete bilateral trade information, transport and protection linkages among regions for all GTAP commodities.

The GTAP model was constructed at the Centre for Global Trade Analysis at Purdue University in the United States. It is the most up-to-date, detailed database of its type in the world.

Tasman Global builds on the GTAP model's equation structure and database by adding five important features: dynamics (including detailed population and labour market dynamics), detailed technology representation within key industries (such as electricity generation and iron and steel production), the ability to repatriate labour and capital income, a detailed emissions accounting abatement framework and explicit representation of the states and territories of Australia.

Nominally the *Tasman Global* database divides the world economy into 120 regions although in reality the regions are frequently disaggregated further.

The GTAP database also contains a wealth of sectoral detail (Table 1). The foundation of this information is the input-output tables that underpin the database. The input-output tables account for the distribution of industry production to satisfy industry and final demands. Industry demands, so-called intermediate usage, are the demands from each industry for inputs. For example, electricity is an input into the production of communications. In other words, the communications industry uses electricity as an intermediate input. Final demands are those made by households, governments, investors and foreigners (export demand). These final demands, as the name suggests, represent the demand for finished goods and services. To continue the example, electricity is used by households, and their consumption of electricity is a final demand.

Each sector in the economy is typically assumed to produce one commodity, although in *Tasman Global*, the electricity, diesel and iron and steel sectors are modelled using a 'technology bundle' approach. With this approach, different known production methods are used to generate a homogeneous output for the 'technology bundle' industry. For example, electricity can be generated using coal, petroleum, gas, nuclear, hydro or non-hydro renewable based technologies, each of which have their own cost structure.

Table 1 Sectors in the Tasman Global database

	Sector		Sector
1	Paddy rice	31	Paper products, publishing
2	Wheat	32	Diesel (incl. nonconventional diesel)
3	Cereal grains nec	33	Other petroleum, coal products
4	Vegetables, fruit, nuts	34	Chemical, rubber, plastic products
5	Oil seeds	35	Mineral products nec
6	Sugar cane, sugar beef	36	Ferrous metals
7	Plant- based fibres	37	Metals nec
8	Crops nec	38	Metal products
9	Bovine cattle, sheep, goats, horses	39	Motor vehicle and parts
10	Animal products nec	40	Transport equipment nec
11	Raw milk	41	Electronic equipment
12	Wool, silk worm cocoons	42	Machinery and equipment nec
13	Forestry	43	Manufactures nec
14	Fishing	44	Electricity
15	Coal	45	Gas manufacture, distribution
16	Oil	46	Water
17	Gas	47	Construction
18	Minerals nec	48	Trade
19	Bovine meat products	49	Road transport
20	Meat products nec	50	Rail and pipeline transport
21	Vegetables oils and fats	51	Water transport
22	Dairy products	52	Air transport
23	Processed rice	53	Transport nec
24	Sugar	54	Communication
25	Food products nec	55	Financial services nec
26	Beverages and tobacco products	56	Insurance
27	Textiles	57	Business services nec
28	Wearing apparel	58	Recreational and other services
29	Leather products	59	Public Administration, Defence, Education, Health
30	Wood products	60	Dwellings

Note: nec = not elsewhere classified

The other key feature of the database is that the cost structure of each industry is also represented in detail. Each industry purchases intermediate inputs (from domestic and imported sources) primary factors (labour, capital, land and natural resources) as well as paying taxes or receiving subsidies.

Factors of production

Capital, land, labour and natural resources are the four primary factors of production. The capital stock in each region (country or group of countries) accumulates through investment (less depreciation) in each period. Both capital and labour are mobile between industries within regions and, to a lesser extent, across regions through international capital flows and labour migration. Land is used only in agriculture industries and is fixed in each region. *Tasman Global* explicitly models natural resource inputs as a sector specific factor of production in resource based sectors (coal mining, oil and gas extraction, other mining, forestry and fishing). Natural resources are not mobile between sectors or regions. With the exception of regions that are known to have little or no deposits, returns to the natural resource in the reference case are assumed to move with the GDP price index, which allows for changes in the level of economic reserves.

Population growth and labour supply

Population growth is an important determinant of economic growth through the supply of labour and the demand for final goods and services. Population growth for the 112 international regions and for the 8 states and territories of Australia represented in the *Tasman Global* database is projected using ACIL Tasman's in-house demographic model. The demographic model projects how the population in each region grows and how age and gender composition changes over time and is an important tool for determining the changes in regional labour supply and total population over the projection period.

The demographic model was derived from the CHIMP (Fisher et al 2006) and GTEM (Pant 2007) demographic models with updated parameter specifications based on the latest data from the ILO, UN (2006), ABS (2008) as well as ACIL Tasman's own estimates. For each of the 120 regions in Tasman Global, the model projects the changes in age-specific birth, mortality and net migration rates by gender for 101 age cohorts (0-99 and 100+). The demographic model also projects changes in participation rates by gender by age for each region, and, when combined with the age and gender composition of the population, endogenously projects the future supply of labour in each region. As with the CHIMP specification, changes in life expectancy are a function of income per person as well as assumed technical progress on lowering mortality rates for a given income (for example, reducing malaria-related mortality through better medicines, education and governance). Participation rates are a function of life expectancy as well as expected changes in higher education rates, fertility rates and changes in the work force as a share of the total population.

Labour supply is derived from the combination of the projected regional population by age by gender and the projected regional participation rates by age by gender. Over the projection period labour supply in most developed economies is projected to grow slower than total population as a result of ageing population effects.

For the Australian states and territories, the projected aggregate labour supply from ACIL Tasman's demographics module is used as the base level potential workforce for the detailed Australian labour market module, which is described in the next section.

The Australian labour market

Tasman Global has a detailed representation of the Australian labour market which has been designed to capture:

- Different occupations
- Changes to participation rates (or average hours worked) due to changes in real wages
- Changes to unemployment rates due to changes in labour demand
- Limited substitution between occupations by the firms demanding labour and by the individuals supplying labour and
- Limited labour mobility between states.

Tasman Global recognises 97 different occupations within Australia, although the exact number of occupations depends on the aggregation. The firms who hire labour are provided with some limited scope to change between these 97 labour types as the relative real wage between them changes. Similarly, the individuals supplying labour have a limited ability to change occupations in response to the changing relative real wage between occupations. Finally, as the real wage for a given occupation rises in one state rise relative to other states, workers are given some ability to respond by shifting their location. The model produces results at the 97 3-digit ANZSCO (Australian New Zealand Standard Classification of Occupations) level.

The labour market structure of Tasman Global is thus designed to capture the reality of labour markets in Australia, where supply and demand at the occupational level do adjust, but within limits.

Labour supply in *Tasman Global* is presented as a three stage process:

1. Labour makes itself available to the workforce based on movements in the real wage and the unemployment rate
2. Labour chooses between occupations in a state based on relative real wages within the state and
3. Labour of a given occupation chooses in which state to locate based on movements in the relative real wage for that occupation between states.

By default, *Tasman Global*, like all general equilibrium models, assumes that markets clear. Therefore, overall, supply and demand for different occupations will equate (as is the case in other markets in the model).

Producer Behaviour

In *Tasman Global*, producers are assumed to operate in perfectly competitive markets using constant returns to scale technologies. Under these assumptions prices are set to cover costs and (unless specifically allowed to do so) industries earn normal profits at all times. Consequently, changes in the market prices are determined by the changes in the cost of production and any changes in taxes/subsidies.

National income, savings and consumption

In *Tasman Global*, a representative household in each region owns all factors of production and receives all payments made to the factors, all tax revenues and all net interregional income transfers. The representative household allocates its net income across private and public consumption and savings. National savings are assumed to move in line with national income.

Total consumption expenditure is calculated as the difference between current household income and savings, with the ratio of private consumption to government consumption assumed to be constant. Given total private consumption, the representative consumer maximises current period utility by choosing consumption levels for each consumption good.

Trade

A key feature of *Tasman Global* is that it models bilateral trade flows of all commodities between all regions. In *Tasman Global* an ‘Armington’ preference structure is adopted. This implies that a good produced in one region is an imperfect substitute for goods produced by the same industry in other regions. Thus the same commodity from different sources can trade at different prices.

Consumers in a given region can substitute goods produced in that region with the same goods produced in other regions. For any given consumption activity, demand for a commodity is allocated between a domestic product and a composite imported product according to a CES (constant elasticity of substitution) function. The demand by a region for each composite imported commodity is then allocated between sources of imports according to a further CES function. Substitution between domestic and imported commodities and between imported commodities will depend on movements in relative prices and the specified elasticity of substitution — the Armington elasticity.

In equilibrium, the exports of a good from one region to the rest of world are equal to the import demand for that good in the remaining regions. *Tasman Global* does not require the current account to be in balance every year. It allows the capital account to move in a compensatory direction to maintain the balance of payments.

Goods are transported between regions by an international transport industry. The cost of international transport is added to the cost of imports to each country.

International capital mobility

Global investment equals global savings in *Tasman Global*. It is assumed that regional borrowers (investors) issue bonds to global savers at a risk free, global average rate of return. At the regional level, however, rates of return may differ to reflect country specific differences in the risk premium required by global savers. For example, global savers tend to place a higher risk premium on investing in developing countries in *Tasman Global* to reflect greater uncertainty of investing in these regions. The equilibrium rates of return in developing countries are therefore higher than in developed countries.

Investment demands, in turn, are determined by changes in regional GDP and regional expected rates of return relative to expected global rates of return. Thus, changes in investment flows represent changes in demand from expansion or contraction effects (changes in real GDP) and expectation effects.

Any excess of investment over domestic savings for a given region causes an increase in net debt for the region. Borrowers service the debt at the global rate of return (interest rate).

Exchange rates

The exchange rate in *Tasman Global* is the price of converting local currency into global currency. It is the price that adjusts to keep the balance of payments in equilibrium. A change in the exchange rate will also influence international transfers associated with foreign debt or lending. For example, in Tasman Global, when a country that has borrowed from international capital markets experiences an exchange rate depreciation its level of debt, denominated in foreign currency, will increase. The debt servicing requirement (interest paid) will increase in domestic currency terms. On the other hand, a country holding foreign assets through international lending will earn more interest income in domestic currency if its exchange rate depreciates. The exchange rate can be interpreted as a measure of the barter terms of trade between the global numeraire and the regional numeraire in question. The exchange rate of all Australian regions with the rest of the world move together.

Greenhouse gas emissions

The model has a detailed greenhouse gas emissions accounting, trading and abatement framework that tracks the status of six anthropogenic greenhouse gases (namely, carbon dioxide, methane, nitrous oxide, HFCs, PFCs and SF_6). Almost all sources and sectors are represented; emissions from agricultural residues and land-use change and forestry activities are not explicitly modelled.

The greenhouse modelling framework not only allows accounting of changes in greenhouse gas emissions but also allows various policy responses such as carbon taxes or emissions trading to be employed and assessed within a consistent framework. For example, the model can be used to measure the economic and emission impacts of a fixed emissions penalty in single or multiple regions whether trading is allowed or not. Alternatively it can used to model the emissions penalty required to achieve a desired cut in emissions based on various trading and taxation criteria.

Detailed energy sector

Tasman Global contains a detailed representation of the energy sector, particularly in relation to the interstate (trade in electricity and gas) and international linkages across the regions represented. To allow for more detailed electricity sector analysis, and to aid in linkages to bottom-up models such as ACIL Tasman's *GasMark* and *PowerMar*k models electricity generation is separated from transmission and distribution in the model. In addition, the electricity sector in the model employs a 'technology bundle' approach that separately identifies different electricity generation technologies (brown coal, black coal, oil, gas, hydro, nuclear and other renewable energy carriers).

3.2 Database aggregation

The database which underpins the *Tasman Global* contains a wealth of sectoral detail. The foundation of this information is the set of input-output tables that underpin the database. Industries and regions in the model can be aggregated or disaggregated as required for a specific project. For this project they have been aggregated to:

- 3 economies, namely eastern Australia, the rest of Australia and the rest of the world
- 27 industries/commodities as presented in Table 2.

Table 2 Industry/Commodity aggregation used in *Tasman Global* modelling

	Industry/Commodity		Industry/Commodity
1	Crops	15	Wood and paper products; publishing and printing (excluding furniture)
2	Livestock	16	Other manufacturing
3	Fishing and forestry	17	Water
4	Processed food	18	Construction
5	Coal	19	Trade services (includes all retail and wholesale trade, hotels and restaurants)
6	Oil	20	Road transport
7	Gas	21	Rail transport
8	Electricity	22	Other Transport
9	Petroleum & coal products	23	Communications services
10	Iron & steel	24	Other business services (including financial, insurance, real estate services)
11	Other mining	25	Recreational and other services
12	Nonferrous metals	26	Government services (including public administration and defence)
13	Non-metallic minerals (including cement, plaster, lime, gravel)	27	Dwellings
14	Chemicals, rubber, plastics		

Note: Excludes micro-industries developed specifically for this analysis

Data source: ACIL Tasman aggregation

Micro industry approach

To accurately assess the economic impacts or economic contribution of a major project such as this, it must be accurately represented in the model's database. An accurate representation is achieved by establishing the proposed project as a new 'micro' industry in the database.

The micro industry approach is so called because it involves the creation of one or more new, initially very small, industries in the *Tasman Global* database. The specifications of each of the micro industry's costs and sales structures are derived from the financial data for the project to be analysed. At the outset, the new industry is necessarily very small so that its existence in the *Tasman Global* database does not affect the database balance or the 'business as usual' reference case outcomes.

ACIL Tasman believes that the micro industry approach to project evaluations is the most accurate way to capture the detailed economic linkages between the project and the other industries in the economy. This approach has been developed because each project is unique relative to the more aggregated industries in the *Tasman Global* database.

Consequently, in addition to the 27 industries identified in Table 2, the database also identified the construction and operation phases of the Melbourne-Brisbane inland railway as separate industries with their own input cost structures, sales, employment, tax revenues and greenhouse gas emissions based on detailed information provided to ACIL Tasman.

3.3 Reference case economic growth

In the reference or base case scenario, the pattern and rate of real economic growth is a function of assumptions on:

- Changes in population – particularly changes in the number of people of working age (15 years old and over)
- Changes in workforce participation rates – defined here as the average number of hours worked in the labour force by all people of working age. This measure encompasses changes in participation rates by age by gender, the unemployment rate and average hours worked
- Growth in labour productivity – defined here as the average output per hour worked.

The projection of each of these elements is discussed in the following sections.

Population growth

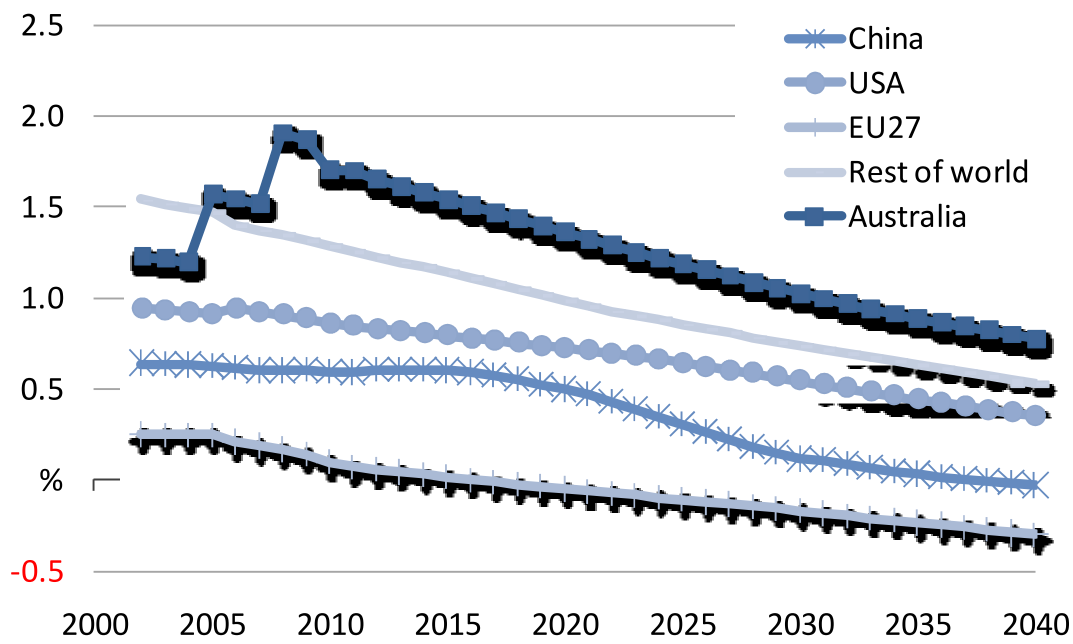
Population growth is an important determinant of economic growth through the supply of labour and the demand for final goods and services. Population growth in 112 international regions and Australia's 8 states and territories is represented in the *Tasman Global* database and has been projected using ACIL Tasman's in-house demographic model. The demographic model projects how the population in each region grows and how age and gender composition changes over time and is an important tool for determining the changes in regional labour supply and total population over the projection period.

For this analysis, global population is projected to increase over the projection period by 0.83 per cent a year, increasing the global population from around 6.7 billion in 2008 to 8.03 billion in 2030. Most of this growth occurs in the next decade, with the average annual growth projected to be 0.95 per cent a year to 2020, falling to 0.67 per cent a year between 2020 and 2030. The slowing rate of growth is due to continuing declines in fertility rates across developing countries coupled with ageing population effects across developed economies and some developing economies such as China. For example, Japan's population is projected to begin declining in the 2009 calendar year while the population of the European Union is projected to increase moderately before falling back to current levels around 2022.

Population growth for the eight Australian states and territories incorporates the latest ABS information on population levels, fertility, mortality and migration rates. The total Australian population in 2030 is projected to be 29.1 million. By 2050 the Australian population is projected to be 8.7 and 33.9 million.[3]

The population growth rate assumptions used for the regions modelled in this analysis are shown in Figure 2.

Figure 2 Assumed growth in population, reference case (per cent, year on year)



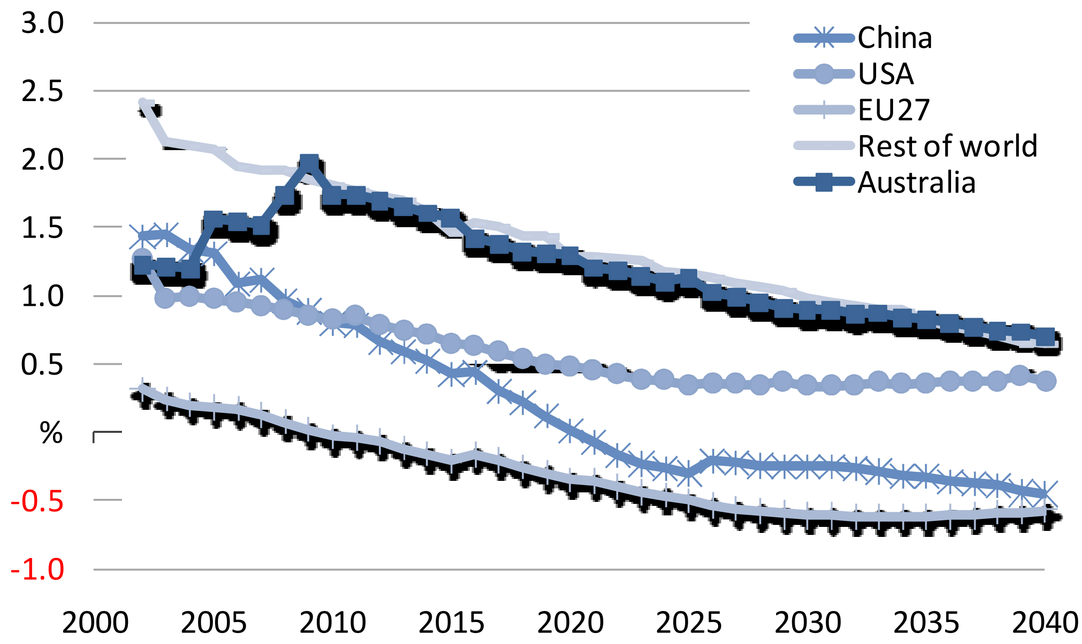
Source: ACIL Tasman projections

Labour supply

Labour supply is derived from the combination of the projected regional population by age and gender and the projected regional participation rates by age and gender. Over the projection period labour supply in most developed economies is projected to grow more slowly than total population as a result of ageing population effects. Some developing economies, notably China, are also projected to have slower growth in labour supply compared to total population. The labour supply growth assumptions used for the regions modelled in this analysis are shown in Figure 3.

[3] This projection is approximately the same as the most current ABS Series B projection of 33.96 million by 2050 (see ABS catalogue number 3222.0 released in September 2008), but is less than the recently released Treasury projection of 35.4 million by 2050. The largest drivers of the different projections are the assumed migration and fertility rates.

Figure 3 Assumed growth in labour supply, reference case (per cent, year on year)



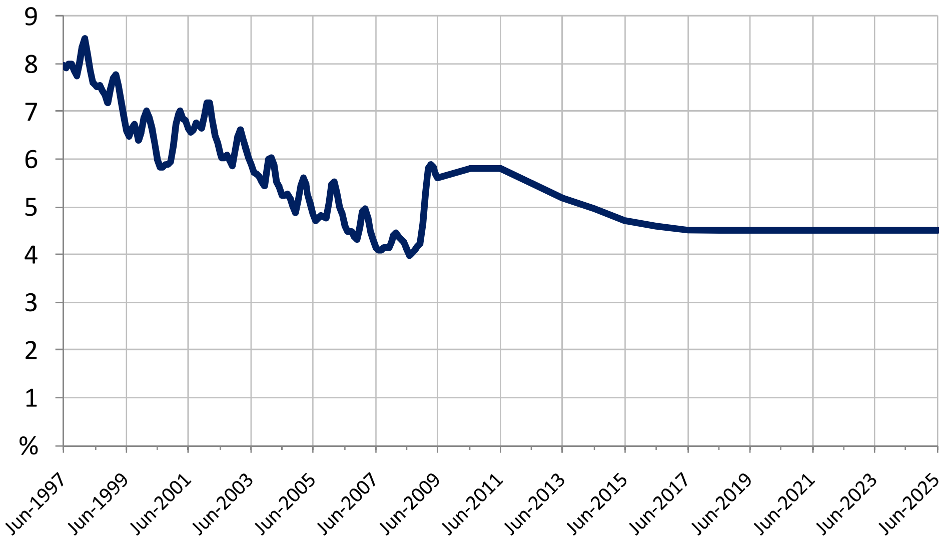
Source: ACIL Tasman projections

Unemployment

In addition to tracking the available workforce through the changes in population demographics and participation rates, *Tasman Global* also tracks unemployment rates. It should be noted that unemployment and participation rates are largely interchangeable in affecting the number of people available for work in the model. Separate identification of the components is undertaken to allow a more representative labour market. In general, when unemployment is high, increases in labour demand can largely be supplied by reducing the unemployment rate but when unemployment is low, increases in labour demand will largely be met by increasing participation rates (and/or hours worked). Changes in participation rates in *Tasman Global* are driven by changes in the real wages offered by employers.

Figure 4 presents the historical unemployment rates in Australia. For the current modelling it has been assumed that the unemployment rate in Australia will trend toward 4.5 per cent by around 2015.

Figure 4 Historical and assumed unemployment by region, reference case



Data source: ABS Detailed Labour Force by region statistics, catalogue number 6291.0.55.001 (three month rolling average) and ACIL Tasman assumptions.

Labour productivity growth

Labour productivity is a measure of the quantity of goods and services per unit of time worked. Growth in labour productivity is highly variable on a year to year basis and is influenced by many developments in the economy, including changes in capital intensity and the composition of the work-force.

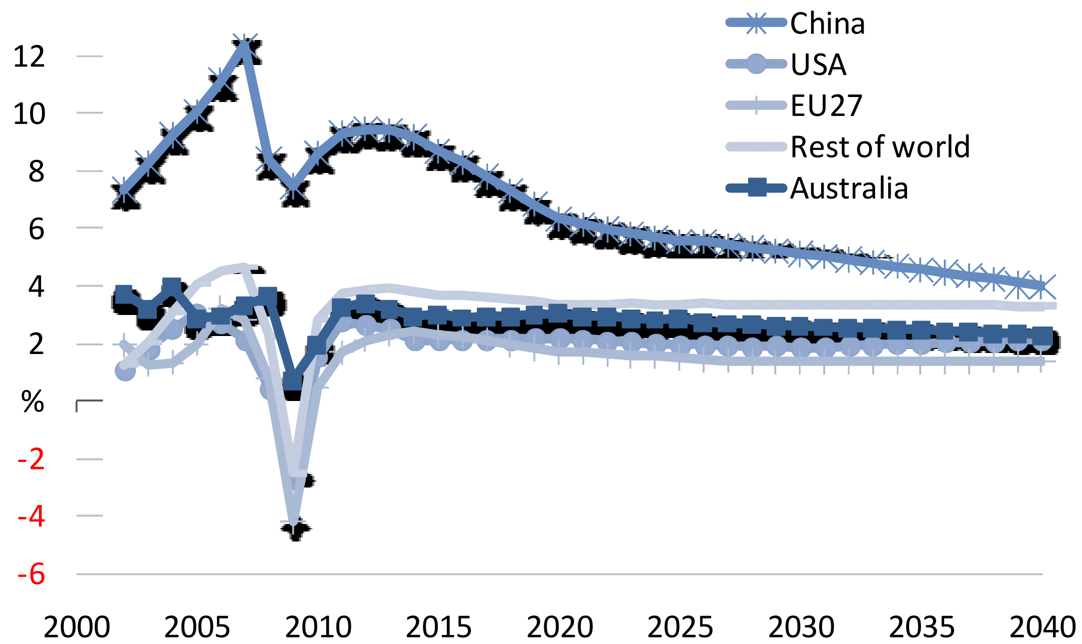
Australian labour productivity growth has averaged 1.8 per cent per annum over the past 40 years. Near term labour productivity growth is based on projections of labour supply and real GDP. In the reference case, the annual growth in Australian labour productivity is assumed to gradually slow from around 1.75 by 2020 to 1.5 per cent a year over the remaining projection period as the composition of the Australian economy continues to shift toward services, which have historically had lower rates of productivity growth compared to the rest of the economy.

Real economic output growth

Reference case growth in economic output (GDP and GSP) is based on a mixture of historical data, near-term projections by the Commonwealth and state treasuries and medium-long run projections. Australian historical GSP growth to 2008 is sourced from the ABS national accounts, while historical growth for the rest of the World is sourced from the IMF World Economic Outlook. Short-term projections (to 2017) for Australia as a whole are sourced from the latest Commonwealth Budget papers. The projections for the rest of the World (to 2014) are sourced from the latest IMF World Economic Outlook (October 2009). Projections for economic growth past these points are determined using ACIL Tasman's projections of labour supply and labour productivity.

The effects of the global financial crisis are expected to take a couple of years to move through the system, with the global economy returning to historical growth trends by 2012. Real economic growth assumptions used for the reference case for this analysis are shown in Figure 5.

Figure 5 Real economic output growth by region, reference case (per cent, year on year)



Source: ACIL Tasman projections

Based on these economic growth assumptions, the level of Australia's real GDP rises from \$1.25 trillion[4] in 2008-09 to \$3.01 trillion in 2039-40.

Labour market assumptions

Traditionally, CGE modelling utilises one of three labour market assumptions:

1. Fixed labour supply (the full employment approach) and zero labour mobility between Australian regions
2. Medium term adjustment to labour supply and zero labour mobility between Australian regions
3. Full labour mobility between regions so that changes to wages are equalised across Australian regions.

Labour market assumption 2 simply allows local supply to vary in the medium term (five to ten years) before returning to its long run position. It provides a temporary reprieve from labour market constraints.

Labour market assumptions 1 and 3 are more extreme. Under assumption 1, the proposed developments would have to be accomplished with only the current labour available in the region with some allowance for natural growth, i.e. no new labour could be drawn to the region as a result of the project. Under assumption 3 changes to wages in the region would be the same as changes to wages in all Australian regions, with labour shifting between Australian regions until changes to wages equalise. Modelling under assumption 3 provides the largest movement in labour across regions.

For this project, we have used a hybrid labour market assumption (which allows for some medium term adjustment potential), rather than resort to the use of assumption 2. The question that then arises is what level of constraint is appropriate (i.e. what level of labour movement between Australian regions makes sense)? In previous work the model has been

4 Where billion is defined as $1x10^9$ as per the US convention. Trillion is defined as $1x10^{12}$.

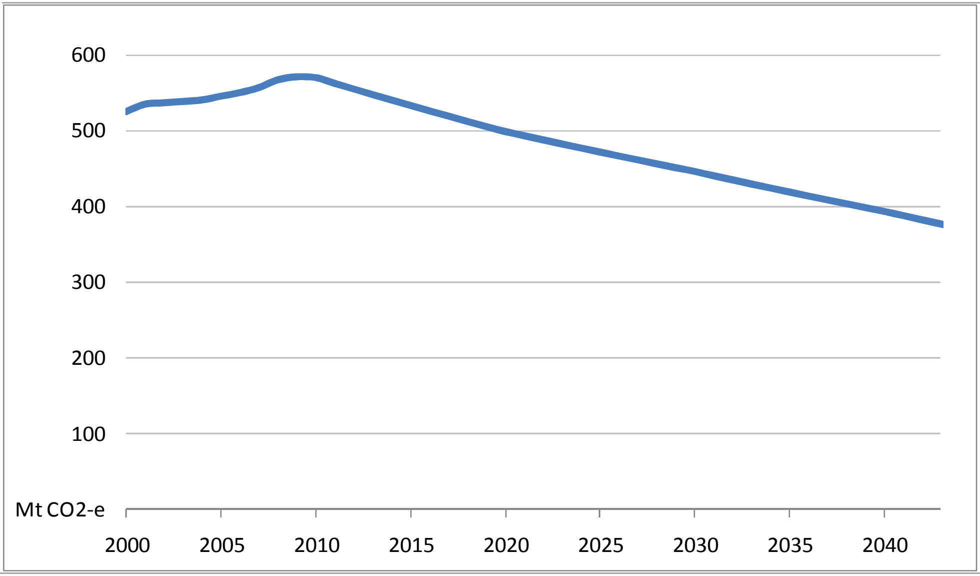
calibrated to replicate the observed movement of labour between Australia's states and territories during the period from 2001 to 2006. These settings have been used for the modelling in this analysis.

CPRS modelling

For this analysis, Australia is assumed to have implemented the carbon pollution reduction scheme (CPRS) with a target of reducing Australia's net greenhouse gas emissions to 5 per cent below 2000 levels by 2020. The emission permit price needed to achieve this target has been solved endogenously in *Tasman Global*.

From 2020, the Australian emissions target has been assumed to fall by a further 10 percentage points per decade with total emissions constrained to be 394 Mt CO_2-e by 2040 (Figure 6).

Figure 6 Assumed Australian net greenhouse gas emissions trajectory, all scenarios



Source: Tasman Global data and projections

The projected reference case emissions permit price required to achieve the emissions abatement targets is shown in Table 3.

Table 3 Projected emissions permit price, reference case

	2010	2020	2030	2040
2010 $/t CO_2-e	0	30	67	80

Data source: Tasman Global projections

4. Macroeconomic aggregates

One of the most commonly quoted macroeconomic variables at a national level is Gross Domestic Product (or GDP) which is a measure of the aggregate output generated by an economy over a period of time (typically a year). From the expenditure side, GDP is calculated by summing total private and government consumption, investment and net trade[5]. At the state level, the GDP equivalent is called Gross State Product (GSP) while at a regional level, the GDP equivalent is called Gross Regional Product (GRP). To reduce potential confusion with the various acronyms, the term ‘economic output’ will be used in the following discussion.

Although changes in real economic output are useful measures for estimating how much the output of the relevant economies may change, changes in the real income of a region is more important as it provides an indication of the change in economic welfare. In Tasman Global changes in real income at the national level is synonymous with real gross national disposable income reported by the ABS.

Real income is equivalent to real economic output plus net foreign income transfers, while the change in real income is equivalent to the change in real economic output, plus the change in net foreign income transfers, plus the change in terms of trade (which measures changes in the purchasing power of a region’s exports relative to its imports). As Australians have experienced firsthand in recent years, changes in terms of trade can have a substantial impact on people’s welfare independently of changes in real GDP.

An important issue in estimating the regional impacts of a project is determining how much of the wealth generated by the project will remain within the region and how much will be transferred to other regions.

Economic output is a measure of the amount of goods and services generated within a region and, consequently, wealth transfers only have a second order effect through the additional consumption induced demand. Wealth transfers will, however, have a significant impact on the real income of a region with consequent impacts on consumer orientated sectors of the economy (primarily services). The income and demand effects will have consequent impacts on employment, real wages and migration incentives in each region.

[5] From the income side, GDP is equal to the returns to factors plus all tax revenues.

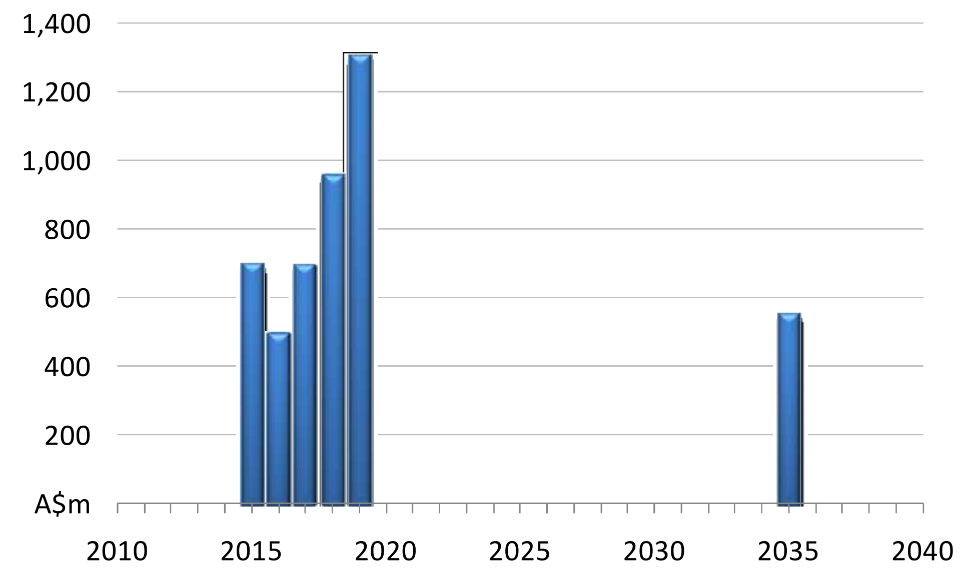
5. Inland railway – analysis

The inland railway project defined in the main report comprises the upgrading of some existing rail infrastructure and the construction of new or greenfield infrastructure to produce an inland rail link between Melbourne and Brisbane, and subsequent operation of the line. Labour and capital would be employed in both the construction and operation phases, with consequences for income, employment and government revenues. The initial construction impacts would be mainly in NSW and Queensland, as the existing line would be used in Victoria.

5.1 Project overview

Annual assumed capital expenditure for the inland rail is presented in Figure 7. In total, the inland railway is expected to cost $4.7 billion, $4.2 billion of which will be spent over the five years 2015 to 2019. The remaining expenditure is delayed until around 2035 when further investment is anticipated to allow the line to cope with growing traffic demand (assumed to be in one year, but in practice may be occur over a longer period).

Figure 7 Annual expenditure for construction phase (in real terms)



Data source: Inland Rail Alignment Study Final Report

The anticipated traffic demand for the proposed inland railway along with the changes in demand for freight transport using the coastal rail and road routes were taken from the Inland Rail Alignment Study Final Report (Chapter 3). Similarly, the above rail and infrastructure operating costs were also taken from the detailed costings underlying the results presented in the main report (Chapter 9).

5.2 Funding scenarios

The macroeconomic impacts of the construction phase are highly dependent on how the new rail project is funded. If the funding is from foreign debt markets then Australians (as a whole) will be indirectly bringing forward consumption at the expense of future consumption. That is, Australia will increase spending on the items necessary to build the inland rail line but will be required to pay back the accumulated debt over subsequent decades. As the construction will require the purchase of imported items, the total debt incurred during the construction phase will actually be greater than the amount spent on domestically produced goods and services. If the project is fully funded domestically, Australians will be foregoing current consumption to supply the resources necessary to build the inland rail line.

In both cases, the benefits to Australia of undertaking the expense involved in building the inland rail line are fundamentally linked to the future stream of income associated with the project. At a national level, the 'income stream' includes the benefits to Australia as a whole associated with the freeing up of Australian labour and capital which can be used elsewhere to increase the total production of goods and services. The productivity improvements associated with transporting a quantity of goods between Melbourne and Brisbane along the proposed inland rail line compared to the current coastal rail line is an example of the freeing up of scarce labour and capital that can benefit the wider Australian economy (even if it does not directly benefit the owners of the individual assets).

For the analysis of the inland railway, two funding scenarios have been considered, namely an foreign debt scenario and a domestic funding scenario.

From a modelling perspective, the domestic funding scenario was modelled by maintaining net foreign debt at the same level as the reference case during the construction period (2015-2019 and 2035) and reducing consumption (by increasing savings) in those years to fund the necessary capital expenditure. Under the increased foreign debt scenario, savings rates are maintained at reference case levels and the capital expenditure is assumed to be funded by increasing the total foreign debt of Australia. As discussed in Section 3.1 above, the debt is funded from the global investment market and is serviced at the global average rate of return.

Allowance was made for the economic impacts of investment which may be deferred on the existing east coast rail line as a result of the operation of the inland railway. Current estimates of the likely size of the potential deferment of investment on the east coast rail line are less than five per cent of the inland railway's capital expenditure over the time period considered for this analysis. Deferred investment should only have a minor impact on the magnitude of the results projected in this analysis.

5.3 Results

The following discussion reports the results of the construction and operation phase of the core scenarios individually and combined.

5.3.1 Construction phase

Table 4 summarises the projected cumulative impacts of the construction phase of the inland rail line under the two funding scenarios. These results do not take into account the operation of the railway. Rather this section reports the impact on economic aggregates of the railway's construction and, in the case of the foreign debt scenario, the repayment of the capital amount borrowed to fund the capital investment the operation phase of the line is discussed in the section 5.3.2 with section 6 reporting the combined impacts of the railway's construction and operation.

Table 4 Inland rail construction – Cumulative change in selected macroeconomic aggregates under different funding scenarios, relative to the reference case

	Increased foreign debt scenario			Domestically funded scenario		
	Total (2015-2040)	NPV (4% discount rate)	NPV (7% discount rate)	Total (2015-2040)	NPV (4% discount rate)	NPV (7% discount rate)
	2010$m	2010$m	2010$m	2010$m	2010$m	2010$m
Economic output (GDP)	–$739	–$253	–$77	–$790	–$418	–$274
Real income (RGNDI)	–$8,509	–$4,368	–$2,761	–$2,865	–$1,561	–$1,041
Real private consumption	–$5,748	–$2,862	–$1,749	–$6,313	–$4,429	–$3,599

Notes: NPV = Net Present Value. The NPV calculation includes the impacts through to 2040 though the project will continue producing impacts beyond that; a longer period would have only a modest effect on the NPV results because of discounting. Also note that the results reported do not reflect any impacts from the operation of the line.

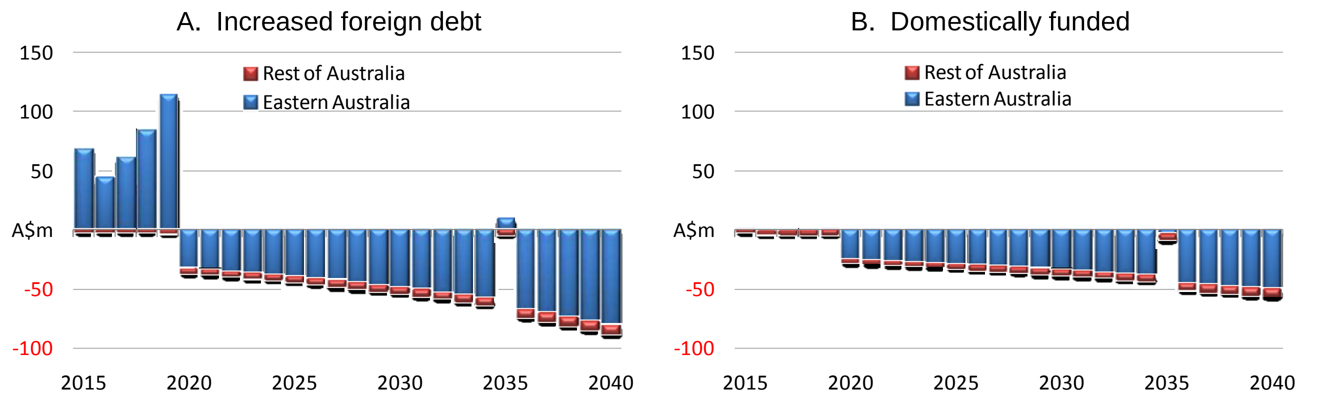
Economic output

The projected cumulative change in real Australian economic output (or real GDP) is projected to be the least affected of the macroeconomic variables presented in Table 4. This is not surprising as the economy's *ability* to produce goods and services has not changed materially as a result of simply constructing the inland rail line (this will primarily be reflected in the operation phase impacts, which are reported in section 6).

Figure 8 presents the annual projected change in Australia's real economic output (GDP) relative to the reference case under the two funding scenarios over the period 2015 to 2040. It can be seen that the size and timing of the changes in real economic output depend on the funding scenario.

If the inland railway is funded by increasing foreign debt, real economic output is projected to increase during construction as the increased investment stimulates demand for Australian goods and services and increases aggregate employment (see Figure 8A). However, once the stimulus associated with the injection of foreign capital is removed, the debt repayments become a drain on economic activity as domestic demand for Australian goods and services declines relative to the reference case.

Figure 8 Inland rail construction – Change in real economic output, relative to the reference case under different funding options (2010A$)



Note: The results reported here do not reflect any impacts from the operation of the line.

If the inland rail is funded domestically, real economic output is projected to be largely unchanged during the construction years (2015-2019). This is because Australia is diverting resources away from consumption toward investment to fund the activity (see Figure 8B).

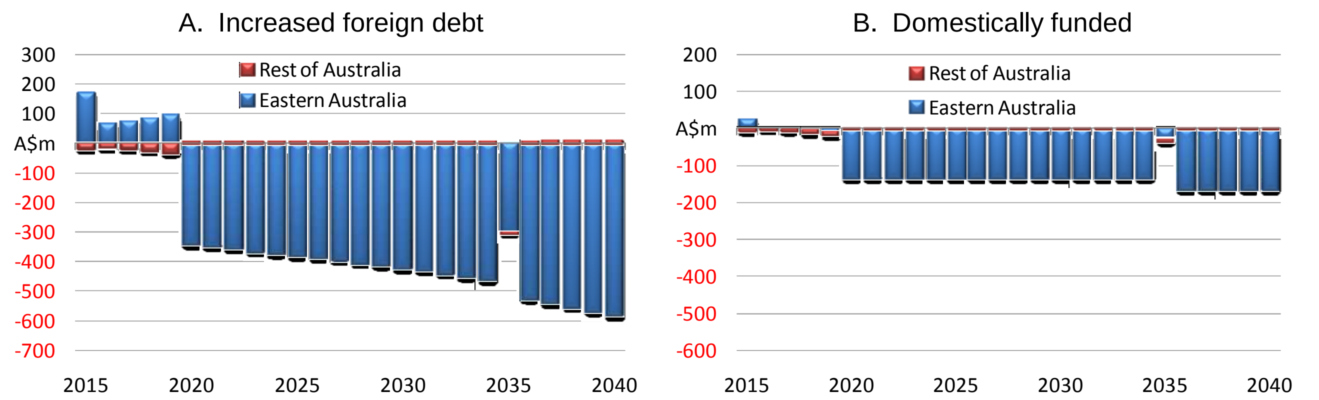
There is projected to be a small (compared to the size of the investment expenditure) decline in real economic output after 2020 as a result of the construction of the inland rail line crowding out other income producing investments.

Using a real discount rate of 7 per cent[6], the effect of the construction (and associated debt repayment under the foreign debt scenario) on the net present value of Australian real economic output (or real GDP) over the period 2015 to 2040 is minus $77 million under the increased foreign debt scenario and minus $274 million under the domestically funded scenario (Table 4).

Real income

Figure 9 presents the annual projected change in real income[7] relative to the reference case under the two funding scenarios.

Figure 9 Inland rail construction – Change in real income, relative to the reference case under different funding options (2010A$)



Note: Real income for Australia as a whole is synonymous with real gross national disposable income (RGNDI) as used by the ABS. Also note that the results reported here do not reflect any impacts from the operation of the line.

Under the foreign debt scenario Australia's real income increases during the construction period (2015-2019 and 2035). This increase is driven by the increased demand for Australian goods and services which is funded by the foreign debt.[8]

At the end of the construction phase, however, the interest payments on the accumulated foreign debt associated with the inland rail line reduce Australia's real income associated with economic activity. The reduced income at the national level has a further effect on the ability of Australians to fund future investment which results a gradual decline (in absolute terms) in real income through time. Over the period 2015-2019, the real income of Australians increases by approximately $305 million, but then falls by an average of $420 million a year over the period 2020 to 2040. In considering these results it should be remembered that this section ignores the operation phase of the railway. Typically an infrastructure investment such as a rail line is only undertaken because the investment will be more than justified by the benefits associated with the operation of the asset into the future. In this sense the results reported here are artificial as they show only one side of the

6 A 7 per cent discount rate is consistent with the discount rate used in the economic analysis in the main report. The results are also presented using a 4 per cent discount rate for information purposes.

7 Recall from section 3.4 that real income is equivalent to real economic output plus net foreign income transfers, while the change in real income is equivalent to the change in real economic output, plus the change in net foreign income transfers, plus the change in terms of trade (which measures changes in the purchasing power of a region's exports relative to its imports).

8 A large portion of the investment expenditure is spent on imported products. Consequently, the economy is incurring debt purchasing items that do not directly benefit the local economic activity.

story. Nevertheless they highlight the costs which can be associated with unproductive investments, particularly if the investment crowds out other productive activity.

Using a real discount rate of 7 per cent, the impact of the railway's construction and debt repayment on the net present value of Australia's real income over the period 2015 to 2040 is minus $2.8 billion under the increased foreign debt scenario (Table 4 above).

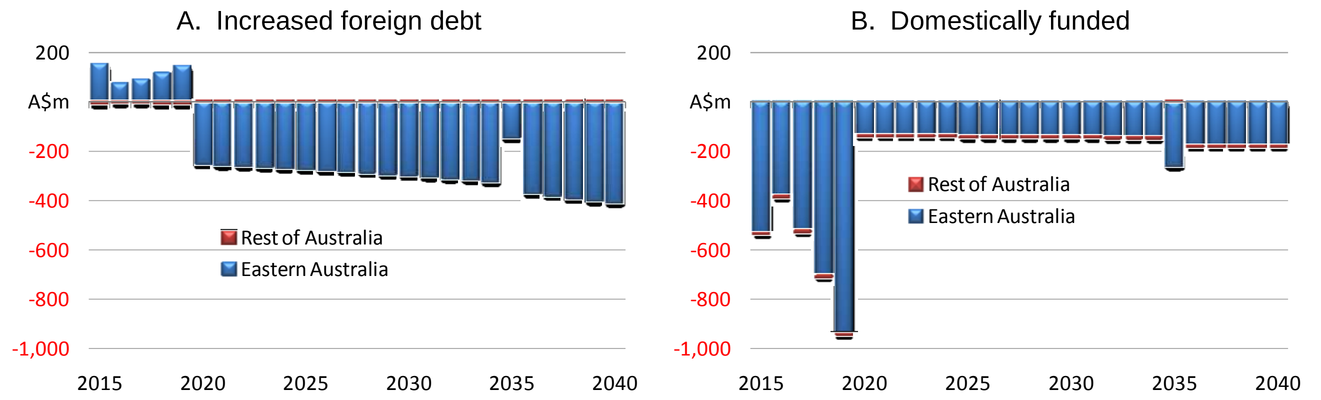
In contrast, under the domestic funding scenario, Australia's real income is projected to remain unchanged during the period 2015-2019 as the investment in the inland railway is funded by reduced consumption over the same period. In the longer term, Australia's real income declines by an average of $142 million a year over the period 2020 to 2040 since the income producing potential of Australia's capital stock is less compared to the reference case. (The income generated by the inland rail infrastructure is discussed separately in Section 5.3.2).

Using a real discount rate of 7 per cent, the impact of the construction of the railway on the net present value of Australia's real income over the period 2015 to 2040 is minus $1.0-0.9 billion under the domestically funded scenario (Table 4 above).

Real private consumption

Figure 10 presents the impact of the construction on projected change in real private consumption relative to the reference case under the two funding scenarios.

Figure 10 Inland rail construction phase – Change in real private consumption, relative to the reference case under different funding options (2010A$)



Note: The results reported here do not reflect any impacts from the operation of the line.

Source: ACIL Tasman CGE modelling

Under the foreign funding scenario there is an increase in real private consumption during the construction period (2015-2019 and 2035). This increase is driven by the increased demand for Australian goods and services which is funded by the foreign debt. At the end of the construction phase, however, the interest payments on this debt reduce the national income available to spend on private consumption. The reduced income at the national level has a further effect on the ability of Australians to fund future investment which results a gradual decline (in absolute terms) in real private consumption through time. Over the period 2015-2019, Australian real private consumption increases by approximately $550 million, but then falls by an average of $300 million a year over the period 2020 to 2040.

Using a real discount rate of 7 per cent, the impact of construction on the net present value of private consumption over the period 2015 to 2040 is minus $1.75 billion under the increased foreign debt scenario (Table 4 above).

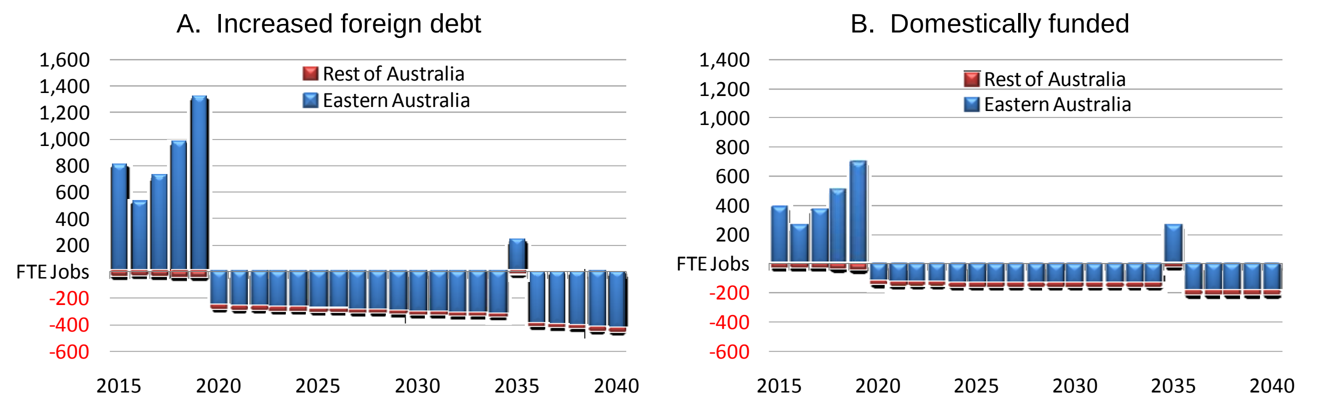
In contrast, under the domestically funded scenario, real private consumption is projected to fall substantially during the period 2015-2019 as Australia's income is redirected toward investment expenditure. In the longer term, real private consumption follows the decline in Australian real income.

Using a real discount rate of 7 per cent, the impact of construction on the net present value of private consumption over the period 2015 to 2040 is minus $3.60 billion under the domestically funded scenario (Table 4). The higher cost to private consumption under the domestic funding scenario compared with the foreign debt funding scenario is explained by the fact that under this scenario Australian's forego higher levels of consumption in the early years of the project.

Employment

Figure 11 presents the projected change in annual employment relative to the reference case under the two funding scenarios.

Figure 11 Inland rail construction phase – Change in total employment, relative to the reference case under different funding options (full time equivalent jobs)



Note: The results reported here do not reflect any impacts from the operation of the line.

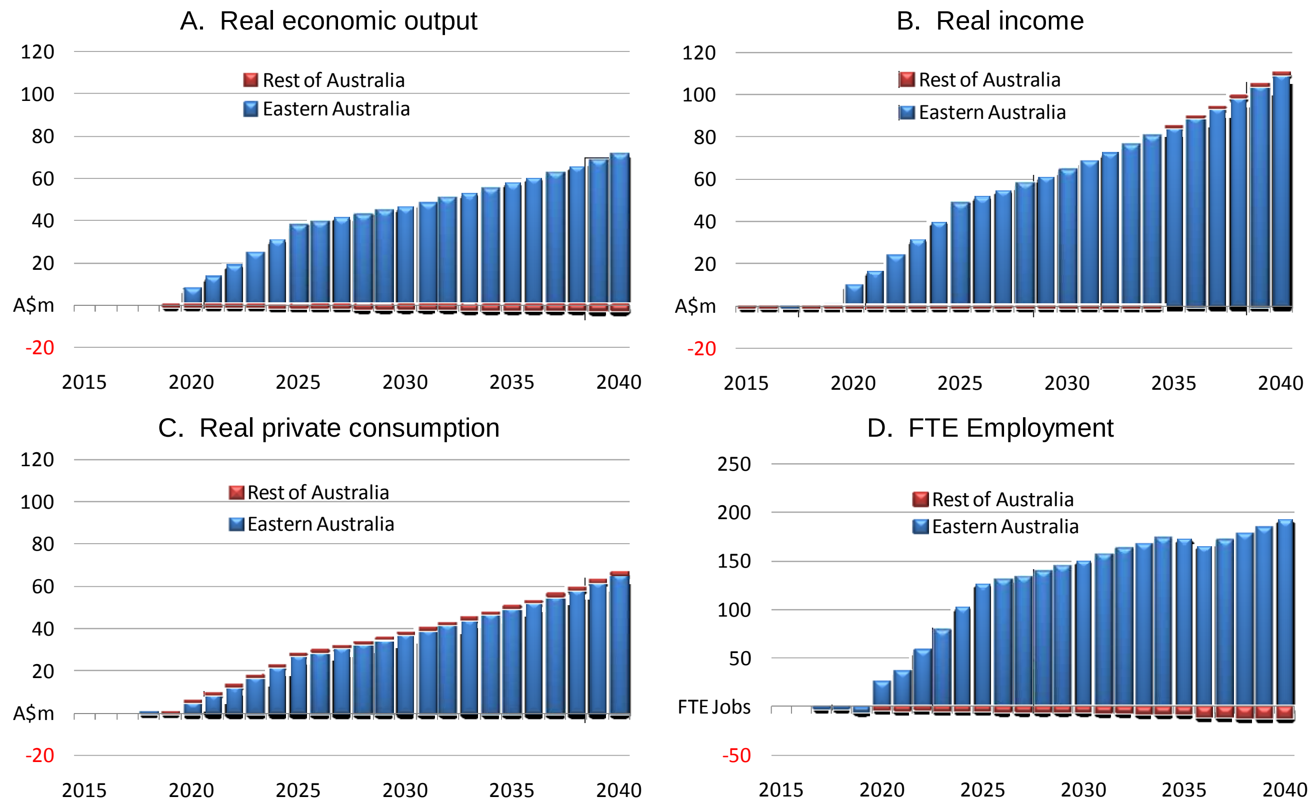
Source: ACIL Tasman CGE modelling

It can be seen that the actual physical construction of the railway in the years 2015-2019 and 2035 has a significantly larger positive impact on employment under the scenario where the investment has been financed using foreign debt. However, over the remainder of the period considered employment losses are higher under the foreign debt scenario. Again in considering these results it should be borne in mind that the railway is assumed not to be operating; this is an artificial construct to highlight the implications of the alternative funding scenarios.

5.3.2 Operation phase

This section briefly reports on the implications of the operation phase of the railway. It has been assumed that once the line becomes operational some freight that would otherwise have been transported on the east coast railway or by road will be diverted to the inland railway. This freight diversion essentially arises as a result of productivity improvements and cost savings associated with the new line. In addition some new freight will be induced on to the new line. The modelling shocks used for this analysis were informed by the freight modelling undertaken by ACIL Tasman (see Chapter 3 in the main report). Figure 12 presents the projected change in selected macroeconomic variables relative to the reference case under the operation phase alone. It can be seen that overall the impacts are positive for Australia. However, in the case of real economic output and employment there are small negative impacts on the rest of Australia due to crowding out effects, which are more than compensated for by the rise in real economic output and employment in the eastern states.

6. **Figure 12 Inland rail operation phase – Change in selected macroeconomic variables, relative to the reference case**



7. *Note: The flow-on effects of the funding of the construction phase are not included in these results. Effectively the results reported here are modelled assuming that the railway line capital used in the operation phase is "free".*

8. *Source: ACIL Tasman CGE modelling*

8.1.1 Total project

The previous sections reported the results for the construction of the railway and its operation separately. As noted previously, this approach, whilst informative, is somewhat artificial. This is because capital investments in infrastructure, such as railway investments, are made in order to produce productive assets, which in combination with other factors of production create economic activity. To be commercially viable, capital investments need to be more than covered by the returns to capital from the operation phase of that infrastructure.

This section therefore brings together the results for the construction and operation phases of the inland railway project.

Table 5 summarises the projected cumulative impacts of the total inland railway project under the two funding scenarios, while Figure 13 and Figure 14 report the annual projected changes in selected macroeconomic variables (relative to the reference case).

Table 5 Inland rail total project (construction and operation) – Cumulative change in selected macroeconomic aggregates under different funding scenarios, relative to the reference case

	Increased foreign debt scenario			Domestically funded scenario		
	Total (2015-2040)	NPV (4% discount rate)	NPV (7% discount rate)	Total (2015-2040)	NPV (4% discount rate)	NPV (7% discount rate)
	2010$m	2010$m	2010$m	2010$m	2010$m	2010$m
Real economic output (GDP)	$153	$195	$202	$170	$62	$26
Real income (RGNDI)	–$6,982	–$3,607	–$2,289	–$1,426	–$848	–$599
Real private consumption	–$4,800	–$2,399	–$1,465	–$5,414	–$3,981	–$3,319

Notes: NPV = Net Present Value. The NPV calculation includes the impacts through to 2040 though the project will continue producing impacts beyond that; a longer period would have only a modest effect on the NPV results because of discounting

Data source: ACIL Tasman CGE modelling

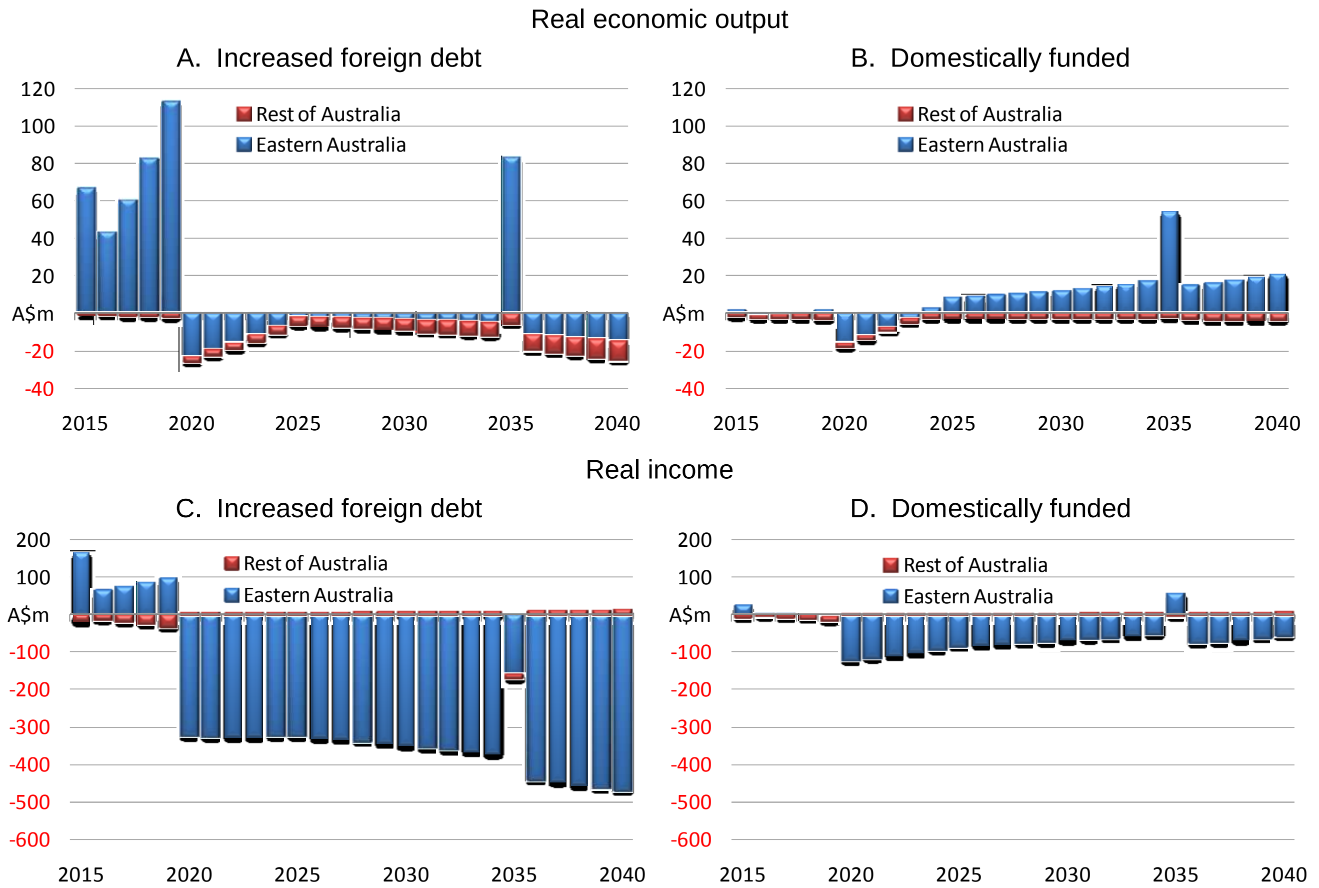
Table 5 shows that, from the perspective of real economic output (GDP), the foreign funding scenario produces the largest increase in real economic output. In NPV terms (at a 7 per cent discount rate) the domestic funding scenario over the period 2015 to 2040, the domestic funding scenario sees the construction and operation phases together increasing Australia's real economic GDP by only $26 million. This compares with an increase in real economic output of $202 million under the foreign debt scenario.

However, the in terms of real income (which is a better measure of the welfare benefit to Australians) the reductions in the negative cumulative outcomes are smaller under the domestic funding scenario. Table 5 shows that both funding scenarios reduce Australia's real income.

For example, the NPV outcome (at a 7 per cent discount rate) over the period 2015 to 2040 is minus $599 million under the domestically funded scenario, compared with minus $2,289 million under the foreign debt scenario. This outcome can be explained by the fact that under the domestically funded scenario annual real income takes a relatively small 'hit' because the bulk of the cost of funding is borne by lost consumption during the construction phase. In contrast, under the foreign debt scenario, the interest on the borrowed debt must be repaid over the operation phase and the annual returns to real income from the operation phase are not sufficient to compensate the economy[9] for the sums borrowed (see Figure 13).

[9] Note that income generated by the project is different for the economy as a whole compared to the owners of individual assets.

Figure 13 Inland rail total project (construction and operation) – Change in real economic output and real income, relative to the reference case under two alternative funding scenarios



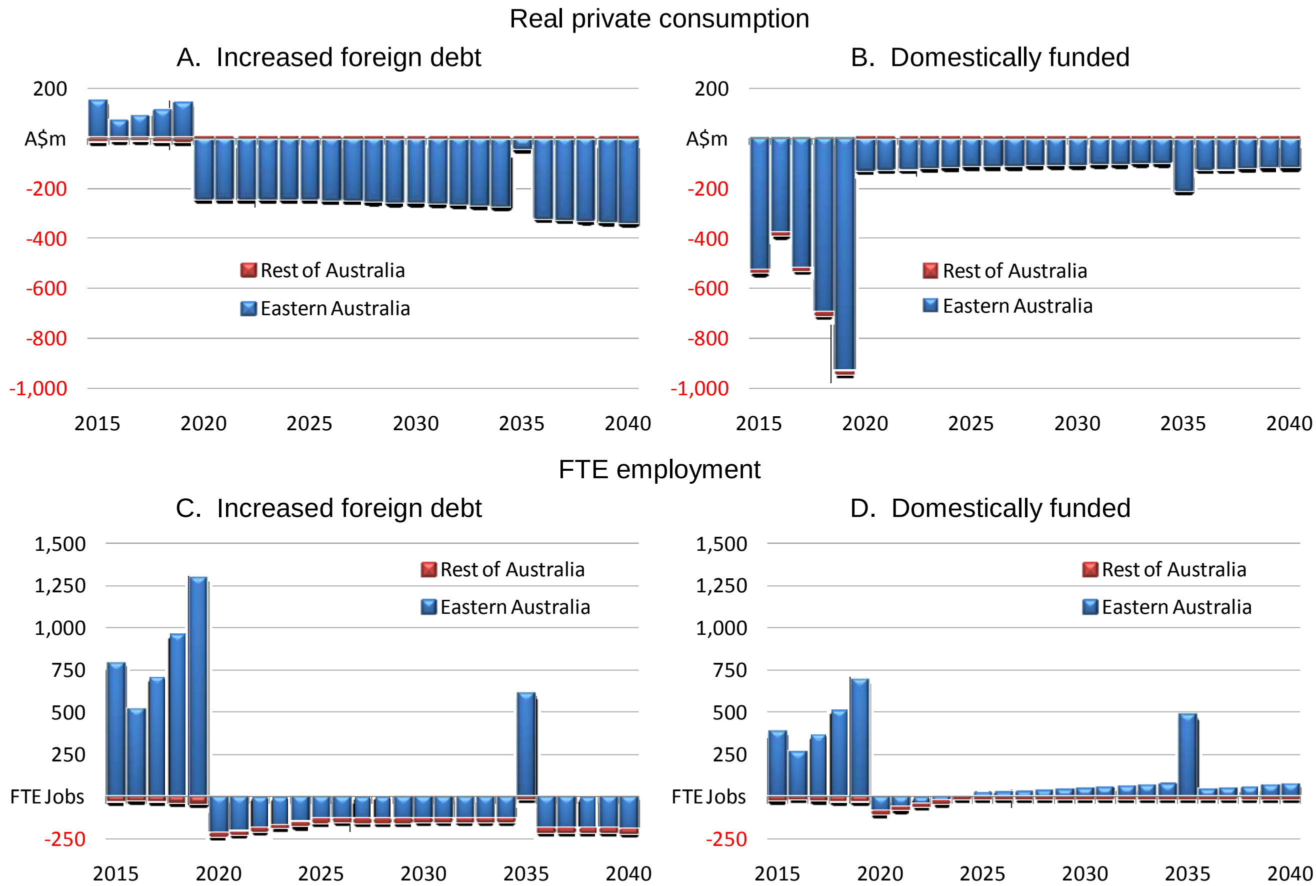
Note: The anticipated construction expenditure for the project is mostly spent over the period 2015-2019 However, further substantial expenditure is assumed to occur in 2035 to cope with anticipated traffic demand, which has a noticeable impact on the projected impacts in that year (in practice it may be smoothed over a longer period).

Source: ACIL Tasman CGE modelling

The NPV stream of real private consumption is negative under both the funding scenarios. However, not surprisingly, the foreign debt funding scenario produces a smaller negative NPV result than the domestic funding scenario. This result, in large part, reflects the fact that higher levels of real consumption must be foregone during the early construction years under the domestic funding scenario (see Figure 14).

Average annual FTE employment is slightly higher than the reference case under the foreign debt scenario with an additional 50 FTE jobs projected to be created over the period (2015-2040). The impact on employment under this scenario varies markedly between the construction years and the operation years. For example, in 2019 FTE employment is approximately 1,260 FTE jobs higher than in the reference case, In most years of the operation FTE employment across Australia is lower than the reference case by around 130 FTE jobs (see Figure 14).

Figure 14 Inland rail total project (construction and operation) – Change in real private consumption and annual employment, relative to the reference case under two alternative funding scenarios



Note: The anticipated construction expenditure for the project is mostly spent over the period 2015-2019 However, further substantial expenditure is assumed to occur in 2035 to cope with anticipated traffic demand, which has a noticeable impact on the projected impacts in that year (in practice it may be smoothed over a longer period).

Source: ACIL Tasman CGE modelling

Under the domestic funding scenario, average employment over the period 2015 to 2040 is projected to increase by 118 jobs. As under the increased foreign debt scenario, most of the additional employment under the domestic funding scenario is projected to be short -term employment created during the construction years of the railway. In particular, average employment during the period 2015-2019 is projected to increase by just under 430 FTE jobs. Under the domestically funded scenario, longer term employment (2020-2040) associated with the inland railway is projected to increase by around 45 FTE jobs a year.