



Australia's Comparative Advantage: economic scenarios

This report was prepared for the Australian Council of
Learned Academies (ACOLA)

May 2015

This report has been produced for the Australian Council of Learned Academies (ACOLA) according to their terms of reference for the project. Independent Economics makes no representations to, and accepts no liability for, reliance on this report by any person or organisation other than ACOLA. Any person, other than ACOLA, who uses this report does so at their own risk and agrees to indemnify Independent Economics for any loss or damage arising from such use.

Independent Economics is an independent provider of economic modelling services to support economic policy analysis and forecasting. We are strongly committed to independent modelling that provides robust analysis and real solutions to meet client needs. In Australia, we provide services to government and industry, and we also provide services internationally.

© 2015 Econtech Pty Ltd trading as Independent Economics. All rights reserved.

Postal Address:

Independent Economics
PO Box 4129
KINGSTON ACT 2604
AUSTRALIA

Email: office@independenteconomics.com.au

Web-site: www.independenteconomics.com.au

Entity: Econtech Pty Ltd (ACN 056 645 197) trading as Independent Economics

Contents

Executive summary	i
1 Introduction	1
2 Policies for advancing competition	4
2.1 Taxation.....	4
2.2 Competition Policy	8
2.3 Free Trade Agreements	8
2.4 Federalism	9
2.5 Workplace Relations	10
3 Policies for investing in the future	12
3.1 Infrastructure.....	12
3.2 Labour Force Participation.....	13
3.3 Innovation	14
3.4 Migration.....	15
3.5 Education.....	18
4 Economic modelling approach	19
4.1 The Independent Macro Model	19
4.2 Modelling “Investing in Growth”	20
4.3 Specifying the Scenarios	21
5 Advancing competition scenario	22
6 Investing in the future scenario.....	28
7 Combined scenario	34
References.....	40
Appendix A: Modelling Methodology	42

Executive summary

Introduction

This report develops and presents alternative economic scenarios for Australia to demonstrate how our economic future depends on whether governments undertake major reform in ten key areas. It finds that without reform, living standards are only likely to rise modestly, taking real annual consumption per head from \$36,000 today to \$45,000 in 2030. However, with comprehensive reform, annual consumption per head is modelled to rise to \$55,000, implying a reform dividend to living standards of \$10,000 per head. By 2050 this reform dividend rises further, to over \$15,000 per head.

This work was commissioned by the Australian Council of Learned Academies (ACOLA) as part of its “Australia’s Comparative Advantage” (ACA) project. Studies conducted within the ACA project have identified the ten key areas for reform. This report aims to bring those studies together by quantifying the overall impact of governments undertaking successful reform across all ten areas.

The reforms are grouped together in two scenarios. The Advancing Competition Scenario focusses on policies to advance living standards by improving the way that economic resources are allocated. It includes the following five key areas of reform:

- taxation;
- competition policy;
- free trade agreements;
- federalism; and
- workplace relations.

The Investing in the Future Scenario focusses on policies to enhance growth in productive capacity. It includes the remaining five key areas of reform:

- infrastructure;
- labour force participation;
- innovation;
- migration; and
- education.

The two scenarios are then merged into the Combined Scenario, which therefore includes reform in all ten key areas. A Baseline Scenario, without reform, serves as a point of reference. The differences in economic outcomes between the three policy reform scenarios and the baseline scenario show the economic impacts of the reforms.

The ten policy areas each make significant contributions to the economic gains from reforms, with education, migration and innovation policies standing out as the largest sources of potential gain. Education and migration policies are the main drivers of higher employment per capita, while innovation policies are the biggest driver of productivity growth. The policies for taxation, labour force participation, workplace relations, federalism and competition also deliver substantial gains. Infrastructure policies and free trade agreements also contribute, but their main impacts are felt in the sectors of the economy that are mostly directly impacted, namely construction and agriculture, rather than more widely.

Policies for advancing competition

Taxation

The shortcomings in Australia's tax system have been analysed in the Australia's Future Tax System Review (AFTSR, 2009), otherwise known as the "Henry Review", and the Australian Government (2015b) "Re:think" Tax Discussion Paper. Those reports were supported by economic modelling that quantifies the costs to consumers of the distortions to economic decision making resulting from major taxes.

Based on that analysis, and further Independent Economics modelling, the top priority taxation reform selected for modelling in this report is to reduce the company income tax rate from 30 per cent to an international competitive 25 per cent. At its current high level, company tax discourages foreign investment in Australia, thus weakening productivity. It also provides an incentive for foreign multinational companies to shift profits out of Australia. The potential contribution to the Budget from company tax is also eroded by the Australian franking credits system.

Other highly worthwhile tax reforms include abolishing stamp duty on conveyances, making more uniform the taxation of income from different assets, broadening the base of the GST to include basic foods, and eliminating bracket creep by automatically indexing the personal income tax brackets to wages, while maintaining discretion in adjusting the rates of tax that apply to the brackets.

Competition Policy

The Final Report of the Harper Competition Policy Review (2015) made many recommendations for improving competition. These included greater competition in the provision of human services, direct pricing of road use, loosening protective regulations on pharmacies, deregulation of retail shopping hours, opening of coastal shipping to competition, loosening protective regulations on the taxi industry, removal of restrictions on parallel imports and less prescriptive and more responsive land zoning.

The Harper Review did not undertake modelling of these reforms, so indicative estimates of likely productivity gains have been made based on past modelling of competition policy reform.

Free Trade Agreements

With trade liberalism stalled at the global level, Australia has been pursuing Free Trade Agreements (FTAs) to boost two-way trade and investment flows. Australia has concluded FTAs with New Zealand, Chile, USA, South Korea, Malaysia, Singapore, Thailand, China and Japan. It has FTAs under negotiation with the GCC countries, India and Indonesia.

The potential economic impacts on Australia from FTAs have been modelled by Tulloh, Jiang and Pearce (2014) of the Centre for International Economics (CIE). That modelling, which shows large gains in agricultural exports, has informed the modelling assumptions used here.

Federalism

The Australian Government has committed to producing a White Paper on Reform of the Federation. In the lead up to the White Paper, it has released a series of five issues papers.

Twomey and Withers (2007) show that, compared to other OECD federations, our central government receives a relatively high share of national tax revenue. This is associated with below best practice

performance through duplication by the Commonwealth of state government services in areas such as education and health, and over-prescription of state government services by the Commonwealth through Special Purpose Payments (SPPs) and National Partnership Payments (NPPs). Cross-country regression analysis by Twomey and Withers (2007) on the potential productivity gains from moving our federal system closer to the OECD best-practice for federations is used to inform the modelling assumptions here.

Workplace relations

For workplace relations, the Productivity Commission is reviewing the Fair Work Act, although its recent analysis of workplace relations in the construction industry understated the economic significance of the issues.

Econtech (2007) traces the moves to progressively deregulate workplace relations through legislative change in 1993, 1996 and 2005. This 3-phase process was then partially reversed through the Fair Work Act 2009. This pattern of change in Australian labour market regulation is reflected in movements in Canada's Fraser Institute's index of labour market regulations for Australia.

In a recent IMF Working Paper, Bernal-Verdugo, Furceri and Guillaume (2012) analyse the impact of labour market flexibility on unemployment. After controlling for other factors, they estimate that, in the medium term, each one point movement in a country's rating on the Fraser's Institute's index of labour market regulation reduces its unemployment rate by 0.8 percentage points. This suggests that Australia could reduce its sustainable unemployment rate by around one percentage point by easing (but not abolishing) unfair dismissal laws and making the role of the Fair Work Commission less prescriptive. Based on other literature, this is also likely to lead to a boost in labour productivity of the order of 1 per cent.

Policies for investing in growth

Infrastructure

Under its infrastructure policy agenda, the Federal Government has significantly increased its expenditure on roads. It also arranged for a Productivity Commission (2014) Inquiry into Public Infrastructure, which recommended that there should be properly-conducted, cost-benefit studies of large projects and well-designed user charges.

Based on the recent increase in federal funding, this report models a sustained 10 per cent in general government investment in infrastructure that is spent in accordance with the Productivity Commission recommendations. Better transport infrastructure boosts business productivity.

Labour force participation

The 2015 Intergenerational Report of the Australian Government (2015a) suggests that “policy settings that seek to remove barriers to participation of females and older age groups in Australia and encourage them to work, if they wish to do so, can drive gains in GDP and income growth”. This echoes a more detailed analysis by Daley, McGannon and Ginnivan (2012) of the Grattan Institute of the scope for policy reforms aimed at lifting participation rates for females and mature age workers.

This Grattan Institute suggests lifting both the eligibility age for the age pension and the preservation age for superannuation benefits to 70, to encourage workforce participation by older workers. It also suggests reducing high effective marginal tax rates and the net cost of childcare to encourage higher

labour force participation by females. These proposals may add around two percentage points to the aggregate labour force participation rate.

Innovation

Australian investment in research and development as a share of GDP is well below the OECD average (OECD, 2007), potentially holding back productivity growth. Major OECD countries with relatively high levels of research and development include Sweden, Japan, Switzerland, the USA, Germany and Singapore. In those countries R&D investment ranges between 2 and 4 per cent of GDP, whereas in Australia it is consistently under 1.5 per cent of GDP.

Tunny (2006) suggests this reflects our situation as a remote country with abundant natural resources. On the other hand, the Department of Industry (2014) sees both strengths and weakness in Australia's R&D effort. In any case, although Australia has a well-designed R&D tax offset, some elements of the Australian policy environment are inconsistent with the best-practice innovation strategy recommended by the OECD (2010). For example, policy towards higher education has not always been directed at excellence, innovators face harsher consequences from bankruptcy than they do in the USA, and the carry back of losses for tax purposes is not allowed, unlike in Singapore. A thorough, independent review of Australia's policies towards innovation against the OECD best-practice strategy is needed, followed by vigorous implementation of policy reforms.

Migration

The age profile of migrants means that they significantly boost the labour force participation rate. The 2015 Intergenerational Report (IGR) (Australian Government, 2015a) assumes a constant level of net overseas migration (NOM) of 215,000 persons from 2014-15 to 2054-55. With a rising population, this implies that the contribution of NOM to population growth declines steadily from 0.9 percentage points to 0.5 percentage points. This is a consequence of the arbitrary assumption that the level of NOM remains constant, despite the rising population.

This study proposes the alternative assumption that the contribution of NOM to population growth is maintained at 0.9 percentage points. In line with growth in the population, this implies that the level of NOM increases steadily from 215,000 persons in 2014-15 to around 368,000 persons in 2049-50. This alternative assumption is more in line with historical experience. From 1999-2000 to 2013-14, NOM contributed an average of 0.85 percentage points to annual population growth, similar to the contribution of 0.9 percentage points that is proposed here.

The economic contribution of the migration program has recently been modelled in detail by Independent Economics for a study published by the Migration Council Australia (2015). A similar approach is used here.

Education

Investment in human capital through education is an important contributor to economic growth. In a study for Universities Australia, KPMG Econtech (2010) modelled the effects of improvement in funding and reform arrangements for universities and Technical and Further Education (TAFE). It found a high internal rate of return of around 15 per cent from additional funding.

The KPMG Econtech study identified 2.0 per cent of GDP as a target for funding of universities that was broadly consistent with the funding recommendations of the Bradley Review. According to the

latest ABS (2014) data, university funding reached 1.7 per cent of GDP in 2012-13. Hence this study models an increase in total university funding from 1.7 to 2.0 per cent of GDP.

The KPMG Econtech study also included an increase in funding for TAFE of 0.1 per cent of GDP. According to the latest ABS (2014) data, TAFE funding was steady at 0.5 per cent of GDP in 2012-13. Thus, this study models an increase in total TAFE funding from 0.5 to 0.6 per cent of GDP.

Economic modelling approach

The scenarios are simulated using the Independent Macro-econometric model. It is the latest in a series of models developed since 1988 (Murphy, 1988; Powell and Murphy, 1997) and used for policy analysis and forecasting. The current model was constructed as a complete re-build to factor in recent developments in macro modelling and the Australian economy. Recent uses of the macro model include scenario analysis for the Parliamentary Budget Office (Independent Economics, 2014) and the Migration Council Australia (MCA, 2015).

The “Investing in Growth” Scenario involves policies designed to lift economic growth. While traditional macro-econometric models are more concerned with cyclical fluctuations in economic activity, semi-endogenous growth models provide an avenue for incorporating growth drivers. Hence, in 2014 the Independent macro-econometric model was further developed to incorporate semi-endogenous growth. This follows similar work with the Quest III model at the European Commission (Varga and Veld, 2011).

The main elements of this new part of the model structure include a demographic model, an education attainment model, occupation detail, a migration model, a treatment of the role of Government infrastructure in production, and a representation of the role of research and development in using highly-skilled labour to develop innovations that raise productivity.

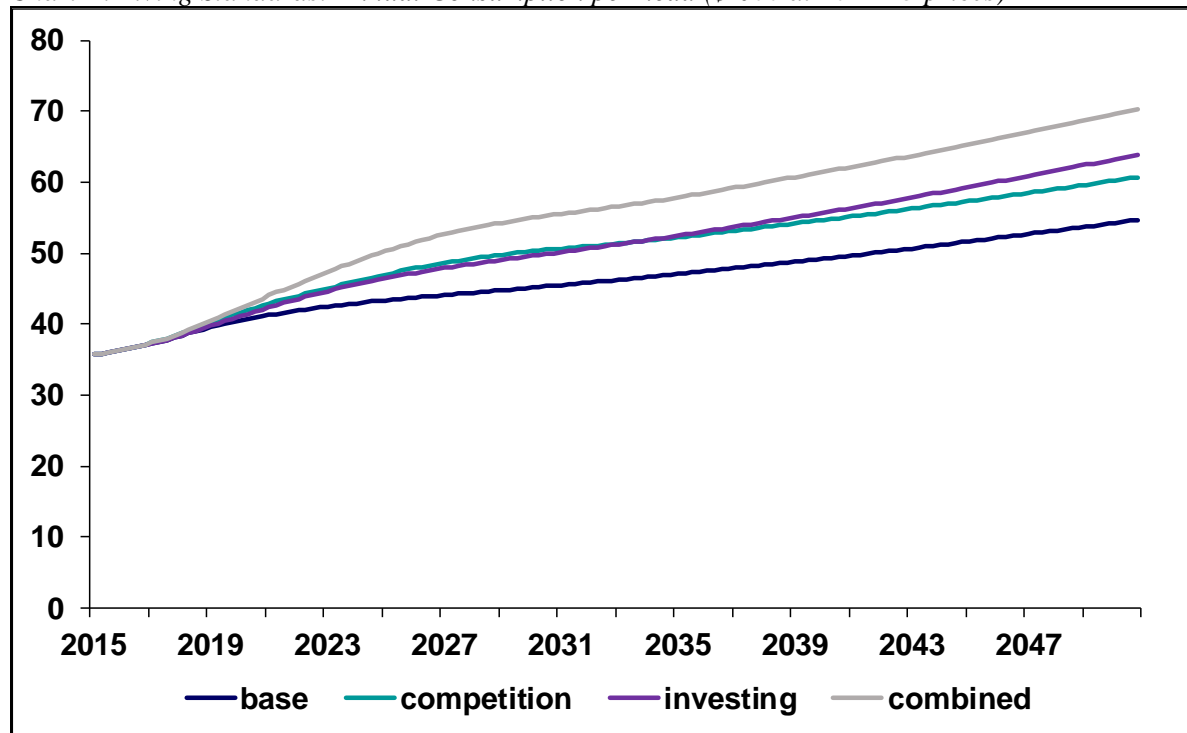
Results of the Scenarios

Chart A shows projections of how living standards, as measured by real household consumption per capita, would evolve under each of the scenarios.

Under the Baseline Scenario, in which there is no reform in the ten policy areas, average, annual consumption per head (in 2012-13 prices) rises modestly from around \$36,000 today to around \$45,000 in 2030. Much larger rises to around \$50,000 per head occur under either the Advancing Competition Scenario or the Investing in the Future Scenario. The Combined Scenario takes this to \$55,000 per head, an annual gain to living standards from reform of \$10,000 per head. By 2050 this reform dividend rises further, to over \$15,000 per head.

These gains depend approximately equally on gains in employment per capita and gains in labour productivity. Some policies mainly stimulate employment per capita while other policies mainly stimulate labour productivity.

Policies to lift the participation rates for females and older workers directly add to employment. Higher migration also adds to employment per capita because a high proportion of migrants fall in the prime working age group.

Chart A. Living Standards: Annual Consumption per head (\$'000 at 2012-13 prices)

Source: Independent macro-econometric model

Five different policies contribute to higher productivity. The cut in the company tax rate from 30 to 25 per cent lifts productivity by encouraging investment in the capital stock. The reforms to competition policy and federalism mean that labour is used more efficiently. Additional government infrastructure adds to productivity by reducing transport times. Higher innovation activity makes an ongoing contribution to productivity growth.

Some policies contribute importantly to gains in both employment per capita and labour productivity. Additional investment in tertiary education adds to employment, because higher-skilled workers have higher participation rates and lower unemployment rates than lower-skilled workers. Higher skilled workers are also more productive. Workplace reform lifts employment by reducing the sustainable unemployment rate. It also lifts productivity by allowing more flexible work practices.

Finally, the FTAs boost our terms-of-trade by raising prices for agricultural exports. This income boost allows a higher level of consumption for a given level of GDP.

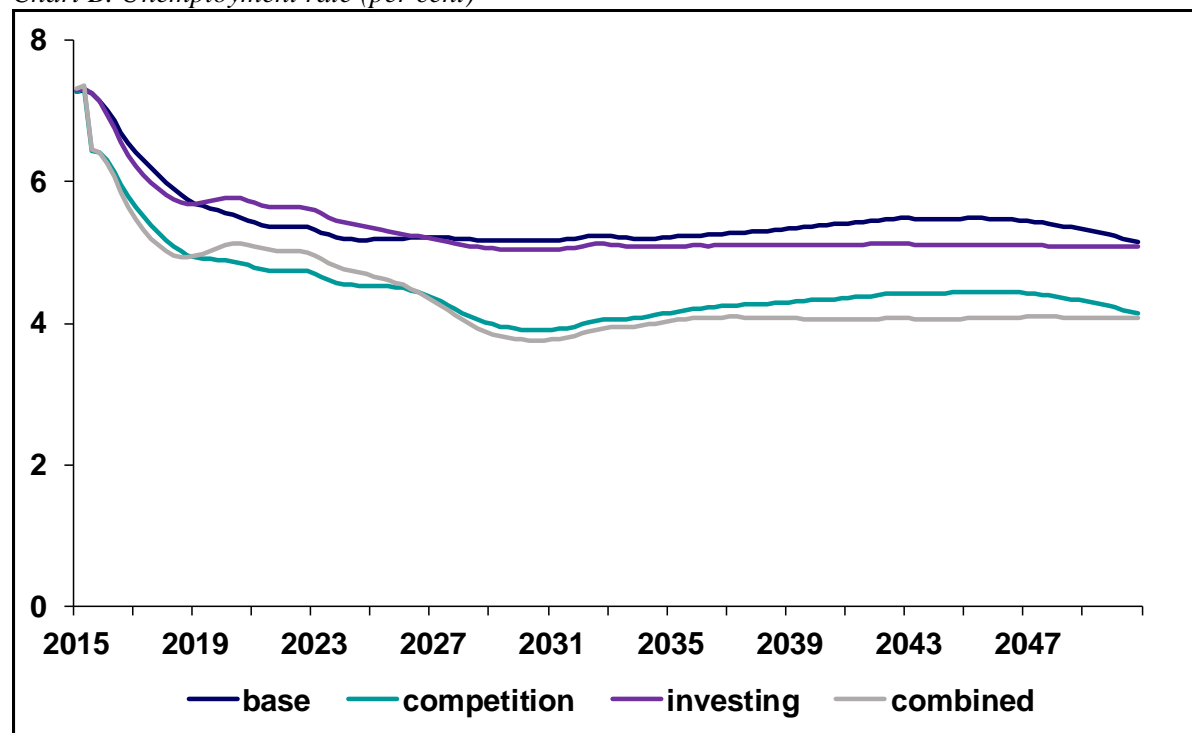
The ten policy areas each make significant contributions to the economic gains from reforms, with education, migration and innovation policies standing out as the largest sources of potential gain. Education and migration policies are the main drivers of higher employment per capita, while innovation policies are the biggest driver of productivity growth. The policies for taxation, labour force participation, workplace relations, federalism and competition also deliver substantial gains. Infrastructure policies and free trade agreements also contribute, but their main impacts are felt in the sectors of the economy that are mostly directly impacted, namely construction and agriculture, rather than more widely.

The reforms benefit some industries more than others. In the Baseline Scenario, without reform, all broad sectors growth at average, annual rates of around 3 per cent to 2030. However, in the Combined Scenario, with comprehensive reform, all sectors benefit but the biggest winner is manufacturing. The

high rate of investment required to support a higher rate of economic growth lifts demand for manufactured investment goods. Agriculture is also a bigger winner, boosted by the FTAs. The gain for mining is subdued because mining activity depends heavily on the availability of mineral resources, and that does not change as part of the Combined Scenario.

Chart B compares the projection for unemployment in the Combined Scenario with the projection in the Baseline Scenario. In the Baseline Scenario unemployment gradually recovers from its current cyclical high to stabilise at a sustainable rate of around 5.3 per cent from 2020 onwards. In the Combined Scenario, unemployment stabilises at just over 4 per cent. This improvement is mainly from the expected reduction in the sustainable unemployment rate from workplace relations reform.

Chart B. Unemployment rate (per cent)



Source: Independent macro-econometric model

Tables A and B provide more detailed snapshots of the economic impacts of the scenarios in 2030 and 2050 respectively, including for living standards.

Comparing the two tables, it is apparent that the gains from the Advancing Competition Scenario are largely realised by 2030: the gains in 2050 are similar to the gains in 2030. This is consistent with the nature of the Advancing Competition Scenario reforms. They are focussed on more efficiently allocating resources. Once that more efficient allocation has been achieved, the benefits persist but do not expand further.

This is in contrast to the Investing in the Future Scenario. Here the gains do not level off but continue to grow with the passage of time. This is because the education, migration and innovation policies all lift economic growth in the medium to long term.

Tables A and B also show that the overall impact of the policy reforms is to strengthen the Federal Government Budget. Some specific reforms, notably for taxation, education and infrastructure, involve a cost to the Budget, especially in the short-term. However, these costs are easily dominated by the growing boost to Budget revenues from the stronger economic growth delivered by all ten reforms.

This means that the same Budget outcomes can be achieved with the lower rates of personal income tax seen in the two tables.

Both tables highlight that the gains are much larger in the Combined Scenario than in the other two scenarios. Reform across the 10 policy areas provides bigger dividends than reforms in five areas alone.

Table A. Broad economic effects in 2030 (per cent deviations from baseline)

	Competition	Investing	Combined
total population	0.0%	1.8%	1.8%
university-educated population	0.0%	13.2%	13.2%
Employment	1.5%	8.4%	10.1%
Consumption	11.3%	12.1%	24.1%
GDP	8.6%	10.0%	19.3%
Consumption per capita (living standards)	11.3%	10.1%	22.0%
GDP per capita	8.6%	8.1%	17.2%
Personal income tax (% point difference)	-4.9%	-7.3%	-11.7%
Real after tax wage	9.1%	4.6%	13.1%

Source: Independent macro-econometric model

Table B. Broad economic effects in 2050 (per cent deviations from baseline)

	Competition	Investing	Combined
total population	0.0%	9.0%	9.0%
university-educated population	0.0%	33.8%	33.8%
Employment	1.1%	19.2%	20.5%
Consumption	11.1%	27.3%	40.0%
GDP	9.2%	24.8%	35.6%
Consumption per capita (living standards)	11.1%	16.9%	28.5%
GDP per capita	9.2%	14.5%	24.4%
Personal income tax (% point difference)	-4.2%	-13.7%	-17.2%
Real after tax wage	9.9%	12.8%	21.5%

Source: Independent macro-econometric model

Finally, it is important to consider the distributional effects of these economic reforms. These can be broadly assessed from a comparison of the impacts on the real after-tax wages received by low, mid and high skill employees.

The Advancing Competition Scenario reforms have broadly neutral distributional impacts. Table B shows a gain in the average real after-tax wage of 9.9 per cent by 2050. The percentage gains are similar for low, mid and high skill employees at 11.9, 9.8 and 9.5 per cent respectively.

The gains from the Investing in the Future Scenario reforms are slanted heavily in favour of low wage earners. Table B shows a gain in the average real after-tax wage of 12.8 per cent by 2050. The percentage gains are 26.5, 12.4 and 5.3 per cent for low, mid and high skill employees respectively. The migration and education reforms both increase the supply of high skilled workers relative to low skilled workers, leading to some narrowing of wage differentials.

1 Introduction

This report develops and presents alternative economic scenarios for Australia to demonstrate how our economic future depends on whether governments undertake major reform in ten key areas. It finds that without reform, living standards are only likely to rise modestly, taking real annual consumption per head from \$36,000 today to \$45,000 in 2030. However, with comprehensive reform, annual consumption per head is modelled to rise to \$55,000, implying a reform dividend to living standards of \$10,000 per head. By 2050 this reform dividend rises further, to over \$15,000 per head.

This work was commissioned by the Australian Council of Learned Academies (ACOLA) as part of its “Australia’s Comparative Advantage” (ACA) project. Studies conducted within the ACA project have identified the ten key areas for reform. This report aims to bring those studies together by quantifying the overall impact of governments undertaking successful reform across all ten areas.

The reforms are grouped together in two scenarios. The Advancing Competition Scenario focusses on policies to advance living standards by improving the way that economic resources are allocated. It includes the following five key areas of reform:

- taxation;
- competition policy;
- free trade agreements;
- federalism; and
- workplace relations.

The Investing in the Future Scenario focusses on policies to enhance growth in productive capacity. It includes the remaining five key areas of reform:

- infrastructure;
- labour force participation;
- innovation;
- migration; and
- education.

The two scenarios are then merged into the Combined Scenario, which therefore includes reform in all ten key areas. This report focusses on economic policies and outcomes that are within the control of Australian governments. Global warming, while important, depends on global government policies and is therefore outside of the scope of this report, which relies on modelling of the Australian economy.

A Baseline Scenario, without reform, serves as a point of reference. The differences in economic outcomes between the three policy reform scenarios and the baseline scenario show the economic impacts of the reforms.

The benefits of reforms in different areas develop at different speeds. To show all of benefits that eventually develop, each scenario extends all the way from 2015 to 2050. However, the benefits of some reforms develop relatively quickly. To show the more immediate benefits, there is a special focus on the gains that have developed by 2030.

The groundwork for the Advancing Competition Scenario reforms is being laid through policy development processes. There are White Paper processes in train for taxation and federalism. For

competition policy, the Harper Competition Policy Review has issued its final report. Free Trade Agreements (FTAs) have been concluded with some countries and are under negotiation with other countries. For workplace relations, the Productivity Commission is reviewing the Fair Work Act.

Preparations for the Investing in the Future Scenario reforms are less developed. The latest Intergenerational Report (2015 IGR) considers in general terms the influence of labour force participation and migration on the economy and the budget. The government has set infrastructure as a priority and the Productivity Commission (2014) has undertaken a public infrastructure inquiry. There is less evidence of a holistic approach to education and innovation.

Paradoxically, it may be easier to achieve reform if it is pursued across-the-board, covering most or all of the ten key areas, than if each area is considered separately. If one area of reform is considered in isolation, the benefits may appear modest, and the barriers daunting, given that for most reforms there are winners and losers. An across-the-board approach delivers much larger benefits. And there will be few losers; the winners and losers vary from one reform to the next, so losses made by some groups in some areas will usually be more than offset by gains that they make in other areas.

The four scenarios to 2050 have been developed using the Independent macro-econometric model. It is the latest in the series of “Murphy” models developed since 1988 and used for forecasting and policy analysis. All of the models in the series blend economic theory and real world data to make them suited to both policy analysis and forecasting. This latest model in the series draws on recent modelling at the European Commission to incorporate “semi-endogenous” growth. This makes it uniquely well-suited among Australian models to analyse the policies in the Investing in the Future Scenario.

The report is organised as follows.

- **Section 2** sets out the policies and related studies for Advancing Competition.
- **Section 3** covers the policies and related studies for Investing in Growth.
- **Section 4** provides an overview of the modelling approach used in this report.
- **Section 5** explains the four scenarios that are simulated.
- **Section 6** presents the economic impacts of the Advancing Competition Scenario.
- **Section 7** discusses the results from the Investing in the Future Scenario.
- **Section 8** covers the Combined Scenario.
- **Appendix A** provides a detailed explanation of the modelling.

While all care, skill and consideration has been used in the preparation of this report, the findings refer to the terms of reference of ACOLA and are designed to be used only for the specific purpose set out below. If you believe that your terms of reference are different from those set out below, or you wish to use this report or information contained within it for another purpose, please contact us.

The specific purpose of this report is to provide ACOLA with an analysis of the economic impacts of the Advancing Competition and the Investing in the Future Scenarios.

The findings in this report are subject to unavoidable statistical variation. While all care has been taken to ensure that the statistical variation is kept to a minimum, care should be taken whenever using this

information. This report only takes into account information available to Independent Economics up to the date of this report and so its findings may be affected by new information. The information in this report does not represent advice, whether express or inferred, as to the performance of any investment. Should you require clarification of any material, please contact us.

2 Policies for advancing competition

The Advancing Competition Scenario focusses on policies to advance living standards by improving the way that economic resources are allocated. It includes the following five key areas of reform:

- taxation;
- competition policy;
- free trade agreements;
- federalism; and
- workplace relations.

The proposed policy reforms in each area are now discussed, along with supporting studies.

2.1 Taxation

The shortcomings in Australia's tax system have been analysed in the Australia's Future Tax System Review (AFTSR, 2009), otherwise known as the "Henry Review", and the Australian Government (2015b) "Re:think" Tax Discussion Paper. Those reports were supported by economic modelling by (KPMG Econtech, 2010 and Cao et al., 2015). This Computable General Equilibrium (CGE) modelling quantifies the costs to consumers of the distortions to economic decision making resulting from major taxes.

Recently, Independent Economics have further developed its CGE model so that it provides the best available estimates of the economic costs of each tax. The distinguishing features of the Independent Extended CGE model that make it particularly suitable for analysing tax reforms are that:

- it has a high degree of industry detail with 288 industries compared to around 110 industries in other models;
- it has a high degree of tax detail, distinguish 24 different taxes and subsidies; and
- it captures more of the economic distortions generated by different taxes e.g. it incorporates a Capital Asset Pricing Model that captures the distortions to asset allocation from the uneven tax treatment of income from different assets.

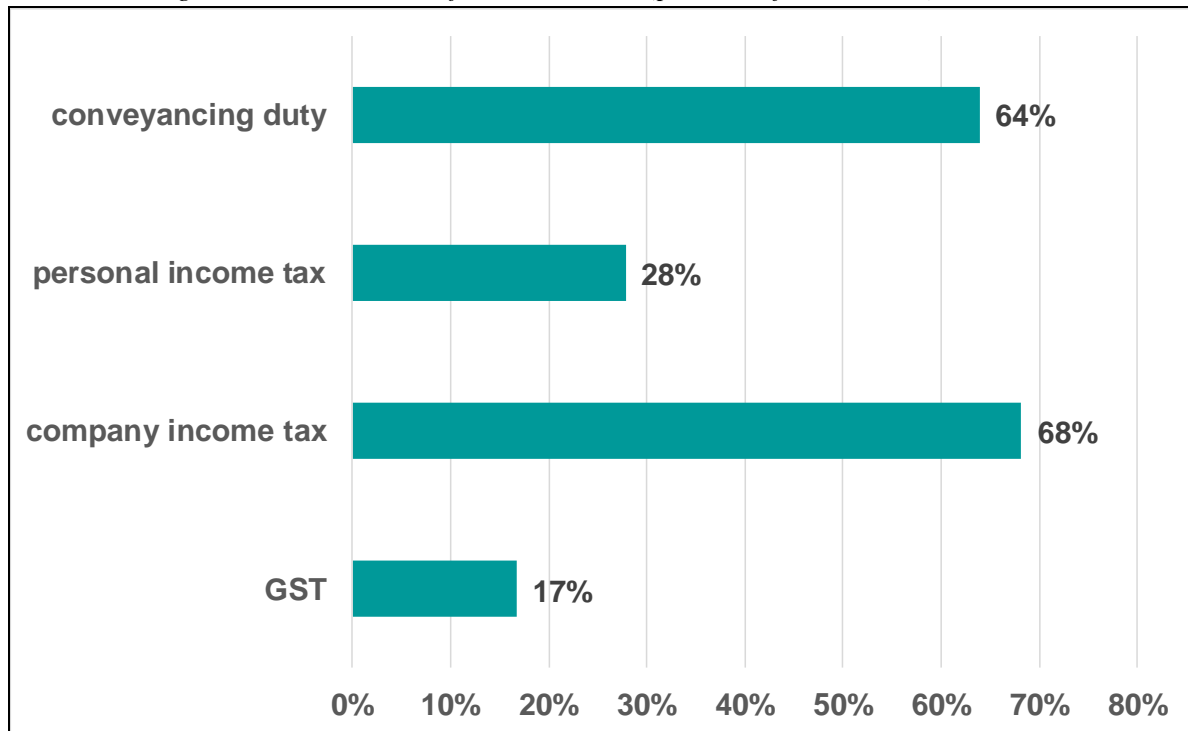
Most taxes have disincentive effects that distort decision making by businesses and/or households and hence have economic costs that ultimately reduce household living standards. A common way of summarising this cost is the *excess burden* of a tax. This refers to the loss in living standards as a result of the tax, over and above the revenue raised.

To allow comparisons between taxes, measures of the excess burden per dollar of revenue raised are used to rate the efficiency of each tax. The *marginal excess burden* (MEB) of taxes refers to the economic cost per dollar of additional revenue raised from a small increase in the tax rate. Here the MEB is estimated by modelling a 5 per cent increase in the rate of the tax, and assuming that governments spend the additional revenue on lump sum payments to households. This way, households are assumed to receive a full dollar of value from the additional government spending. The loss in living standards from the higher tax rate is compared to the net revenue raised, to estimate the economic cost per additional dollar of revenue.

The MEBs of four, major selected taxes are shown in Chart 2.1. The economic efficiency of the tax system can be increased by placing less reliance on taxes with relatively high MEBs and more reliance on taxes with relatively low MEBs. To the extent that a tax policy scenario involves a shift in this

direction from high burden to low burden taxes, it can be expected to increase consumer welfare. This increase comes about because the distortions to economic choices from the tax system have been reduced.

Chart 2.1 Marginal Excess Burdens of Selected Taxes (per cent of net revenue)



Source: Independent Extended CGE model simulations

Note: Excess burdens have been calculated by simulating a small tax increase of approximately 5 per cent.

In general, a tax will have a relatively low MEB if it is applied at a low rate to an immobile base. Such a tax is likely to have only a modest impact on economic choices. Conversely, a tax will have a relatively high MEB if it is applied at a high rate to a mobile base. It is likely to heavily distort economic choices relative to a situation in which the tax was not applied. These ideas can be applied in interpreting the various MEBs presented in Chart 2.1.

Two taxes in Chart 2.1 stand out as having high MEBs of between 60 and 70 cents in the dollar of revenue – company income tax and conveyancing duty. The reasons for the high MEBs for these two taxes are now discussed in turn.

Company Income Tax

Company income tax is a tax on the returns to capital. As a small, open economy, Australia faces a mobile world supply of capital funding. Company tax discourages foreign investment in Australia because it increases the hurdle pre-tax rate of return needed from an investment before it can deliver the post-tax return required on world capital markets. The capital stock, labour productivity and real wages, will all be lower as a result.

Company income tax is an inefficient tax because it applies a medium tax rate of 30 per cent to a highly mobile base. The mobility of the tax base from the sensitivity of foreign investment to company tax is exacerbated by so-called profit shifting. Foreign multi-national companies who invest in Australia may be able to reduce their liability for Australian company tax by shifting some of their Australian-sourced

profits to other jurisdictions that have lower rates of company tax. The efficiency of company tax as a method of raising revenue is further eroded by the Australian franking credits system, which provides tax credits for Australian company tax to Australian entities who receive franked dividends.

These factors more than outweigh two other features of the company tax system that tend to reduce its excess burden. First, the deductibility of interest on debt reduces the overall tax burden on capital. Second, while there is a high excess burden from taxing the normal return to capital that makes up the larger proportion of company profits, there is no excess burden from taxing the smaller portion of company profits that represents economic rents.

Given the highly inefficient nature of company tax, the Henry Tax Review recommended that its rate be cut from 30 per cent to a more internationally competitive rate of 25 per cent.

Conveyancing Duty

Conveyancing duty applies to transactions in both residential property and commercial property. For owner-occupiers of residential property, it applies when moving from one residence to another. Hence, for residential property conveyancing is modelled as a tax on investment in moving. It acts as a disincentive to moving, so the current stock of residential land and housing is used less efficiently. Because of residential conveyancing duty, families are less likely to move to a different house as their needs change in terms of housing attributes or location.

Conveyancing duty meets both of the conditions for an inefficient tax. The effective tax rate is very high because a large amount of conveyancing duty is collected from the relatively narrow base of moving costs. While the amount of residential conveyancing duty is calculated using the value of a residential land and structure, this is not the economic base for the tax because liability for conveyancing duty is only triggered by moving. So the economic base for the tax is moving costs. This is a mobile base because moving costs, and the associated liability for conveyancing duty, can be avoided by choosing not to move.

Given the highly inefficient nature of conveyancing duty, reflected in its high MEB, the Henry Review recommended that conveyancing duty be abolished.

GST

GST is one of a suite of taxes on labour. By raising consumer prices, it reduces the purchasing power of labour income. Payroll tax is likely to have a similar effect, as firms pass it on in higher prices. Personal income tax also taxes labour, but in the more direct way of reducing after-tax wages. In the long run, all three taxes have a similar effect of establishing a tax wedge between the real producer wage paid by firms and the real after-tax consumer wage received from employment.

When all of these taxes are taken into account, labour income is seen to be taxed at a medium-high rate. However, the labour income tax base is only moderately mobile¹. Consequently, GST has a relatively low MEB of 17 cents per dollar of revenue. This could be reduced further by broadening the GST tax base to include basic foods. This base broadening would reduce the extent to which the GST distorts

¹ For example, de Mooij and Devereux (2011) cite previous research in assuming that when the after-tax real wage is 1.0 per cent lower, with no compensation, labour supplied is reduced by only around 0.2 per cent. The Independent Extended CGE model uses this same uncompensated elasticity of 0.2. With full compensation, the elasticity rises to around 0.5, and it is this compensated elasticity that drives the excess burden of taxes on labour income.

consumer spending patterns in favour of goods and services that are currently GST free, and would be accompanied by measures to neutralise the potential impact on equity.

Personal Income Tax

As they are both taxes on labour, personal income tax and GST might be expected to have similar MEBs. However, there are some important differences. The most important of these for economic efficiency is that while GST is a proportional tax, the personal income tax system, and the related social security system, are progressive. The purpose of this is to promote equity by redistributing income.

The model allows for progressivity in the tax-transfer system in two ways. First, it assumes that cash benefits are not subject to personal income tax. While technically many cash benefits are regarded as taxable income, they are largely received by individuals on relatively low incomes with low effective tax rates. Second, the model takes into account the tax-free threshold for personal income tax. These two features elevate the marginal rate of personal income tax in the model above its average rate, increasing the disincentive effects relative to the revenue that is raised.

The overall outcome is that personal income tax is estimated to have a medium MEB of 28 cents per additional dollar of revenue, compared to 17 cents for GST. However, the higher MEB for personal income largely reflects its greater progressivity, which is designed to promote equity.

General Observations

If the aim is to maintain the current progressivity of the tax-transfer system, there may be little efficiency benefit from attempting to use an increase in the rate of GST to fund a cut in personal income tax. To maintain overall progressivity, the cut in personal income tax would need to be accompanied by an increase in the progressivity of the personal income tax scale, and this would be likely to largely nullify any potential efficiency gain.

Efficiency gains are more likely to be achieved by reforming both personal income tax and GST to make them more efficient. Personal income tax, together with superannuation tax, distort asset allocations through large tax concessions for income from particular assets. For example, franking credits greatly reduce taxation of dividend income sourced in Australia while doing little to encourage business investment.

Bracket creep has become the major method of attempting to bring the Government budget back to surplus. However, it is causing major changes in the impacts of personal income tax: average rates of tax are rising and progressivity is falling. These major changes to the structure of taxation are being brought about by accident rather than design and, left unchecked, will continue to develop.

Directions for Reform

Based on the Henry Review, Re:think and modelling of the economic costs of different taxes, five top priorities for tax reform can be nominated:

- reduce the company income tax rate from 30 per cent to an international competitive 25 per cent;
- abolish stamp duty on conveyances;

- make more uniform the taxation of income from different assets, with a particular focus on overhauling the franking credits system;
- broaden the base of the GST to include basic foods; and
- eliminate bracket creep by automatically indexing the personal income tax brackets to wages, while maintaining discretion in adjusting the rates of tax that apply to the brackets.

A Budget-neutral package could be devised in which the Budget costs of the first and second reforms were funded by the third and fourth reforms.

In modelling the Advancing Competition Scenario, the first reform of cutting the company tax rate to 25 per cent, is the most important and has the widest acceptance, and so has been modelled. Because the other reforms have not been included, the estimates of the gains from tax reform are conservative.

2.2 Competition Policy

The Final Report of the Harper Competition Policy Review (2015) made many recommendations for improving competition. Some of the more important recommendations were as follows:

- greater competition in the provision of human services, including health, education, aged care and job services;
- cost-reflective, direct pricing of road use;
- removal of barriers to entry to pharmacy from location and ownership rules;
- deregulation of retail shopping hours;
- opening of coastal shipping to competition;
- lifting restrictions on the number of taxi licences and opening the industry to competition;
- removal of restrictions on parallel imports; and
- less prescriptive and more responsive land zoning.

The Review did not undertake any modelling of the economic impacts of these recommendations. However, it cites previous modelling of competition policy reform as giving some indication of the potential benefits. These include an estimate in 1995 that the Hilmer competition policy reforms could provide a gain in GDP of 5.5 per cent and a 2005 estimate that implementation of Hilmer to date had added 2.5 per cent to GDP. For the purposes of this report, the conservative assumption is made that the Harper Competition Policy Review recommendations, if implemented in full, would add 2.5 per cent to productivity.

2.3 Free Trade Agreements

With virtually no progress for many years in liberalism of international trade at the global level through the World Trade Organisation (WTO), Australia has been pursuing Free Trade Agreements (FTAs). FTAs aim to boost two-way trade and investment flows. The pace of FTAs has stepped up since 2013, and the current situation is as follows.

Australia has FTAs in force with:

- New Zealand;
- Chile;
- USA;
- South Korea;
- Malaysia;

- Singapore and Thailand.

Australia has concluded FTAs with:

- China and;
- Japan.

FTAs are under negotiation with:

- the GCC countries;
- India; and
- Indonesia.

The potential economic impacts on Australia from FTAs have been modelled by Tulloh, Jiang and Pearce (2014) of the Centre for International Economics (CIE). In the widest scenario, the estimated gain in exports is 2.0 per cent. This included gains of 26 per cent for agriculture and 2 per cent for manufacturing. It also included declines of 2 per cent for mining and 3 per cent for services. The gains in agriculture and manufacturing from improved access to export markets would strengthen the Australian dollar, which would account for the losses in mining and services exports. The simulated gain to GDP was 0.15 per cent. These results suggest that FTAs are a relatively small reform for the economy as a whole, but are important for agriculture.

The potential FTAs that were included in this CIE modelling are an FTA between Australia, China, Japan and South Korea and a further FTA between Australia and the EU. Since the time of the CIE study, Australia has concluded FTAs with South Korea, Japan and China, but not with the EU.

In developing the Advancing Competition Scenario, the modelling of FTAs is informed by the CIE study. Export demand curves are shifted to the right by 24 per cent for agriculture and 4 per cent for manufacturing. Taking into account that in the model the export price elasticity of demand is -4 in both cases, this is equivalent to upward shifts of 6 and 1 per cent respectively.

2.4 Federalism

The Australian Government has committed to producing a White Paper on Reform of the Federation. In the lead up to the White Paper, it has released a series of five issues papers.

The major issues for any Federation are the assignment of responsibilities in providing government services between the central government and state governments, and funding arrangements. The funding arrangements include the choice and assignment of taxing instruments, the resolution of vertical fiscal imbalances between the central and state governments, and addressing differences in the fiscal capacities of different state governments through horizontal fiscal equalisation.

Twomey and Withers (2007) find that federations, compared to unitary governments, allow services to be better tailored to the needs of different communities, and have more efficient government as a result of competitive pressures between different states. For OECD countries, over the last fifty years federations have achieved a 15 per cent gain in GDP relative to unitary states, after controlling for other factors.

Twomey and Withers (2007) show that, compared to other OECD federations, our central government receives a relatively high share of national tax revenue. This is associated with below best practice performance of our federation through:

- duplication by the Commonwealth of state government services in areas such as education and health; and
- over-prescription of state government services by the Commonwealth through Special Purpose Payments (SPPs) and National Partnership Payments (NPPs).

Twomey and Withers (2007) use cross-country regression analysis to estimate the likely GDP gain for Australia from reform based on a shifting of some revenue raising from the Commonwealth to the states. They estimate a GDP gain of 7 per cent from a shift to the OECD average for federations and a gain of 10 per cent for a larger shift to the average level of the three OECD best-practice federations of Canada, Germany and Switzerland. Given the size of the standard errors of the regression coefficients, this study adopts the more conservative assumption of a potential GDP gain of 5 per cent.

Another issue for the Australian federation is state government reliance on taxes that are mostly relatively inefficient. In this study, that issue is considered under the heading of tax reform.

The final major federation issue is horizontal fiscal equalisation (HFE). Australia operates a relatively comprehensive system of HFE. It promotes the efficient allocation of resources between states by making interstate transfer payments to offset various fixed fiscal costs and benefits, such as Western Australia's high endowment of minerals and the Northern Territory's high indigenous population. However, a relatively small component of HFE transfers equalise for differences in fiscal costs and benefits that operate at the margin, such as differences in wage levels; this reduces efficiency. However, the changes to HFE from removing that component, and the associated gain in national income, are both small. HFE is modelled in detail in *Independent Economics* (2012, 2015).

2.5 Workplace Relations

For workplace relations, the Productivity Commission is reviewing the Fair Work Act, although its recent analysis of workplace relations in the construction industry understated the economic significance of the issues.

Econtech (2007) traces the moves to progressively deregulate workplace relations through legislative change in 1993, 1996 and 2005. This 3-phase process was then partially reversed through the Fair Work Act 2009.

This pattern of change in Australian labour market regulation is reflected in movements in Canada's Fraser Institute's index of labour market regulations. The index has a possible range of values from 0 to 10, with 10 for the lowest level of regulation. The Australian index increased from 5.43 in 1995 to 8.36 in 2005, before declining to 7.27 in 2011 following the implementation of the Fair Work Act.

This value of 7.27 leaves Australia with a less regulated labour market than either France (5.89) or Greece (4.29). However, it leaves us with a more regulated labour market than Japan (8.33), the UK (8.27) and the USA (9.01).

In an IMF Working Paper, Bernal-Verdugo, Furceri and Guillaume (2012) analyse the impact of labour market flexibility on unemployment. After controlling for other factors, they estimate that, in the medium term, each one point increase in a country's rating on the Fraser's Institute's index reduces its unemployment rate by 0.835 percentage points.

On that basis, Australia could reduce its normal unemployment rate by around 0.8 percentage points by deregulating to match Japan and the UK or by 1.5 percentage points by deregulating to match the USA. While it seems unlikely that Australia would decide to adopt US-style labour market regulation, it does

suggest an indicative estimate of the potential gain from achievable workplace reform is of the order of a 1 percentage point reduction in the unemployment rate.

The six components of the Fraser Institute index provide a guide to the direction for reform. Australia has relatively low ratings for hiring and firing regulations (3.72) and centralized collective bargaining (5.09). This is consistent with the view that there is a job-creating case for easing (but not abolishing) unfair dismissal laws and making the role of the Fair Work Commission less prescriptive.

The literature on workplace relations and labour productivity is reviewed in Econtech (2007). Based on that literature, it estimates that the 3-phase process of deregulation since 1993 increased labour productivity by 1.4 per cent. While that deregulation has been partially reversed, the labour market is still less regulated than it was in 1993, so the potential gains from deregulation are also less. An indicative estimate of the potential productivity gain would be of the order of 1 per cent.

3 Policies for investing in the future

The Investing in the Future Scenario focusses on policies to enhance growth in productive capacity. It includes the remaining five key areas of reform:

- infrastructure;
- labour force participation;
- innovation;
- migration; and
- education.

The proposed policy reforms in each area are now discussed, along with supporting studies.

3.1 Infrastructure

The general government sector, including Commonwealth, state and local governments, has the primary responsibility in Australia for providing infrastructure for land transport. The major expenditure is on roads followed by rail. The Federal Government's infrastructure policy agenda has two main elements.

The first element is a significant increase in Commonwealth funding of roads, as set out in the "Building Australia's Infrastructure" document released as part of the 2014/15 Federal Budget. This includes \$11.6 billion in additional Commonwealth infrastructure spending over seven years.

The second element is a review of infrastructure policy. The Productivity Commission was tasked with undertaking an inquiry into "public infrastructure" and released its final report in 2014 (Productivity Commission, 2014). Included in the recommendations were that:

- there should be properly-conducted cost-benefit studies of large projects;
- well-designed user charges for infrastructure should be used to the extent that they are economically justified; and
- government should drive reform of the poor industrial relations environment in the construction industry to ensure that infrastructure construction is cost-effective.

The government observed that the final report contained few surprises and generally accepted the recommendations.

In modelling infrastructure policy for this report, it is noteworthy that our macro-econometric model is the only Australian macro-econometric models that separately identifies general government infrastructure spending. Further, it takes into account the contribution that the associated infrastructure stock makes to productivity in the business sector. The government's increased funding of infrastructure investment is modelled as a permanent increase of 10 per cent in general government investment in infrastructure. This increase is equivalent to around \$1 billion annually, in today's terms.

The Productivity Commission's recommendations are directed at ensuring that infrastructure spending achieves a satisfactory rate of return for the community. This is already factored into the modelling, because the model is calibrated on the assumption that the infrastructure capital stock achieves a hurdle rate of return comparable to business investment.

3.2 Labour Force Participation

The 2015 Intergenerational Report of the Australian Government (2015a) suggests that “policy settings that seek to remove barriers to participation of females and older age groups in Australia and encourage them to work, if they wish to do so, can drive gains in GDP and income growth”. This echoes a more detailed analysis by Daley, McGannon and Ginnivan (2012) of the scope for policy reforms aimed at lifting participation rates for females and mature age workers. This Grattan Institute study suggests several policy reforms.

For older workers, under existing legislation, the eligibility age for the age pension will rise from 65 to 67 by 2023, while the preservation age for superannuation benefits will rise from 55 to 60 by 2024. The Grattan Institute proposes that, in view of longer life expectancies, both of these ages be raised further to 70. That is, it proposes:

- raising the eligibility age for the age pension from 67 to 70, which is a government proposal not so far supported by the Senate; and
- raising the preservation age for superannuation from 60 to 70.

It estimates that these measures would contribute 1.4 percentage points to the aggregate labour force participation rate.

This estimate may be a little optimistic. Australia’s participation rate for older workers has risen considerably over the last 35 years and is already above the OECD average. The Grattan Institute refers to other countries, including New Zealand, which have higher participation rates than Australia for older workers. However, other factors may contribute to these differences between countries besides the proposed policy changes.

The 2015 IGR estimates that an increase in the age pension eligibility age from 65 to 70 would add 0.8 percentage points to the aggregate labour force participation rate. This estimate is not directly comparable with the Grattan Institute estimate because it refers to a larger increase in the age pension eligibility age (by five years rather than three years) but it does not include the effects of a change in the preservation age.

Taking all of the above into account, this study adopts the conservative, indicative assumption that the reforms proposed by the Grattan Institute for older workers would add 1 percentage point to the aggregate labour force participation rate.

For female workers, like mature age workers, Australia has a labour force participation rate that is above the OECD average but below that of certain OECD countries. The Grattan Institute estimates that if Australia’s female participation rate increased to match that of Canada, GDP would be around 1.5 per cent higher. However, part of this gap in females labour force participation rates is likely to be explained by Australia’s higher total fertility rate of 1.9 compared to 1.6 in Canada. A slightly more conservative estimate is that reforms in this area might add a further 1 percentage point to the aggregate labour force participation rate.

The Grattan Institute idea for achieving this outcome is reforms to reduce high effective marginal tax rates and the net cost of childcare. The actual impacts on labour force participation, as well as the budget cost, would depend on more specific details.

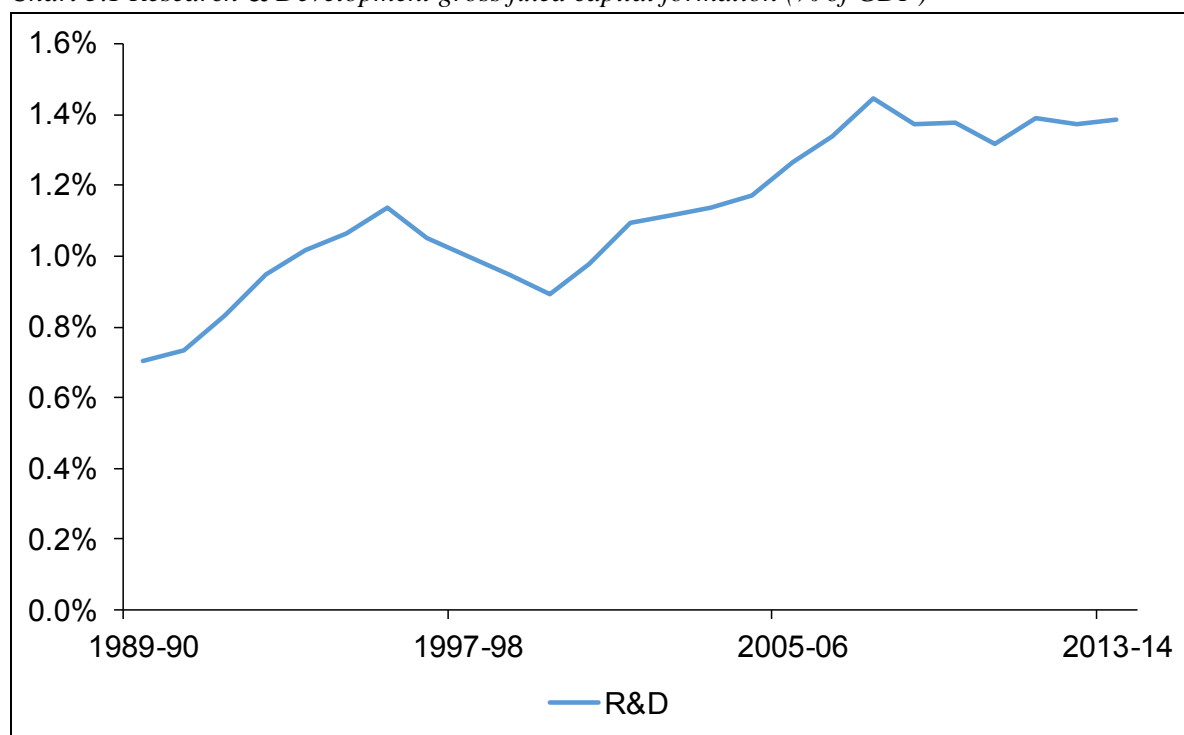
Thus, it is estimated that the policy reforms targeting higher labour force participation by older workers and women would each add one percentage point to the aggregate labour force participation rate, giving

a total gain of two percentage points. The proposals for older workers would benefit the budget while the less well-defined proposal for female workers would involve a budget cost.

3.3 Innovation

Innovation is recognised as a key driver of productivity growth. However, Australian investment in research and development as a share of GDP is well below the OECD average (OECD, 2007). Major OECD countries with relatively high levels of research and development include Sweden, Japan, Switzerland, the USA, Germany and Singapore. In those countries R&D investment ranges between 2 and 4 per cent of GDP. In Australia, R&D investment is consistently under 1.5 per cent of GDP, as seen in Chart 3.1.

Chart 3.1 Research & Development gross fixed capital formation (% of GDP)



Source: ABS Cat No. 5204.0

Tunny (2006), writing in the Australian Treasury Economic Roundup, argues this low rating for R&D investment is not due to inappropriate R&D policy. Rather, he suggests that it reflects our situation as a remote country with abundant natural resources. This leads to an industrial structure that does not include large pharmaceutical or electronics industries; industries that are associated with high R&D activity.

On the other hand, the Department of Industry (2014) sees both strengths and weakness in Australia's R&D effort. It finds the following in its 2014 Australian Innovation Systems Report.

- Australia's small and medium sized businesses appear innovative by OECD standards.
- Australia's large businesses, which do almost all our exporting, are not innovation leaders by international standards.
- Australian businesses of all sizes perform poorly on new to market innovation compared to other countries and this situation is getting worse not better.

- Australia has several, mostly resource, industries that are internationally competitive, and high innovation capability, including high R&D intensity, is found in these sectors.
- The scale and impact of innovation appears to be hampered by a poor management culture of innovation and collaboration, and shortages in a range of skills.

So while the factors that Tunny (2006) highlights offer some explanation for Australia's low R&D effort, it appears that our R&D performance is lacking. This is of concern as R&D is a key driver of economic growth.

In a more recent study, the OECD (2010) has identified key elements of an innovation strategy, which include the following:

- excellence in higher education;
- strong links between universities and industry;
- international mobility and co-operation for researchers;
- excellence in public research;
- ease of market entry and exit for small firms;
- SME access to finance;
- well-functioning venture capital markets – but venture capital investment in Australia is low (OECD, 2007);
- more symmetric tax treatment of profits and losses – but Australia recently withdrew a proposal to allow carry back of losses;
- R&D tax credits – Australia does provide a R&D tax offset of 40% for larger businesses and 45% for smaller business, both rates being above the company tax rate of 30%;
- the availability of high-speed broadband internet; and
- patent regimes that strike an appropriate balance between providing incentive and rewards to innovators and providing access to new knowledge for users.

A thorough, independent review of Australia's policies towards innovation against this best-practice strategy is needed. The aim would be to develop a specific agenda for policy reform in this area.

Given the central role of innovation in productivity growth, and that Australia's R&D effort is low, the potential for lifting economic growth through a stronger R&D performance is high. The modelling assumes that comprehensive innovation policy reform could add 0.25 percentage points to annual economic growth.

3.4 Migration

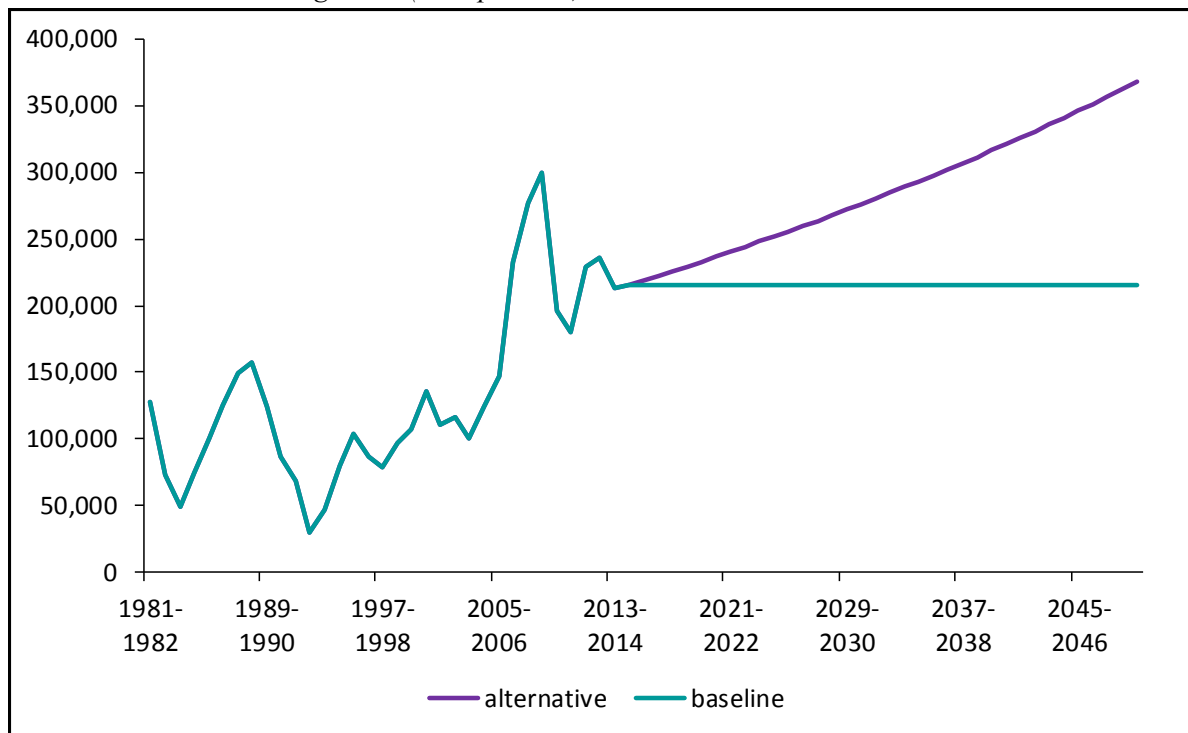
Overseas migration makes an important contribution to Australia's population and economic growth. In 2013-14 net overseas migration (NOM) was 213,000 persons. This translates to a 0.9 percentage point contribution to annual population growth of 1.6 per cent.

The 2015 IGR (Australian Government, 2015a) assumes a constant level of NOM of 215,000 persons from 2014-15 to 2054-55. This is reflected in the Baseline Scenario assumption for NOM shown in Chart 3.2. With a rising population, this implies that the contribution of NOM to population growth declines steadily from 0.9 percentage points to 0.5 percentage points. This is a consequence of the arbitrary assumption that the level of NOM remains constant, despite the rising population.

This study proposes the alternative assumption that the contribution of NOM to population growth is maintained at 0.9 percentage points. In line with growth in the population, this implies that the level of

NOM increases steadily from 215,000 persons in 2014-15 to around 368,000 persons in 2049-50. This is reflected in the Investing in the Future Scenario for NOM, also shown in Chart 3.2.

Chart 3.2 Net overseas migration ('000 persons)



This alternative assumption is more in line with historical experience. From 1999-2000 to 2013-14 NOM contributed an average of 0.85 percentage points to annual population growth, similar to the contribution of 0.9 percentage points that is proposed here.

The economic contribution of the migration program has recently been modelled in detail by Independent Economics for a study published by the Migration Council Australia (2015). This study updates and advances on earlier Productivity Commission (2006) work as follows:

- it takes into account that the migration program has become larger;
- it takes into account that temporary visas have become a more important pathway to permanent migration; and
- it factors in important advances in best-practice modelling of the economic impacts of migration.

Australia's migration policy consists of the Migration Programme, Temporary Entry visas and the Humanitarian Programme. Table 3.1 summarises the key types of visa (streams) that are included under each programme.

The composition of NOM by visa stream has been changing, with temporary visas growing in importance. The Department of Immigration and Border Protection (2014) has recently projected NOM by visa stream to 2017-18. It projects that student visas will become the single largest source of migrants. This development is supported by the introduction of a temporary graduate visa that allows recent graduates to live and work in Australia for 18 months or four years. By 2020-21, migrants who initially enter Australia on a student visa were expected by DIBP to account for about 122,000 migrants out of total NOM of around 250,000 migrants.

Table 3.1. Migration streams

Migration Programme	
Skilled	Grants permanent residency to those individuals with skills that are in demand in Australia.
Family	Grants permanent residency to relatives of an Australian citizen, permanent resident or eligible New Zealand citizen.
Temporary Entry	
Student	For individuals completing a university qualification, vocational education and training qualification or other qualification at an Australian education institution.
Temporary work (sub-class 457)	Allows businesses, who cannot find an Australian citizen to complete the skilled work, to sponsor a migrant worker. The worker is able to stay in Australia for up to four years.
Visitor	Allows individuals to travel to Australia for business or holiday purposes for up to a year.
Working Holiday & other temporary	The working holiday visa is designed for young people from certain eligible countries to holiday and work in Australia for up to one year.
Humanitarian	
Humanitarian	Grants permanent residency to individuals who are subject to persecution or discrimination in their home country.

This DIBP projection for total NOM of 250,000 is significantly above the more recent 2015 IGR assumption of NOM of 215,000. To achieve consistency, the Baseline Scenario uses the 2015 IGR assumption for the level of NOM, but applies the DIBP projection for its percentage composition by visa stream. The Investing in the Future Scenario also uses the DIBP projection for the visa composition of NOM.

The macro-econometric model is well suited for analysing the economic effects of migration. It captures the standard linkages between migration and the economy, such as the boost to the labour force and its productivity from skilled migration. In addition, it goes beyond previous Australian studies to allow for other factors.

It takes into account that a higher population from migration can provide an economic advantage through economies of scale in providing infrastructure, as well as an economic disadvantage from spreading the benefits of fixed natural resources, including land and mineral resources, over a larger population. Skilled migrants can also contribute to research and development, boosting economic growth with spill over benefits for existing residents. This is taken into account by including semi-endogenous growth theory into a large scale model of the Australian economy for the first time. This follows similar recent work at the European Commission (Varga and Veld, 2011).

The modelling has also been developed to better represent the effects of the migration program on the Government's budget, including on both spending and taxation revenue. Any net fiscal benefit from migration can be used to keep tax rates lower than otherwise. This net fiscal benefit provides an important channel through which the economic benefits that migrants obtain from their migration to Australia can be shared with existing residents.

3.5 Education

Investment in human capital through education is an important contributor to economic growth. In a study for Universities Australia, KPMG Econtech (2010) modelled the effects of improvement funding and reform arrangements for universities and Technical and Further Education (TAFE). It found a high internal rate of return of around 15 per cent from additional funding.

This high rate of return was driven primarily by gains in labour productivity and labour force participation rates. The gains in labour productivity are consistent with the high wage premiums enjoyed by university-educated employees and, to a lesser extent, TAFE-educated employees, relative to school-educated employees. The gains in labour force participation rates are considered with the finding that tertiary-educated employees have considerably high labour force participation rates than school-educated employees. These gains in wages and participation are measured after controlling for other factors.

This study's Investing in the Future Scenario includes modelling of a similar increase in tertiary education funding to that analysed in the KPMG Econtech study.

The KPMG Econtech study identified 2.0 per cent of GDP as a target for funding of universities that was broadly consistent with the funding recommendations of the Bradley Review. According to the latest ABS (2014) data, university funding reached 1.7 per cent of GDP in 2012-13. Hence this study models an increase in total university funding from 1.7 to 2.0 per cent of GDP.

The KPMG Econtech study also included an increase in funding for TAFE of 0.1 per cent of GDP. According to the latest ABS (2014) data, TAFE funding was steady at 0.5 per cent of GDP in 2012-13. Thus, this study models an increase in total TAFE funding from 0.5 to 0.6 per cent of GDP.

Universities and TAFE are financed by a mix of government and private funding. For universities the government share is around one-half while for TAFE it is about four-fifths. The modelling assumes that the government and private sectors contribute equi-proportionately to the modelled increase in funding.

While increases in tertiary education spending lead to an immediate budget cost, the benefits build gradually. This occurs as each new, more-educated cohort passes through the education system into the labour force, replacing the cohort moving into retirement. The average level of educational attainment in the workforce gradually increases, leading to cumulating gains in productivity. This in turn leads to higher tax revenues, partly offsetting the cost to the budget of higher education spending. These mechanisms are all factored into the Independent macro-econometric model.

4 Economic modelling approach

This section provides an overview of the modelling approach. This overview begins with the general features of the model. It then turns to the “semi-endogenous” growth features of the model that are important in modelling the “Investing in the Future” scenario.

4.1 The Independent Macro Model

The scenarios are simulated using the Independent Macro-econometric model. It is the latest in a series of models developed since 1988 and used for policy analysis and forecasting.

The Independent Macro-econometric model (“the macro model”) shares common design features with the earlier models in this series as follows:

- it uses quarterly data, and the parameters are estimated econometrically;
- stickiness in wages and prices means it is demand-driven or Keynesian over short time horizons;
- market clearing means it is supply-driven or neoclassical over long time horizons;
- a representative business in each industry maximises profits in the long run;
- financial markets are forward-looking, with model-consistent expectations, while other markets are generally backward looking.

The original model was based on one industry (Murphy, 1988) but this was extended to 12 and then 18 industries in Murphy Model 2 (Powell and Murphy, 1997). The current macro model has six industries: Agriculture, Mining, Manufacturing, Government Services, Other Services and Housing Services. This broad industry detail is designed to provide a stronger base for macro policy analysis and forecasting.

The current model was constructed as a complete re-build to factor in developments in macro modelling and the Australian economy. This is reflected in the following new design features.

- a short-term interest rate rule in which the Reserve Bank pursues its inflation target in setting monetary policy, taking into account developments in inflation, unemployment and the bond market;
- the inclusion of fixed factors such as land and natural resources in industries such as Agriculture, Mining and housing services, so that these industries respond more realistically to macroeconomic shocks;
- modelling of consumer and investment behaviour that allows for the GFC;
- a new approach to modelling household consumption that uses a target for asset holdings based on labour income;
- a detailed representation of the interactions between building and construction activity in each industry and the broader economy; and
- an allowance for structural change in the labour market.

Recent uses of the macro model include scenario analysis for the Parliamentary Budget Office (Independent Economics, 2014) and the Migration Council Australia (MCA, 2015).

4.2 Modelling “Investing in Growth”

The “Investing in Growth” Scenario involves policies designed to lift economic growth. The drivers of growth considered are: infrastructure; labour force participation; innovation; migration; and education.

While traditional macro-econometric models are more concerned with cyclical fluctuations in economic activity, semi-endogenous growth models provide an avenue for incorporating growth drivers. Hence, in 2014 the Independent macro-econometric model was further developed to incorporate semi-endogenous growth. This follows similar work with the Quest III model at the European Commission (Varga and Veld, 2011). The main elements of this new part of the model structure are as follows.

Demographic model

Based on assumptions for fertility, mortality and migration, this uses the cohort-component method to project the Australian population cross-classified by single year of age, gender and state. It is able to closely replicate demographic projections such as those published by the ABS and in the 2015 IGR. Underlying labour force participation rates are projected by gender-age group and aggregated for use in modelling labour force participation in the macro model.

Education attainment model

This captures the link over time from government education funding to the education attainment of the population. The three attainment categories used are school, VET and university.

Occupation detail

Three broad occupations are distinguished in the model: high-skilled; mid-skilled; and low-skilled. A matrix is used to convert the labour supply by education attainment to the labour supply by occupation. Each industry demands the three skill categories as substitutable inputs in production. High-skilled labour has higher participation rates, a lower sustainable rate of unemployment and is more productive than its lower-skilled counterparts.

Migration model

This model captures the different contributions to the labour supply according to labour force status and occupation of each migration streams. The streams consist of five permanent visa categories (family, skilled independent, other points tested, other skilled visa, humanitarian) and four temporary categories (student, 457 (working), working holiday and visitor).

Government infrastructure investment

General government infrastructure investment is distinguished as a separate category of investment. The associated stock of government infrastructure capital is included as a productive input for the business sector with economies of scale in its provision.

R&D investment

R&D investment is undertaken using high-skill labour. Patents are produced that raise productivity.

4.3 Specifying the Scenarios

For each of the ten policy reforms introduced in the model, section 3 described the nature and magnitude of each change. The following two tables show how these changes are expressed in the inputs fed into the model. In the tables, an “s” superscript refers to a shock value of a variable while a “b” superscript refers to a baseline value.

Table 4.1. Model Inputs for the “Advancing Competition Scenario”

Policy reform area	Change	Model Inputs
Taxation	company tax rate cut from 30% to 25%	$POLCORP^s = (25/30) * POLCORP^b$
competition policy	Productivity lift of 2.5%	$\Delta[AN_{ij}/AN_{ij}(-1)]^s = \Delta[AN_{ij}/AN_{ij}(-1)]^b + (2.5\%/40)$ for all i, j , $t=1 \dots 40$
FTAs	Upward shifts of 6% and 1% in export demand curves for agriculture and manufacturing	$PEXA_A^s = PEXA_A^b + 0.06$ $PEXC_A^s = PEXC_A^b + 0.01$
federalism	Productivity lift of 5%	$\Delta[AN_{ij}/AN_{ij}(-1)]^s = \Delta[AN_{ij}/AN_{ij}(-1)]^b + (5\%/40)$ for all i, j , $t=1 \dots 40$
workplace relations	Productivity lift of 1% NAIRU reduction of 1% point	$\Delta[AN_{ij}/AN_{ij}(-1)]^s = \Delta[AN_{ij}/AN_{ij}(-1)]^b + (1\%/40)$ for $t=1 \dots 40$ $TTj_A^s = TTj_A^b - 1.0$ for all j

Definitions:

AN_{ij} refers to labour productivity

TTj_A is a shift factor for the NAIRU

$PEXi_A$ is a shift factor for export demand

i is the industry subscript and j is the labour skill category subscript

Table 4.2. Model Inputs for the “Investing in the Future Scenario”

Policy reform area	Change	Model Inputs
Infrastructure	Permanent 10% lift to general government infrastructure investment	$CFGGR^s = 1.1 * CFGGR^b$
Labour force participation	Participation rate lift of 2 percentage points	$\Delta UPRT^s = \Delta UPRT^b + 0.1$ for $t=1 \dots 20$
innovation	Gain of 0.25% in annual growth in labour productivity	$\Delta[AN_{ij}/AN_{ij}(-1)]^s = \Delta[AN_{ij}/AN_{ij}(-1)]^b + (0.25\%/4)$ for all i, j
migration	Hold constant as a contribution to population growth (0.9% p.a.) rather than as a level (215k p.a.)	see Chart 3.2
education	Lift funding as a share of GDP for VET (0.5% to 0.6%) and Universities (1.7% to 2.0%)	$GCONVET^s = GCONVET^b * (0.6/0.5)$ $GCONHED^s = GCONHED^b * (2.0/1.7)$

Definitions:

$CFGGR$ refers to real general government infrastructure investment

$GCONVET$ refers to real general government expenditure on VET

$GCONHED$ refers to real general government expenditure on universities

$UPRT$ refers to the underlying labour force participation rate generated by the demographic model

AN_{ij} refers to labour productivity

i is the industry subscript and j is the labour skill category subscript

5 Advancing competition scenario

This section reports the economic impacts of the Advancing Competition Scenario. This scenario is based on policies to advance living standards by improving the way that economic resources are allocated. It includes these five key areas of reform:

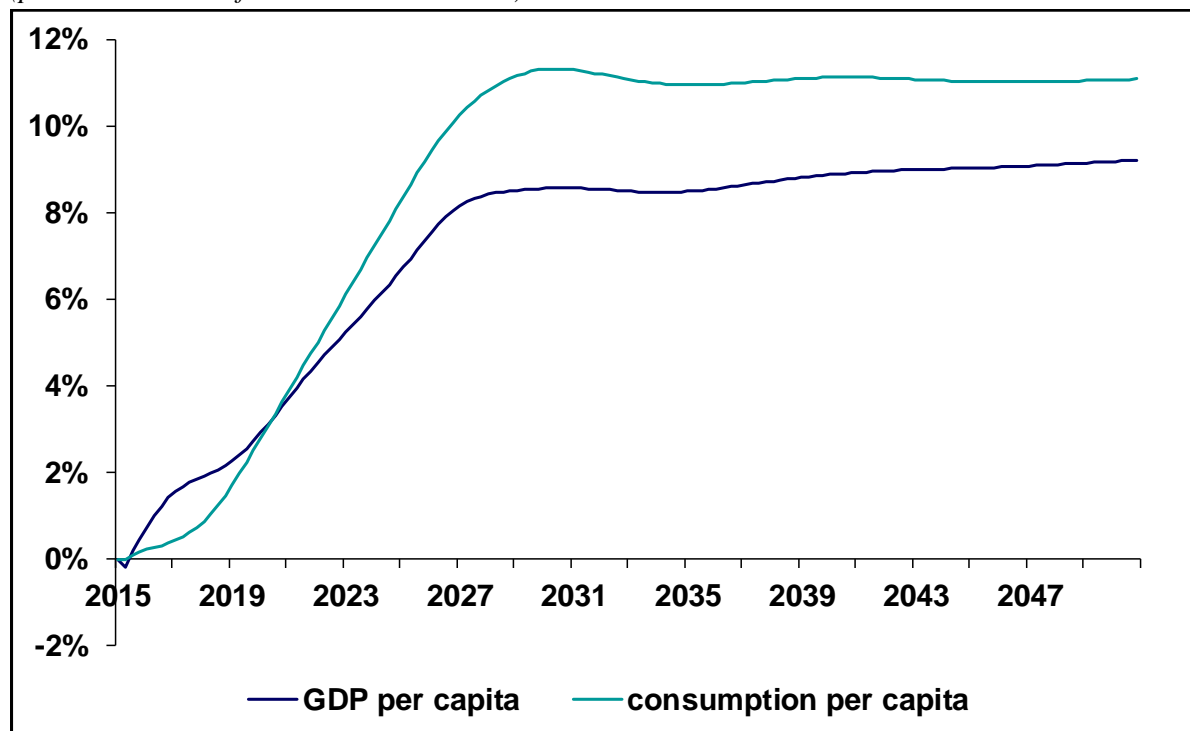
- taxation;
- competition policy;
- free trade agreements;
- federalism; and
- workplace relations.

These policies were set out in section 2, while section 4 explained how they are modelled.

Chart 5.1 provides an overview of the impact of this scenario on real GDP and household consumption. Both measures are expressed on a per capita basis, but as this scenario does not involve any change in population, the results are the same with or without this per capita adjustment. Consumption per capita is a more appropriate measure of living standards.

For each year, the chart shows the percentage deviation between the outcome in the Advancing Competition Scenario and the outcome in the same year for the Baseline Scenario. Because the inputs to the two scenarios only differ in the assumptions made in the five Advancing Competition policy areas, the results in the chart show the economic impacts of these policy differences. Further such economic impacts are shown in subsequent charts and tables.

Chart 5.1. Advancing Competition Scenario: GDP per capita and Consumption per capita (per cent deviation from Baseline Scenario)



Source: Independent Extended CGE model

The gain in GDP rises steadily before reaching a plateau at around 8.5 per cent from 2028 onwards. This gain in GDP mainly reflects higher labour productivity, although higher employment also makes a contribution. Higher employment occurs as the workplace relations reforms reduce unemployment.

Four different policies contribute to higher productivity. First, the cut in the company tax rate from 30 to 25 per cent encourages investment. This raises the capital intensity of the economy, making labour more productive. Second, the competition policy reforms, the federalism reforms and the workplace relations reforms all mean that labour is used more efficiently.

While this gain in GDP is substantial, the improvement in living standards is better measured by the gain in household consumption. The gain in household consumption reaches a plateau at the same time as GDP, in 2028, but at a higher level of around 11 per cent. This represents a very substantial boost in living standards, which is only possible from pursuing reform across five different policy areas.

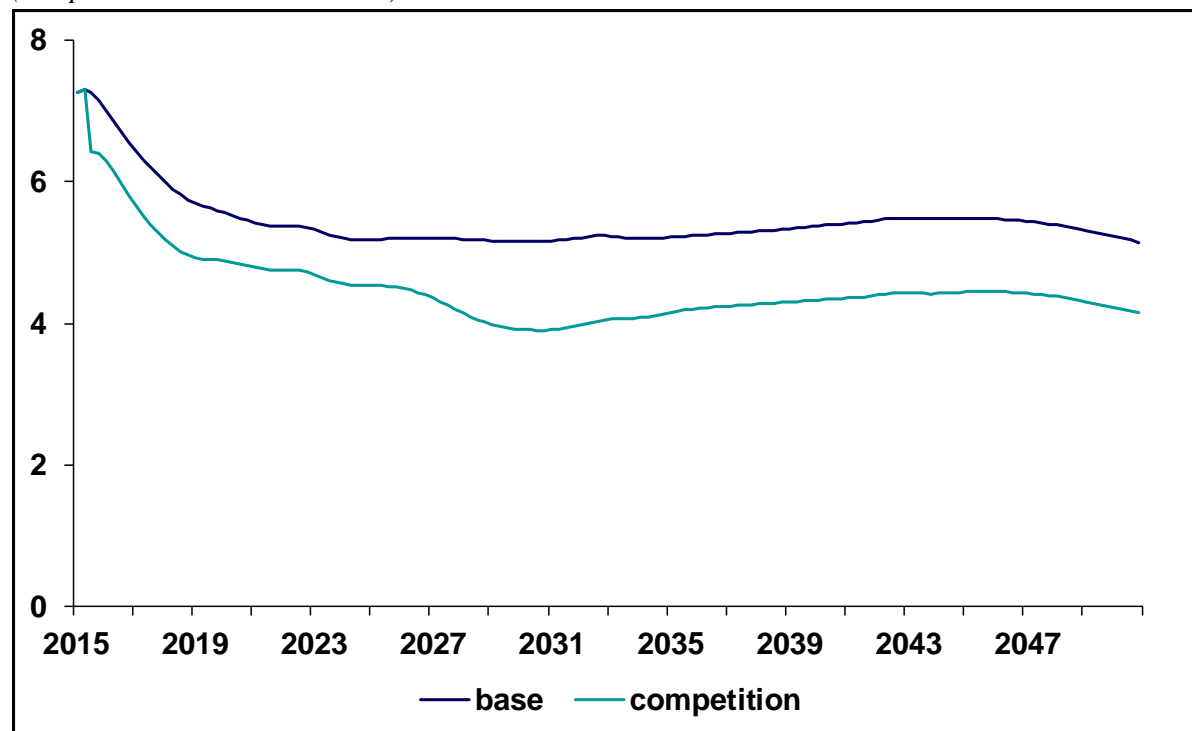
The same factors that drive the gain in GDP also drive the gain in household consumption. However, there are two further factors that boost the gain in household consumption to a higher level.

By providing better export market access, FTAs lead to higher prices for exports, especially in agriculture i.e. the terms-of-trade is boosted. Higher export incomes fund higher consumption.

The modelling assumes that government expenditure requirements do not rise in line with the gain in GDP. This allows the benefit of higher GDP to be concentrated in a higher percentage gain in household consumption.

While the percentage gain in household consumption ultimately betters the percentage gain in GDP, in the early years it lags behind. This is because household spending takes time to fully adjust to the higher incomes that flow from higher GDP.

Chart 5.2. Advancing Competition Scenario: Unemployment rate (compared to Baseline Scenario)



Source: Independent Extended CGE model

Chart 5.2 compares the projection for unemployment in the Advancing Competition Scenario with the projection in the Baseline Scenario. In the Baseline Scenario unemployment gradually recovers from its current cyclical high to stabilise at a sustainable rate of around 5.3 per cent from 2020 onwards.

In the Advancing Competition Scenario, the assumed reduction in the sustainable unemployment rate from workplace relations reform leads to unemployment stabilising one percentage point lower, at around 4.3 per cent. As explained in section 2.5, the key elements of such a reform would involve easing unfair dismissal laws and making the role of the Fair Work Commission less prescriptive.

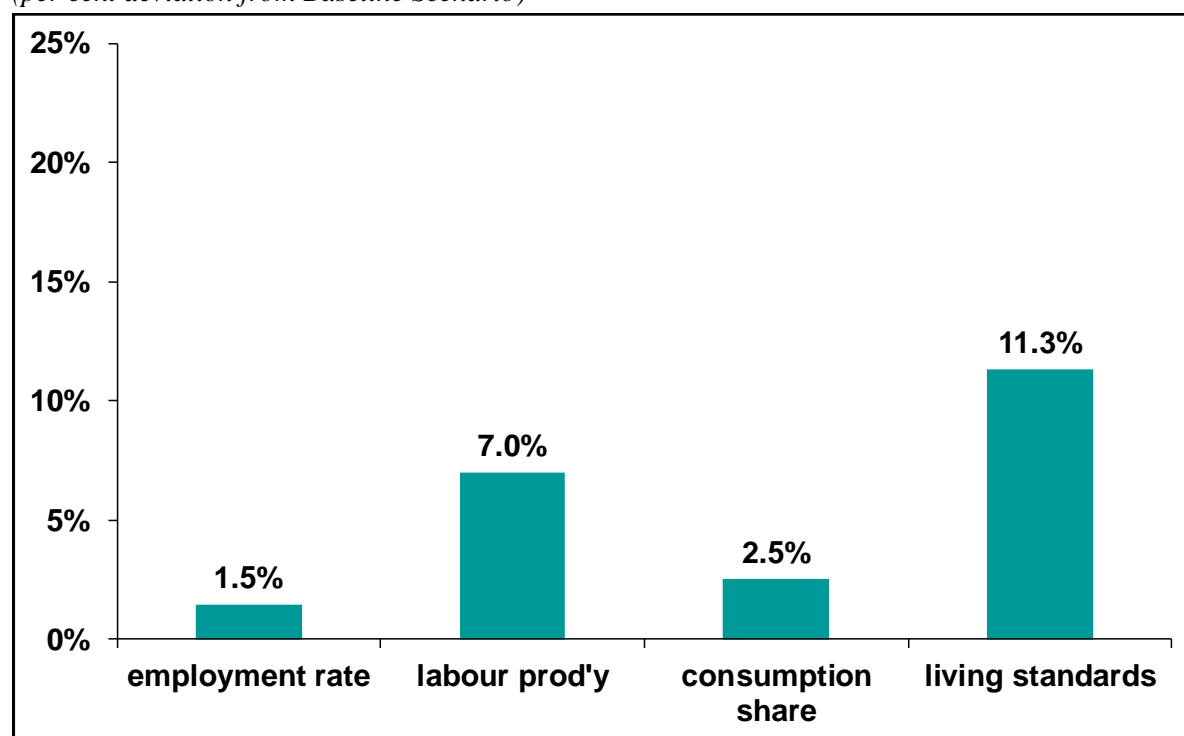
Chart 5.3 provides a dissection of the drivers of the gain in living standards seen in the Advancing Competition Scenario. As noted above, from 2028 onwards, the gain in living standards, as measured by real household consumption, is around 11 per cent. Taking 2030 as an example, the precise gain is 11.3 per cent.

Chart 5.3 shows that most of this gain originates from higher labour productivity. Reform of taxation, competition policy, federalism and workplace relations all combine to deliver this productivity gain.

The next source of gain in living standards is a higher consumption share of GDP. This is supported by the higher terms-of-trade from FTAs. In addition, this also reflects the assumption that the benefit of higher incomes from higher GDP is concentrated in higher household consumption rather than higher government spending.

The final source of gain in living standards is higher employment as a result of workplace relations reform.

Chart 5.3. Advancing Competition Scenario: Sources of gain in living standards in 2030 (per cent deviation from Baseline Scenario)

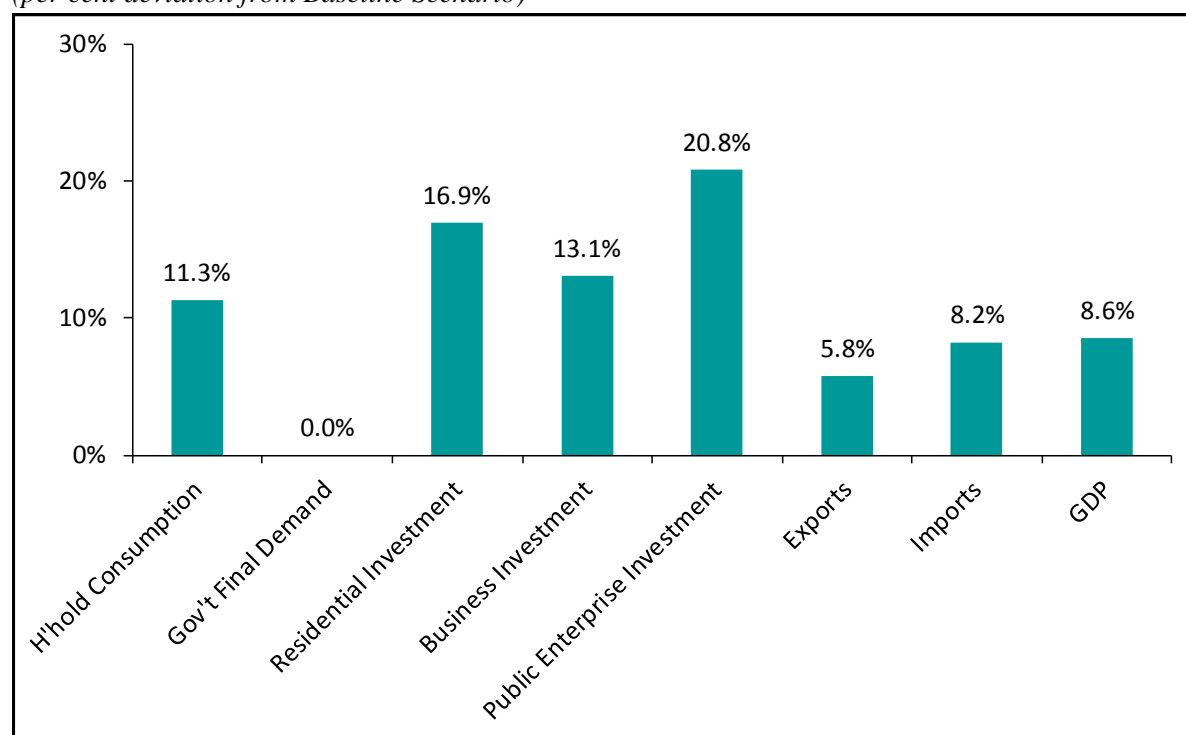


Source: Independent Extended CGE model

Charts 5.4 and 5.5 provide alternative breakdowns of the gain in GDP per capita in 2030. As noted above, the gain in GDP per capita reaches a plateau at around 8.5 per cent from 2028 onwards, and the precise result in 2030 is a gain of 8.6 per cent. Chart 5.4 shows how this impact varies when GDP is broken down by expenditure, while Chart 5.5 shows the breakdown by industry.

In Chart 5.4, the assumption that real government expenditure is not increased in response to the gain in real GDP is seen clearly in the result that General Government final demand is unaffected. The sources of the gain in household consumption of 11.3 per cent were covered in the discussion of Chart 5.3. However, the most striking feature of Chart 5.4 is the relatively high percentage gains in the three categories of investment, relative to the percentage gain in GDP. In 2030 investment is occurring at high rates so that capital stocks can expand in line with the higher productive capacity of the labour force. As this capital stock adjustment process runs its course in subsequent years, the gains in investment gradually moderate to be more in line with the gains in GDP.

*Chart 5.4. Advancing Competition Scenario: GDP per head by Expenditure in 2030
(per cent deviation from Baseline Scenario)*



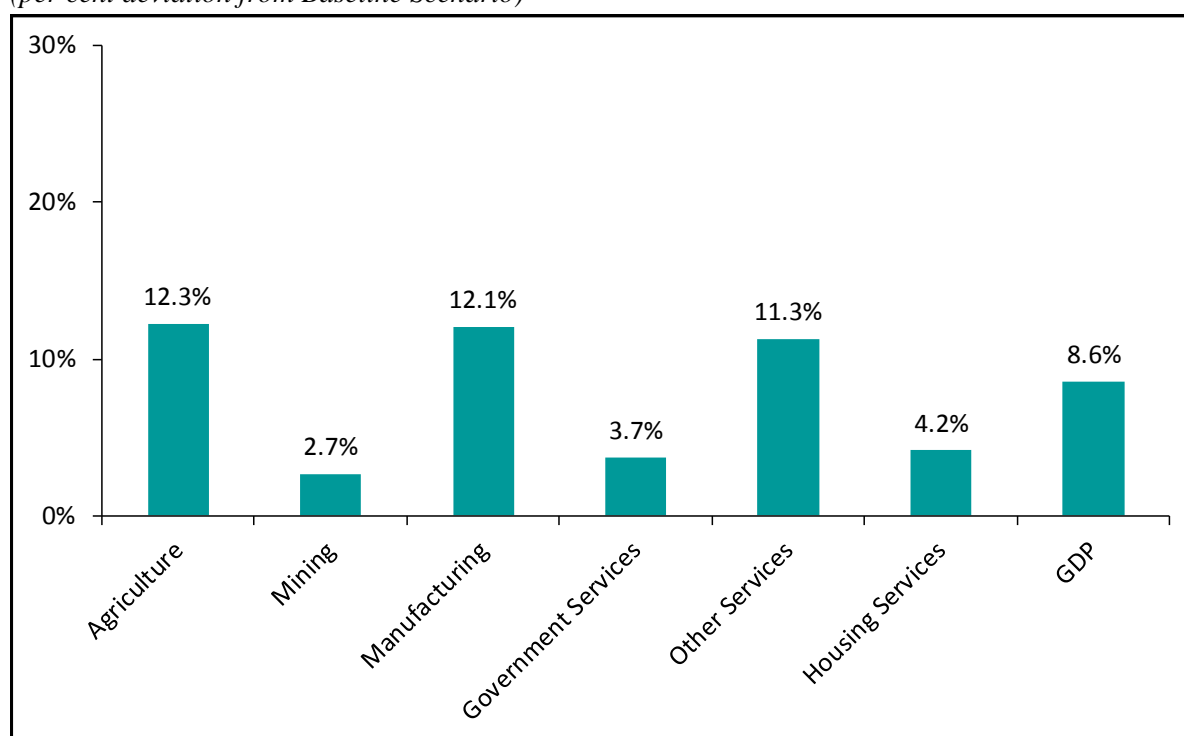
Source: Independent Extended CGE model

Chart 5.5 shows how the gains in real GDP from the Advancing Competition Scenario vary by industry. Again, the point of comparison is the gain in total GDP of 8.6 per cent.

Agriculture receives a relatively high gain as it benefits most from FTAs. The gain for mining is subdued: mining activity depends heavily on the availability of mineral resources, and that does not change as part of the Advancing Competition Scenario. The gain in Government Services is also modest, reflecting the earlier assumption that government spending is unaffected by the gain in GDP.

Finally, the gain in Housing Services is also relatively modest. This is because it takes time for the housing stock to expand in line with higher real incomes. Thus, in subsequent years, the gain in housing services gradually builds to be more in line with the gain in GDP.

*Chart 5.5. Advancing Competition Scenario: GDP per head by Industry in 2030
(per cent deviation from Baseline Scenario)*



Source: Independent Extended CGE model

Table 5.1 provides a perspective on how the gains from the Advancing Competition Scenario develop with time. It is apparent that these gains are largely realised by 2030: the gains in 2050 are similar to the gains in 2030. This is consistent with the nature of the Advancing Competition Scenario reforms. They are focussed on more efficiently allocating resources. Once that more efficient allocation has been achieved, the benefits persist but do not expand further. This is in contrast to the Investing in the Future Scenario, which is considered in the next section.

*Table 5.1. Advancing Competition Scenario: Broad economic effects
(per cent deviations from baseline)*

	2030	2050
total population	0.0%	0.0%
university-educated population	0.0%	0.0%
Employment	1.5%	1.1%
Consumption	11.3%	11.1%
GDP	8.6%	9.2%
Consumption per capita (living standards)	11.3%	11.1%
GDP per capita	8.6%	9.2%
Personal income tax (% point difference)	-4.9%	-4.2%
Real after tax wage	9.1%	9.9%

Source: Independent Extended CGE model

Finally, it is important to consider the distributional effects of these economic reforms. These can be broadly assessed from a comparison of the impacts on the real after-tax wages received by low, mid and high skill employees.

The Advancing Competition Scenario reforms have broadly neutral distributional impacts. Table 5.1 shows a gain in the average real after-tax wage of 9.9 per cent by 2050. The percentage gains are similar for low, mid and high skill employees at 11.9, 9.8 and 9.5 per cent respectively.

6 Investing in the future scenario

This section reports the economic impacts of the Investing in the Future Scenario. This scenario is based on policies to advance living standards by enhancing growth in productive capacity. It includes the remaining five key areas of reform:

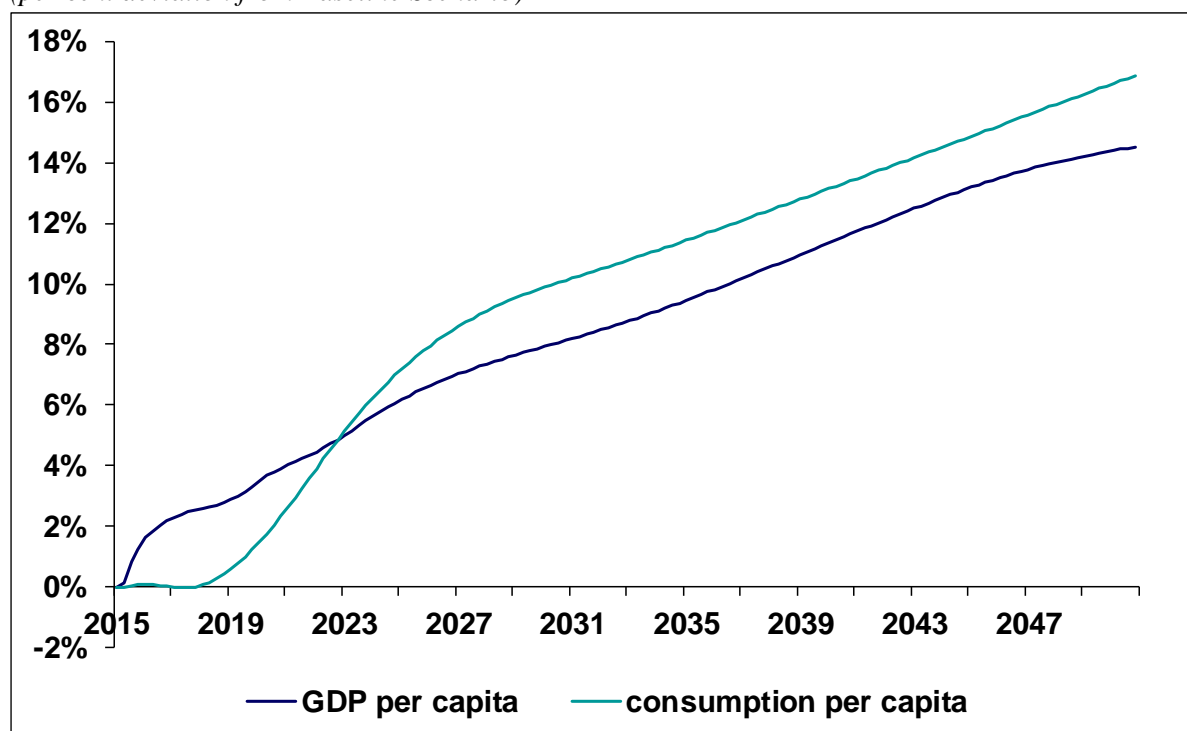
- infrastructure;
- labour force participation;
- innovation;
- migration; and
- education.

These policies were set out in section 3, while section 4 explained how they are modelled.

Chart 6.1 provides an overview of the impact of this scenario on living standards, as measured by real GDP and household consumption. Both measures are expressed on a per capita basis. This is because the migration policy leads to a higher population than in the Baseline Scenario, and to properly assess the impact of this on living standards the results need to be expressed in per capita terms.

For each year, the chart shows the percentage deviation between the outcome in the Investing in the Future Scenario and the outcome in the same year for the Baseline Scenario. Because the inputs to the two scenarios only differ in the assumptions made in the five Investing in the Future policy areas, the results in the chart show the economic impacts of these policy differences. Further such economic impacts are shown in subsequent charts and tables.

Chart 6.1. Investing in the Future Scenario: GDP per capita and Consumption per capita (per cent deviation from Baseline Scenario)



Source: Independent Extended CGE model

The gain in GDP per capita rises steadily. Unlike in the Advancing Competition Scenario, the gains do not level out. For example, by 2030 the gain in GDP per capita has reached 8.1 per cent but by 2050 this has expanded further to 14.5 per cent.

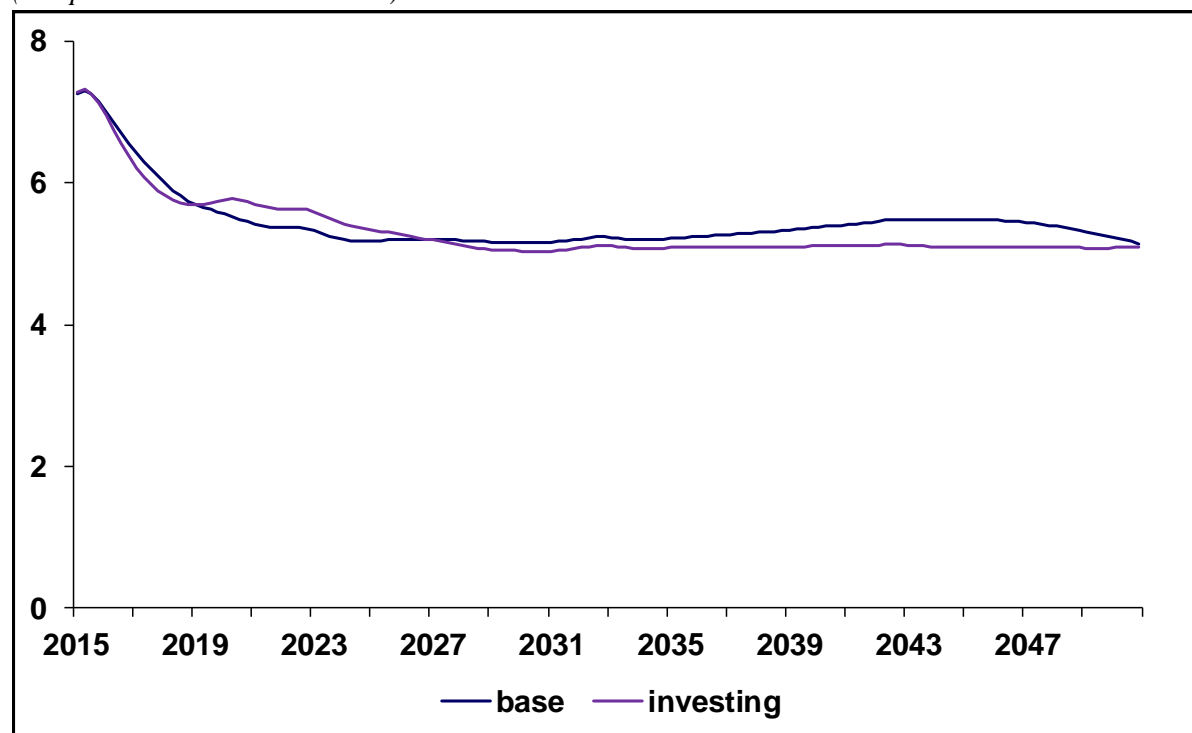
This is because the policies in the Investing in the Future are growth oriented. In particular, the education, migration and innovation policies all lift economic growth in the medium to long term. These gains in growth in GDP per capita mainly reflect higher growth in employment per capita, although higher labour productivity growth also plays an important role.

Three different policies contribute to higher growth in employment per capita. Policies to lift the participation rates for females and older workers add to employment. Additional investment in tertiary education also adds to employment, because higher-skilled workers have higher participation rates and lower unemployment rates than lower-skilled workers. Higher migration also adds to employment per capita, mainly because a high proportion of migrants fall in the prime working age group.

Higher productivity growth is driven by three policies. Additional government infrastructure (mainly road and rail infrastructure) adds to productivity by reducing transport times. Higher innovation activity makes an ongoing contribution to productivity growth. Additional investment in tertiary education boosts productivity by adding to the average skill level of the workforce.

While these gain in GDP per capita are substantial, the improvement in living standards is better measured by the gain in household consumption per capita. The percentage gain in household consumption per capita passes the gain in GDP per capita in 2023, and then maintains its lead. This is because the modelling assumes that the benefit of higher GDP per capita are concentrated in gains in household consumption rather than government spending. Consumption lags behind in the early years, because household spending takes time to fully adjust to the higher incomes that flow from higher GDP.

Chart 6.2. Investing in the Future Scenario: Unemployment rate (compared to Baseline Scenario)



Source: Independent Extended CGE model

Chart 6.2 compares the projection for unemployment in the Investing in the Future Scenario with the projection in the Baseline Scenario. In the Baseline Scenario unemployment gradually recovers from its current cyclical high to stabilise at a sustainable rate of around 5.3 per cent from 2020 onwards.

In the Advancing Competition Scenario, higher investment in tertiary education leads to a slightly lower unemployment rate. This is because higher-skilled workers have higher labour force participation rates than lower skilled workers.

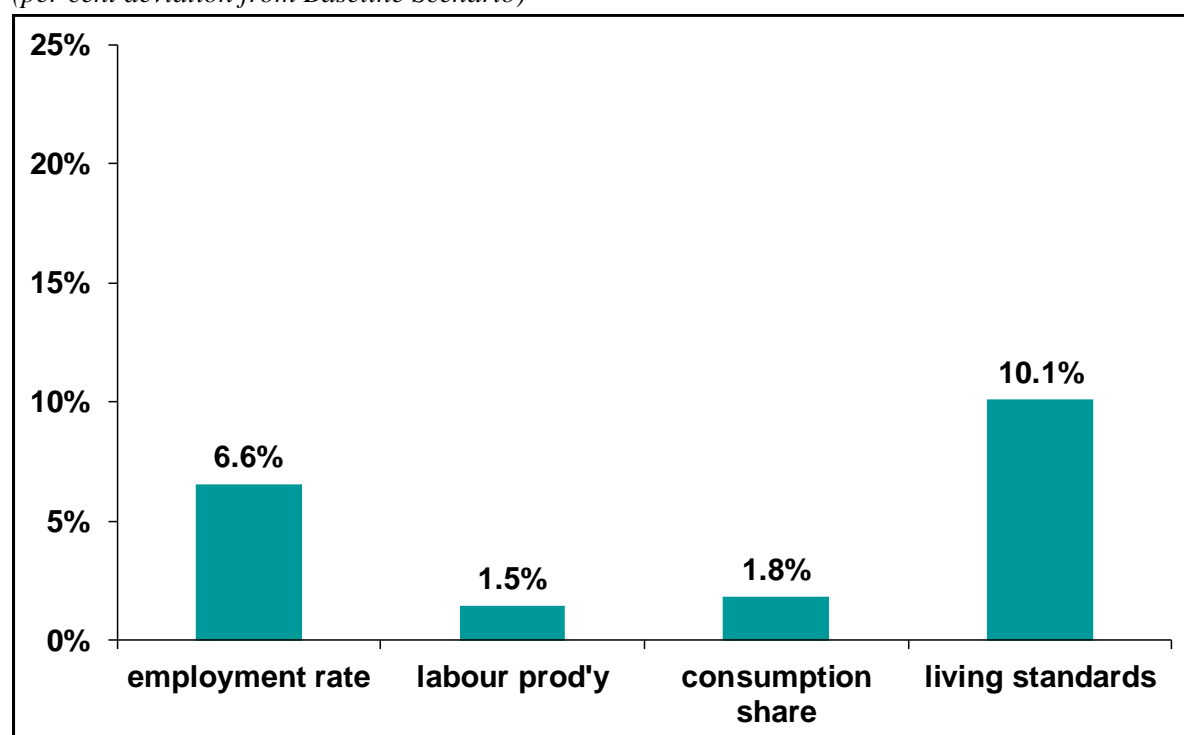
Chart 6.3 provides a dissection of the drivers of the gain in living standards seen in the Investing in the Future Scenario. It takes the year 2030 as an example, when the gain in living standards, as measured by real household consumption, is 10.1 per cent.

It confirms that most of the gain in living standards in this scenario originates from higher employment per capita. As noted above, this originates from higher participation rates for female and older workers, additional investment in tertiary education, and higher migration.

The more modest gain in productivity arises from additional government infrastructure, higher innovation activity and additional investment in tertiary education, as noted above.

The higher consumption share of GDP reflects the assumption that the benefit of higher incomes from higher GDP per capita is concentrated in higher household consumption rather than higher government spending.

Chart 6.3. Investing in the Future Scenario: Sources of gain in living standards in 2030 (per cent deviation from Baseline Scenario)

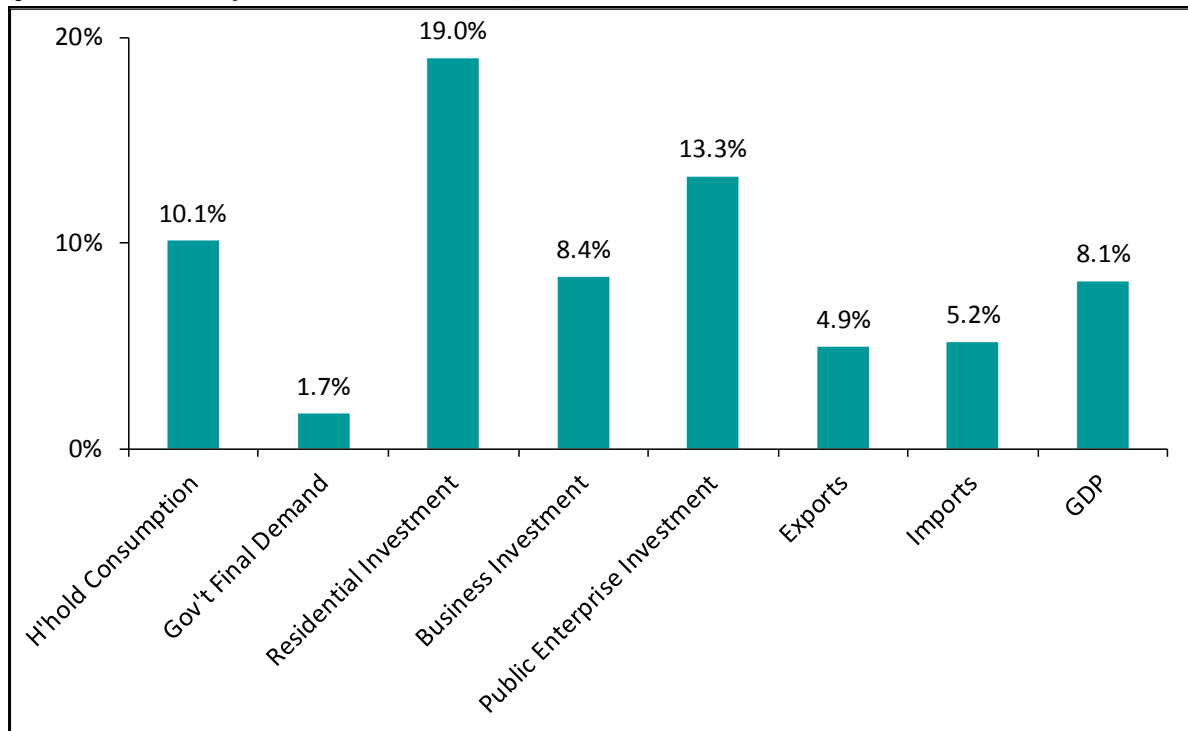


Source: Independent Extended CGE model

Charts 6.4 and 6.5 provide alternative breakdowns of the gain in GDP per capita in 2030 of 8.1 per cent. Chart 6.4 shows how this impact varies when GDP is broken down by expenditure, while Chart 6.5 shows the breakdown by industry.

In Chart 6.4, the gain in real government expenditure is modest. This is because it assumes that government expenditure is related to population, and thus rises in response to higher migration, but not in response to reforms that raise GDP per capita. The sources of the gain in household consumption of 10.1 per cent were covered in the discussion of Chart 6.3. Chart 6.4 shows particularly strong percentage gains in the three categories of investment, relative to the percentage gain in GDP. To maintain the higher rate of economic growth of this scenario, a higher share of GDP is devoted to investment, so that capital stocks can grow at higher rates.

*Chart 6.4. Investing in the Future Scenario: GDP per head by Expenditure in 2030
(per cent deviation from Baseline Scenario)*

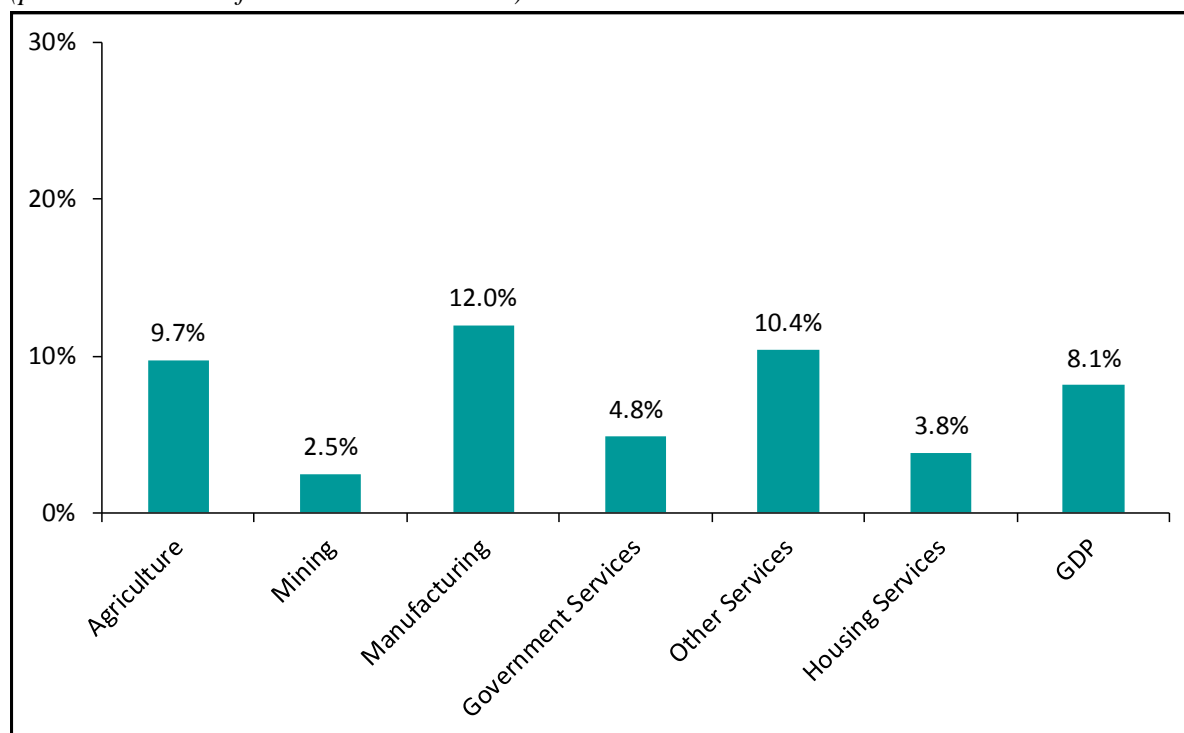


Source: Independent Extended CGE model

Chart 6.5 shows how the gains in real GDP from the Investing in the Future Scenario vary by industry in 2030. Again, the point of comparison is the gain in total GDP in that year of 8.1 per cent.

The biggest winner from the Investing in the Future Scenario is manufacturing. The high rate of investment required to support a higher rate of economic growth lifts demand for manufactured investment goods. Similar to the Advancing Competition Scenario, the gain for mining is subdued. Again, this is because mining activity depends heavily on the availability of mineral resources, and that does not change as part of the Investing in the Future Scenario. The gain in Government Services is also modest, reflecting the earlier assumption that government spending is unaffected by gains in GDP per capita. Finally, the gain in Housing Services is also relatively modest. Similar to the Advancing Competition Scenario, this is because it takes time for the housing stock to expand in line with higher real incomes.

*Chart 6.5. Investing in the Future Scenario: GDP per head by Industry in 2030
(per cent deviation from Baseline Scenario)*



Source: Independent Extended CGE model

Table 6.1 provides a perspective on how the gains from the Investing in the Future Scenario develop with time. Unlike in the Advancing Competition Scenario, where the gains level off, in the Investing in the Future Scenario the gains continue to grow with the passage of time. This is because the education, migration and innovation policies all lift economic growth in the medium to long term.

*Table 6.1. Investing in the Future Scenario: Broad economic effects
(per cent deviations from baseline)*

	2030	2050
total population	1.8%	9.0%
university-educated population	13.2%	33.8%
Employment	8.4%	19.2%
Consumption	12.1%	27.3%
GDP	10.0%	24.8%
Consumption per capita (living standards)	10.1%	16.9%
GDP per capita	8.1%	14.5%
Personal income tax (% point difference)	-7.3%	-13.7%
Real after tax wage	4.6%	12.8%

Source: Independent Extended CGE model

Thus, while the Advancing Competition Scenario shows larger gains in 2030, the Investing in the Future Scenario shows larger gains in 2050.

Finally, it is important to consider the distributional effects of these economic reforms. These can be broadly assessed from a comparison of the impacts on the real after-tax wages received by low, mid and high skill employees.

The gains from the Investing in the Future Scenario reforms are slanted heavily in favour of low wage earners. Table 6.1 shows a gain in the average real after-tax wage of 12.8 per cent by 2050. The percentage gains are 26.5, 12.4 and 5.3 per cent for low, mid and high skill employees respectively. The migration and education reforms both increase the supply of high skilled workers relative to low skilled workers, leading to some narrowing of wage differentials.

7 Combined scenario

This section reports the economic impacts of the Combined Scenario. This scenario includes all of the policies of both the Advancing Competition Scenario and the Investing in the Future Scenario. Thus, it includes all ten key areas of reform.

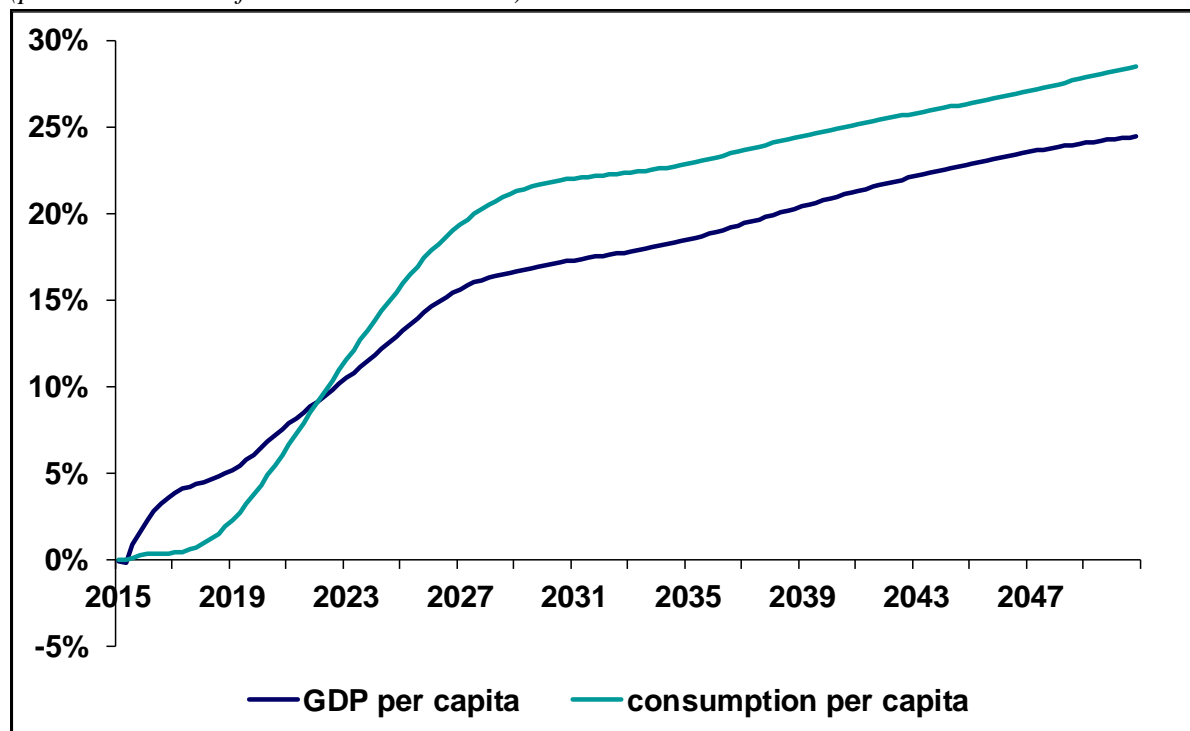
Advancing Competition	Investing in the Future
taxation	infrastructure
competition policy	labour force participation
free trade agreements	innovation
Federalism	migration
workplace relations	education.

These policies were set out in sections 2 and 3, while section 4 explained how they are modelled.

The economic impacts of this Combined Scenario are not exactly equal to the sum of the economic impacts of the two constituent scenarios, but they are approximately equal. Thus, the Combined Scenario does not introduce any significant new impacts. However, it does provide a more complete picture of the economic gains from economic reform by including all ten policy areas.

Chart 7.1 provides an overview of the impact of this scenario on living standards, as measured by real GDP and household consumption. Both measures are expressed on a per capita basis. For each year, the chart shows the percentage deviation between the outcome in the Combined Scenario and the outcome in the same year for the Baseline Scenario. These reflect the economic impacts of the policy reforms across the ten areas.

*Chart 7.1. Combined Scenario: GDP per capita and Consumption per capita
(per cent deviation from Baseline Scenario)*



Source: Independent Extended CGE model

The gain in GDP per capita rises more quickly at first and then more slowly. For example, by 2030 the gain in GDP per capita has reached 17.2 per cent but by 2050 this has expanded further to 24.4 per cent. This reflects the mixture of policies with some focussed on efficient resource allocation boosting the level of GDP and others on growth. In particular, the education, migration and education policies all lift economic growth in the medium to long term.

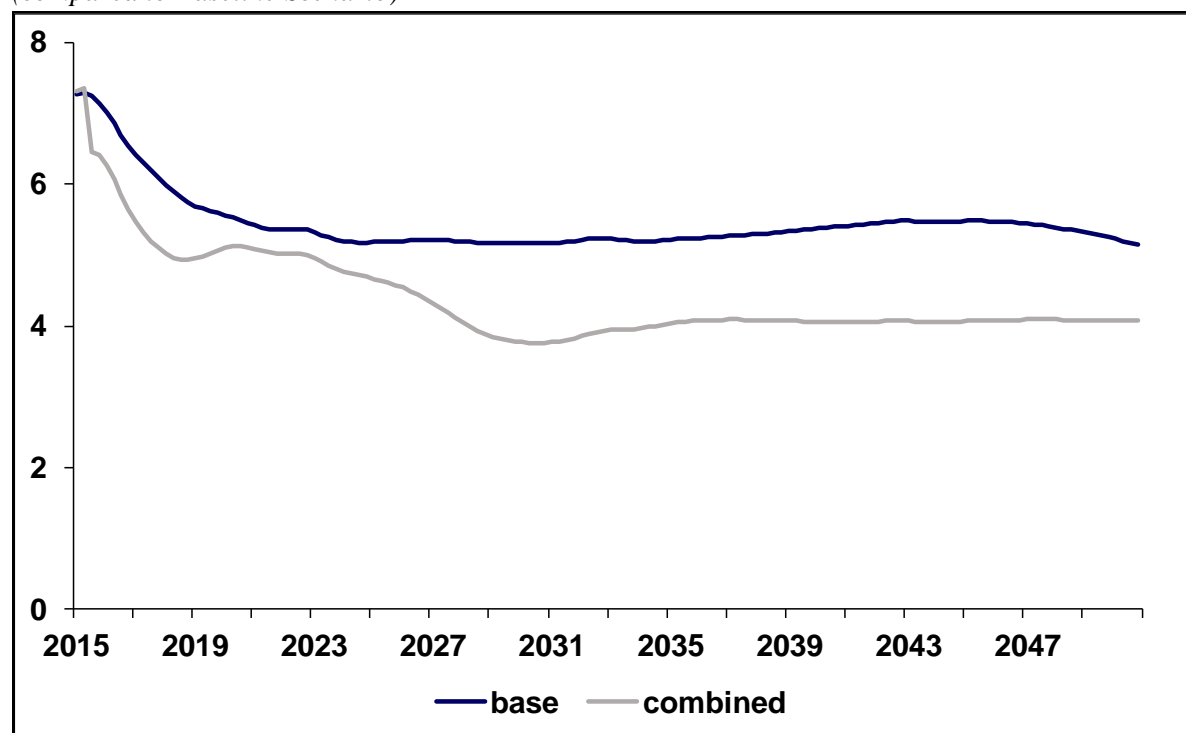
The gains in GDP per capita depend approximately equally on gains in employment per capita and gains in labour productivity. Some policies mainly stimulate employment per capita while other policies mainly stimulate labour productivity.

Two different policies mainly contribute to higher employment per capita. Policies to lift the participation rates for females and older workers add to employment. Higher migration adds to employment per capita because a high proportion of migrants fall in the prime working age group.

Five different policies contribute to higher productivity. The cut in the company tax rate from 30 to 25 per cent lifts productivity by encouraging investment in the capital stock. The reforms to competition policy and federalism both mean that labour is used more efficiently. Additional government infrastructure (mainly road and rail infrastructure) adds to productivity by reducing transport times. Higher innovation activity makes an ongoing contribution to productivity growth.

Two policies contribute importantly to percentage gains in both employment per capital and labour productivity. Additional investment in tertiary education adds to employment, because higher-skilled workers have higher participation rates and lower unemployment rates than lower-skilled workers. Higher skilled workers are also more productive. Workplace reform lifts employment by reducing the sustainable unemployment rate. It also lifts productivity by allowing more flexible work practices.

*Chart 7.2. Combined Scenario: Unemployment rate
(compared to Baseline Scenario)*



Source: Independent Extended CGE model

While these gain in GDP per capita are substantial, the percentage gain in household consumption per capita is even higher. This is because the modelling assumes that the benefits of higher GDP per capita are concentrated in gains in household consumption rather than government spending.

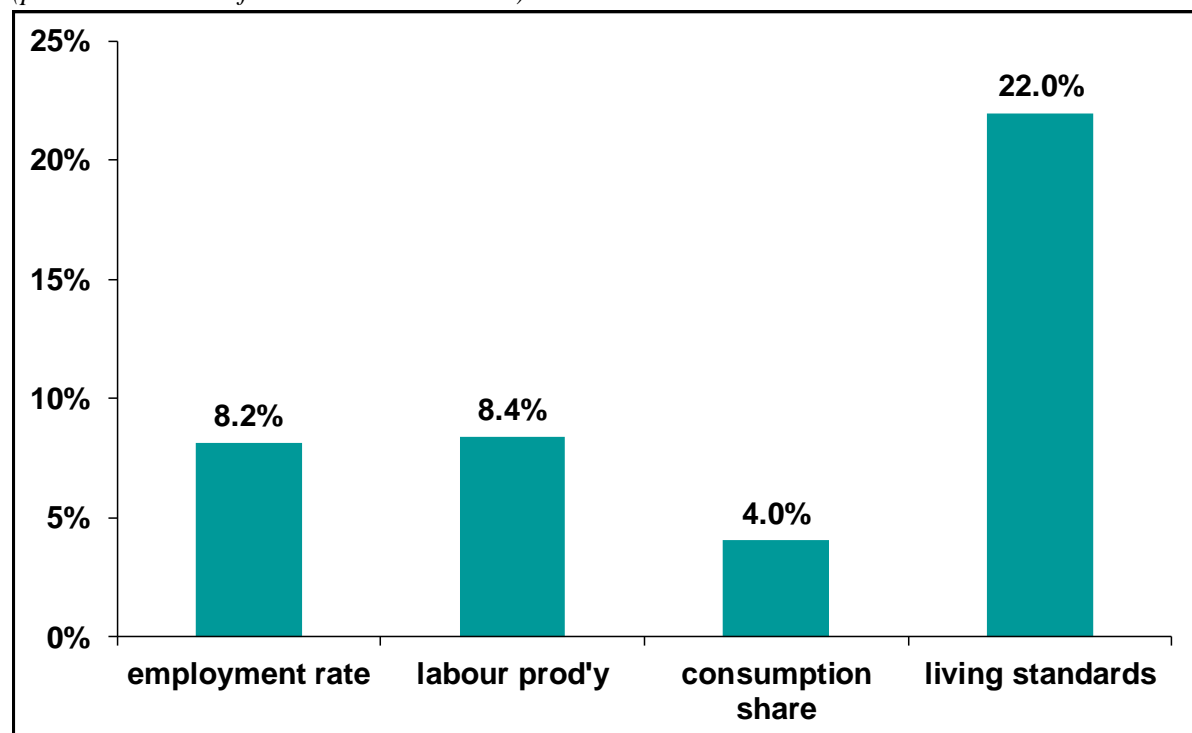
The ten policy areas each make significant contributions to the economic gains from reforms, with education, migration and innovation policies standing out as the largest sources of potential gain. Education and migration policies are the main drivers of higher employment per capita, while innovation policies are the biggest driver of productivity growth. The policies for taxation, labour force participation, workplace relations, federalism and competition also deliver substantial gains. Infrastructure policies and free trade agreements also contribute, but their main impacts are felt in the sectors of the economy that are mostly directly impacted, namely construction and agriculture, rather than more widely.

Chart 7.2 compares the projection for unemployment in the Combined Scenario with the projection in the Baseline Scenario. In the Baseline Scenario unemployment gradually recovers from its current cyclical high to stabilise at a sustainable rate of around 5.3 per cent from 2020 onwards. In the Combined Scenario, unemployment stabilises at just over 4 per cent. This is mainly because of the assumed reduction in the sustainable unemployment rate from workplace relations reform.

Chart 7.3 provides a dissection of the drivers of the gain in living standards seen in the Combined Scenario. It takes the year 2030 as an example, when the gain in living standards, as measured by real household consumption, is 22.0 per cent.

It confirms that the gain in living standards in this scenario depends in about equal measure on gains in employment per capita and labour productivity. As noted above, this is because some policies mainly add to employment per capita, others mainly add to labour productivity, and others add to both.

*Chart 7.3. Combined Scenario: Sources of gain in living standards in 2030
(per cent deviation from Baseline Scenario)*



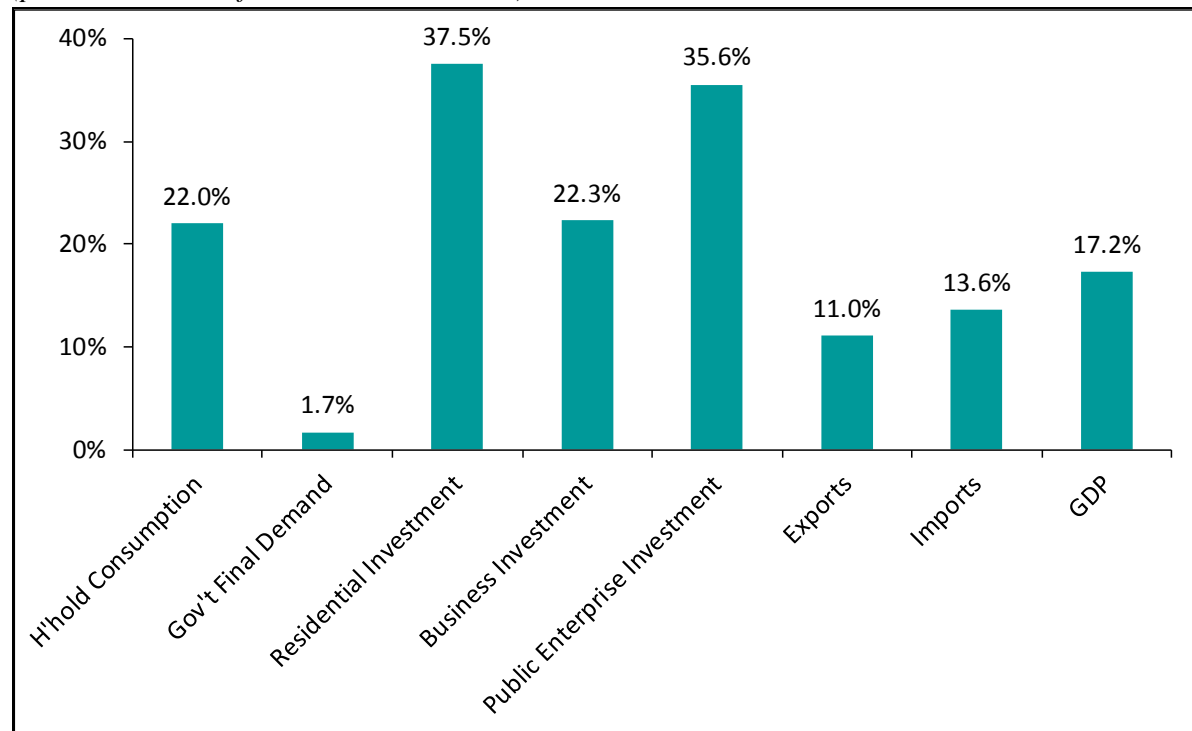
Source: Independent Extended CGE model

A higher consumption share of GDP also contributes to the gain in GDP per capita. The consumption share is supported by the higher terms-of-trade from FTAs. In addition, the higher consumption share also reflects the assumption that the benefit of higher incomes from higher GDP per capita is concentrated in higher household consumption rather than higher government spending.

Charts 7.4 and 7.5 provide alternative breakdowns of the gain in GDP per capita in 2030 of 17.2 per cent. Chart 7.4 shows how this impact varies when GDP is broken down by expenditure, while Chart 7.5 shows the breakdown by industry.

In Chart 7.4, the gain in real government expenditure is modest. This is because it assumes that government expenditure is related to population, and thus rises in response to higher migration, but not in response to reforms that raise GDP per capita. The sources of the gain in household consumption of 22.0 per cent were covered in the discussion of Chart 7.3. Chart 7.4 shows strikingly strong percentage gains in the three categories of investment, relative to the percentage gain in GDP. To maintain the higher rate of economic growth of this scenario, a higher share of GDP is devoted to investment, so that capital stocks can grow at higher rates.

*Chart 7.4. Combined Scenario: GDP per head by Expenditure in 2030
(per cent deviation from Baseline Scenario)*



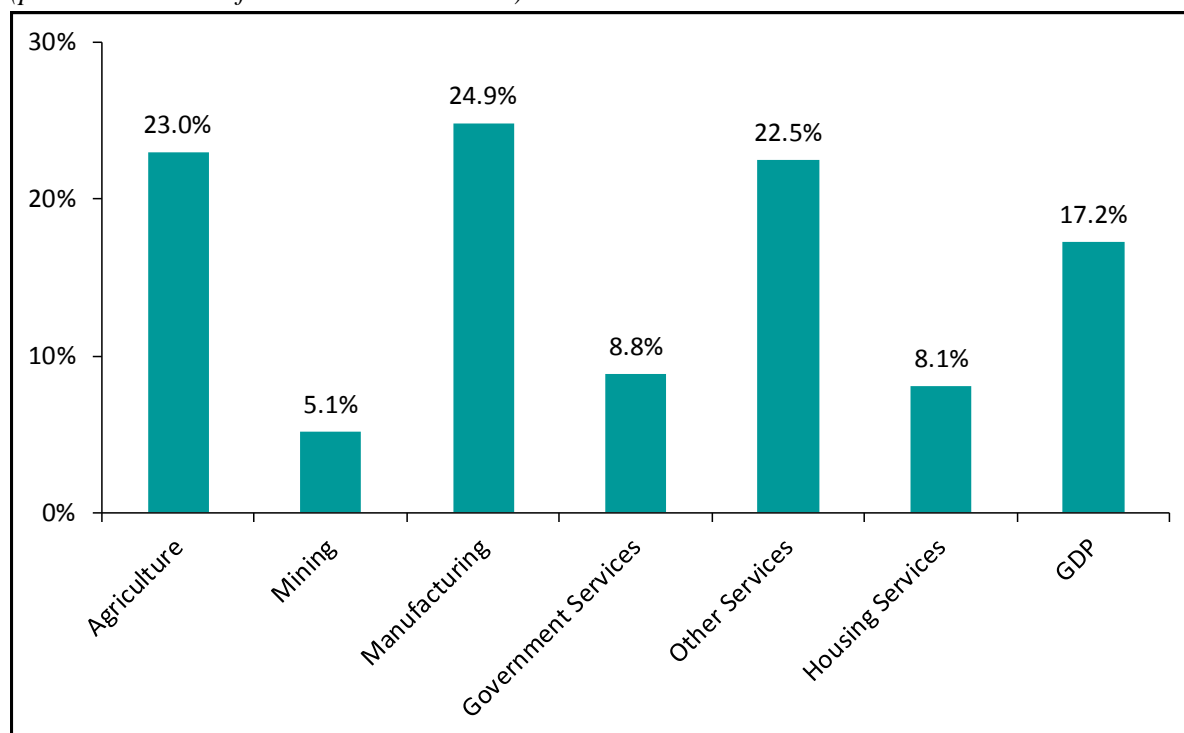
Source: Independent Extended CGE model

The reforms benefit some industries more than others. In the Baseline Scenario, without reform, all broad sectors growth at average, annual rates of around 3 per cent to 2030. Chart 7.5 shows how the gains in real GDP from the Combined Scenario vary by industry in 2030. Again, the point of comparison is the gain in total GDP in that year of 17.2 per cent.

The biggest winner from the Combined Scenario is manufacturing. The high rate of investment required to support a higher rate of economic growth lifts demand for manufactured investment goods. Agriculture is also a bigger winner, boosted by the FTAs. The gain for mining is subdued because mining activity depends heavily on the availability of mineral resources, and that does not change as

part of the Combined Scenario. The gain in Government Services is also relatively modest, reflecting the earlier assumption that government spending is unaffected by gains in GDP per capita. Finally, the gain in Housing Services is also relatively modest. This is because it takes time for the housing stock to expand in line with higher real incomes.

*Chart 7.5. Combined Scenario: GDP per head by Industry in 2030
(per cent deviation from Baseline Scenario)*



Source: Independent Extended CGE model

Table 7.1 provides a perspective on how the gains from the Combined Scenario develop with time. The gains develop relatively quickly at first, with all ten policy areas contributing. Once a more efficient allocation of resources has been achieved, further gains depend mainly on the growth-oriented policies: those for education, migration and innovation. Those three policy areas are responsible for further gains developing from 2030 to 2050.

*Table 7.1. Combined Scenario: Broad economic effects
(per cent deviations from baseline)*

	2030	2050
total population	1.8%	9.0%
university-educated population	13.2%	33.8%
Employment	10.1%	20.5%
Consumption	24.1%	40.0%
GDP	19.3%	35.6%
Consumption per capita (living standards)	22.0%	28.5%
GDP per capita	17.2%	24.4%
Personal income tax (% point difference)	-11.7%	-17.2%
Real after tax wage	13.1%	21.5%

Source: Independent Extended CGE model

Tables 7.1 also shows that the overall impact of the policy reforms is to strengthen the Federal Government Budget. Some specific reforms, notably for taxation, education and infrastructure, involve a cost to the Budget, especially in the short-term. However, these costs are easily dominated by the growing boost to Budget revenues from the stronger economic growth delivered by all ten reforms. This means that the same Budget outcomes can be achieved with the lower rates of personal income tax seen in the table.

Finally, it is important to consider the distributional effects of these economic reforms. These can be broadly assessed from a comparison of the impacts on the real after-tax wages received by low, mid and high skill employees.

The gains from the Combined Scenario reforms are slanted in favour of low wage earners. Table 7.1 shows a gain in the average real after-tax wage of 21.5 per cent by 2050. The percentage gains are 38.1, 20.9 and 13.1 per cent for low, mid and high skill employees respectively. The migration and education reforms both increase the supply of high skilled workers relative to low skilled workers, leading to some narrowing of wage differentials.

References

- Australian Bureau of Statistics (2014), *Government Financial Statistics, Australia, 2012-13*, ABS Cat. No. 5518.0.
- Australia's Future Tax System Review (2009), "Report to the Treasurer", Commonwealth of Australia.
- Australian Government (2014), "Budget 2014-15: Building Australia's Infrastructure", Commonwealth of Australia.
- Australian Government (2015a), "2015 Intergenerational Report", Commonwealth of Australia.
- Australian Government (2015b), "Re:think Tax Discussion Paper", Commonwealth of Australia.
- Bernal-Verdugo, Lorenzo; Furceri, Davide; and Guillaume, Dominique (2012), "Labour Market Flexibility and Unemployment: New Empirical Evidence of Static and Dynamic Effects", IMF Working Paper 2012/64.
- Cao, Liangyue; Hosking, Amanda; Kouparitsas, Michael; Mullaly, Damian; Rimmer, Xavier; Shi, Qun; Stark, Wallace; and Wende, Sebastian (2015), "The economy-wide efficiency and incidence of major Australian taxes", Treasury Working Paper 2015-01.
- Commonwealth Grants Commission (2015), "Report on GST Revenue Sharing Relativities: 2015 Review", Australian Government, February 2015.
- Competition Policy Review (2015), Final Report, March 2015, Commonwealth of Australia.
- Cully, Mark (2012), "More than Additions to Population: The Economic and Fiscal Impact of Immigration", *Australian Economic Review*, 45(3), 344-9.
- Daley, John; McGannon, Cassie; and Ginnivan, Leah (2012), "Game-changers: Economic reform priorities for Australia", Grattan Institute, Melbourne.
- Department of Immigration and Border Protection (2014), *The Outlook for Net Overseas Migration*, September quarter 2014 issue.
- Department of Industry (2014), "Australian Innovation System Report, Commonwealth of Australia.
- Econtech, (2007), "The economic impact of Industrial Relations reforms since 1993", report for the Australian Chamber of Commerce and Industry.
- Independent Economics (2012), "Horizontal Fiscal Equalisation: Modelling the welfare and efficiency effects", report for South Australian Department of Treasury and Finance.
- Independent Economics (2014), "Economic impact of selected macroeconomic shocks", Parliamentary Budget Office.
- Independent Economics (2015), "Horizontal Fiscal Equalisation: Modelling update and policy options", report for South Australian Department of the Premier and Cabinet, forthcoming.
- KPMG Econtech (2010), "CGE Analysis of the Current Australian Tax System", 26 March 2010.

KPMG Econtech (2010). “Economic Modelling of Improved Funding and Reform Arrangements for Universities”, report for Universities Australia.

Migration Council Australia (2015), “The Economic Impact of Migration”.

Murphy, C.W. (1988), “An Overview of the Murphy Model”, in Burns, M.E. and Murphy, C.W. (eds), *Macroeconomic Modelling in Australia*, *Australian Economic Papers*, Supp., 175-199.

OECD (2007), “Innovation and Growth: Rationale for an Innovation Strategy”, Paris.

OECD (2010), “Ministerial report on the OECD Innovation Strategy, Paris.

Powell, A.A. and Murphy, C.W. (1997), *Inside a Modern Macroeconomic Model — A Guide to the Murphy Model*, second ed., Springer, Berlin, 455 pp.

Productivity Commission (2006), “Economic Impacts of Migration and Population Growth”, 24 April 2006.

Productivity Commission (2014), “Public Infrastructure Inquiry Report”, 27 May 2014, Commonwealth of Australia.

Tulloch, Catherine; Jiang, Tingsong; and Pearce, David (2014), “The impact of Free Trade Agreements on Australia”, RIRDC Publication No. 14/002.

Tunny, Gene “Innovation across the OECD: a review of recent studies”, Treasury Economic Roundup, Summer 2006.

Twomey, Anne; and Withers, Glenn (2007), “Australia’s Federal Future”, report for the Council for the Australian Federation.

Varga, Janos and Veld, Yan (2011), “A model-based analysis of the impact of Cohesion Policy expenditure 2000-06: Simulations with the QUEST III endogenous R&D model”, *Economic Modelling*, 647-663.

Appendix A: Modelling Methodology

This section explains the model used by Independent Economics to generate the scenarios. Independent Economics has used a suite of linked economy-wide models to develop the estimates. This suite of models includes a demographic model and a macro-econometric model. This section provides more detail on the macro-econometric model and the extensions to the model. Section A.1 describes the core model and section A.2 describes the extensions.

A.1 Economy-wide modelling methodology

The Independent Macro-econometric model (Macro Model) is Independent Economics' forecasting and policy model. It uses economic principles and evidence from the historical data to capture the broad workings of the Australian economy. This makes it a powerful tool to enhance the robustness of economic forecasting whether the time horizon is short (to 2015) or long (to 2050). Notably, the approach taken is rigorous in its application of economic theory; this means that it also delivers powerful insights into fiscal and monetary policies. For example, the six-sector Macro Model converges to a balanced growth path. In addition, a separate demographic model is used to provide population inputs and to determine long-term trends in the participation rate.

In the Macro Model, households, firms, the government and foreign agents interact in factor, product and financial markets. The role of each agent is discussed, in turn, below. This is followed by a discussion of the model's market clearing mechanisms.

A.1.1 Economic Agents

Households

Households supply labour, own capital and government bonds, purchase goods and services from businesses and pay taxes to government.

The household's inter-temporal budget constraint is imposed by assuming that households have a savings target. This savings target is defined as the locally-owned stock of produced capital expressed as a multiple of labour income and its value is estimated from historical data. Since there is a target for the stock of capital that households hold, changes in the government's debt position do not affect the household's stock of real assets in the long run. Consumption gradually adjusts so that this savings target is gradually met. Consumption is positively affected by income from labour, produced capital, natural resources and bonds and transfers. Conversely, consumption is negatively affected by unanticipated inflation.

Once the aggregate level of consumption is determined it is allocated across the six industries identified in the model (Agriculture, Mining, Manufacturing, Government services and Housing services). Households choose their allocation to maximise a Constant Elasticity of Substitution (CES) utility function.

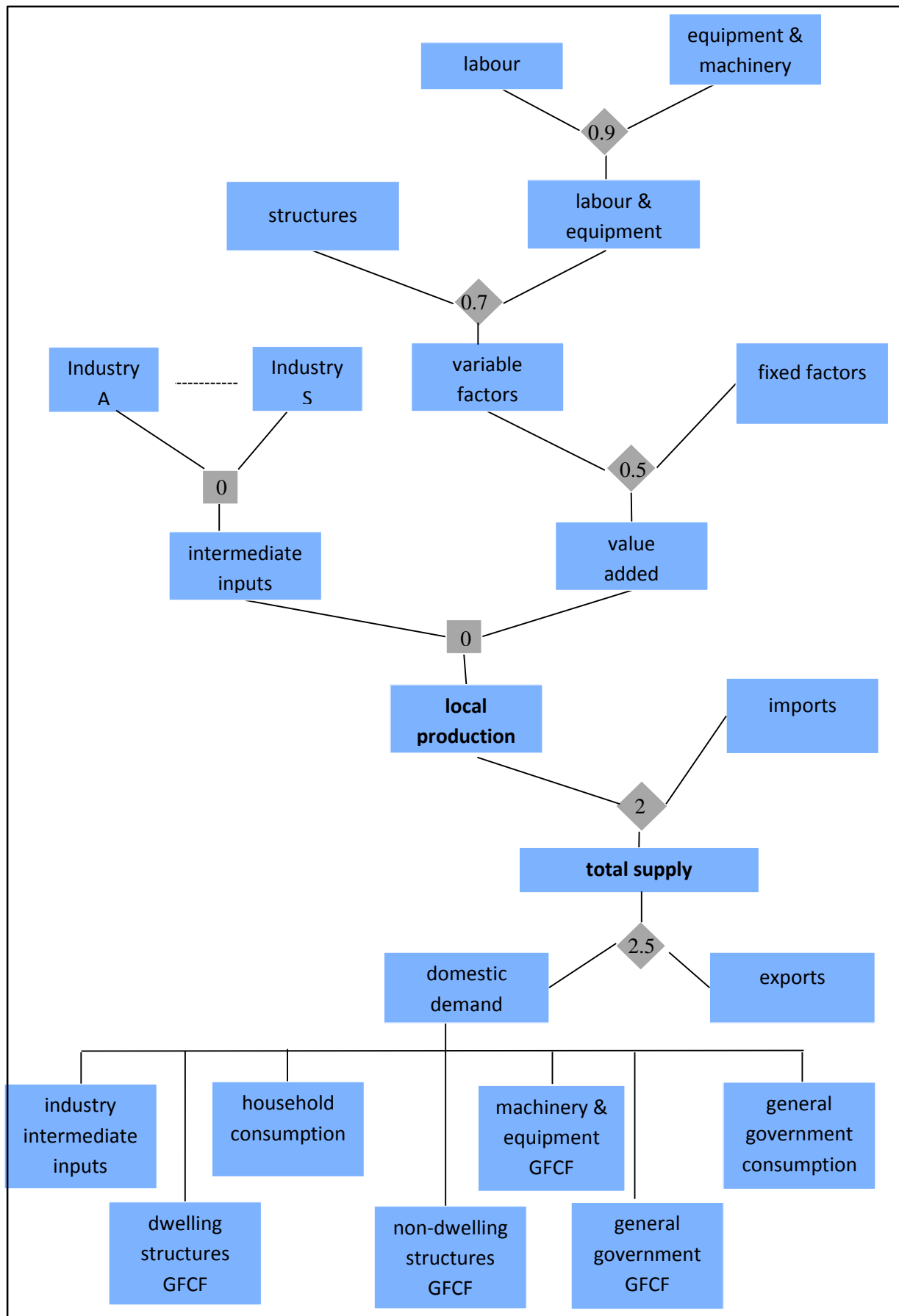
Labour supply is determined by the age, gender and education structure of the population, underlying trends in the participation rate and an encouraged worker effect.

Businesses

A representative business in each industry produces goods and services using labour, natural resources, structures, other types of capital and intermediate inputs. The six industries featured in the Independent Macro-econometric model are based on the latest Australian and New Zealand Standard Industrial Classification (ANZSIC 2006). The mapping between the model's industries and ANZSIC 2006 industries is shown in the table below.

Macro Model Industry	ANZSIC2006 Industries	ANZSIC2006 Codes
Agriculture (A)	Agriculture, forestry & fishing	A
Mining (B)	Mining	B
Manufacturing (C)	Manufacturing	C
Government services (G)	Public administration & safety Education & training Health care & social assistance	O P Q
Other Service Industries (S)	Electricity, gas, water & waste services Construction Wholesale trade Retail trade Accommodation and food services Transport, postal and warehousing Information media & telecommunications Financial & insurance services Rental, hiring & real estate services Professional, scientific & technical services Administrative and support services Arts and recreation services Other services	D E F G H I J K L M N R S
Housing services (T)	Ownership of Dwellings	-

The production technology for a typical industry in the Independent Macro-econometric model is shown in the figure below.



A representative business in each industry combines labour and non-structures capital (including machinery and equipment) into a labour and equipment bundle using a Constant Elasticity of Substitution (CES) technology with an elasticity of substitution of 0.9. Similarly, structures and the labour and equipment bundle are combined using CES technology to produce a variable factors bundle. Notably, this variable factors bundle is then combined with fixed factors to produce value added. The explicit modelling of fixed factors in production is a key feature of the Independent Macro-econometric model and is important in allowing for the role of land supply in the housing services sector and the role of mineral resources supply in the mining sector.

Local production is derived by combining value added and intermediate inputs in fixed proportions, a standard assumption in these types of models. A CES function is also used by firms to produce total supply from local production and imports. A high elasticity of substitution (2) is assumed between local production and imports. Finally, domestic businesses decide whether to sell on the domestic or export market based on a Constant Elasticity of Transformation technology, with an elasticity of transformation of 2.5.

In the short term, the quantity of output produced is determined by demand. Businesses are also constrained by the amount of capital they own. Thus, businesses choose the profit maximising level of labour, imports and exports based on a given level of domestic demand, capital, fixed factors, wages, and trade prices.

Over time, domestic prices adjust to equal marginal cost. In addition, the capital stock gradually adjusts so that the marginal product of capital is equal to its user cost. A Tobin's Q formulation is used to model capital stock adjustment. Importantly, the adjustment speed of domestic prices and the capital stock is estimated from quarterly historical data. This means that over time, the short-term constraints on firms are removed and firms simply maximise profits subject to the production technology.

Government

Governments collect taxes from households and businesses, purchase goods and services on behalf of households, invest in the economy, provide transfers to households, borrow from households, and set monetary policy.

The Independent Macro-econometric model recognises the key taxes collected by government and models their impact on behaviour. For example, the model forecasts revenue collections from the corporate income tax and recognises that corporate income tax affects the cost of capital and thus impacts investment decisions. Other taxes recognised in the Independent Macro-econometric model are labour income tax, production taxes by industry, and product taxes by end user.

Similar to households, the government's inter-temporal budget constraint is met by specifying a target deficit relative to nominal GDP. Labour income tax is the swing fiscal policy instrument and gradually adjusts to ensure that the deficit target is met in the long term.

Monetary policy in the Independent Macro-econometric model mimics how the Reserve Bank of Australia (RBA) pursues its inflation-targeting policy. Specifically, a Taylor rule is used to determine how the short-term interest rate reacts to deviations of inflation and the unemployment from their targets. The inflation target is set to 2.5 per cent, the mid-point of the RBA's target band, while the target unemployment rate is the NAIRU, which is estimated from historical data. The responsiveness of the short-term interest rates to deviations of the inflation rate and unemployment rate from their

respective targets is estimated using historical data from the mid-1990s, since this is when the RBA's inflation targeting regime began in earnest.

Foreign sector

The foreign sector provides funds, demands exports and supplies imports. As a small country, Australia is assumed to be a price taker for imports. However, it is assumed that Australia has some market power in export markets. That is, an increase in the volume of exports supplied by Australia leads to a small reduction in export prices.

Since households and the government meet their budget constraints in the long term, this means that external balance is also achieved in the long term and growth in net foreign liabilities is sustainable.

A.1.2 Market clearing

There are three key types of markets in the Independent Macro-econometric model, the labour market, the goods markets and asset markets. For each, prices adjust to clear the market.

Wages are 'sticky' and gradually adjust to clear the labour market. An inflation-expectations augmented Phillips curve is used to model wage adjustment. In the long-run, wage growth is driven by consumer price inflation and growth in labour efficiency and the unemployment rate settles to the NAIRU.

As noted previously, in the short-term demand drives activity so that demand shocks cause business cycles. Over time, prices gradually adjust to clear the goods market. This means that, in the long term, activity is driven by supply-side factors such as the level of population, participation, productivity and the fixed factor.

In asset markets, the rate of return on capital is determined exogenously since Australia is a small, open economy. For financial assets, the rate of return on long-term bonds is based on the expectations theory of the term structure. Uncovered interest rate parity is used in determining the nominal exchange rate. The underlying assumption is that long-term domestic securities, short-term domestic securities and short-term foreign securities are perfectly substitutable.

A.1.3 Empirical aspects

Behavioural equations in the Independent Macro-econometric model are estimated econometrically from quarterly data starting, in most cases, from the early 1980s. The general-to-specific approach to incorporating dynamic adjustment is used, so that dynamics are fully captured. Diagnostic tests are performed on each estimated equation to check for model adequacy and statistical fit. This high level of data consistency means that the model is not only suitable for policy analysis, but also for forecasting.

A.2 Extensions to the Macro Model

Extending the Macro Model to incorporate semi-endogenous growth involves two separate elements of development work. The first is to explicitly model the link between government education funding and the education attainment of the population. The links between greater education attainment and more favourable labour market outcomes are also incorporated into the model. The second is to extend the firm's production technology to capture the effects of R&D investment on productivity growth.

In addition, the model is extended to capture economies of scale from government investment in public infrastructure. The production technology includes fixed factors, leading to diseconomies of scale. Introducing economies of scale allows the model to provide more robust estimates of the effects of policies, such as migration policies, which change the size of the Australian economy.

The extensions to the model are discussed in the following subsections. The diagram below summarises the structure of the extended Macro Model.

A.2.1 Human Capital Accumulation

An education attainment module is used to estimate the effects on changes in government funding on the education attainment of the population by gender by age. Ten age groups and three education attainment levels are separately identified in the module. These education attainment groups are based on an aggregation of the Australian Bureau of Statistics (ABS) Australian Standard Classification of Education.

Several assumptions have been made to simplify the analysis of human capital accumulation. The main assumption is that there is excess demand for education, so that an increase in education funding by government always results in a boost to the number of students.

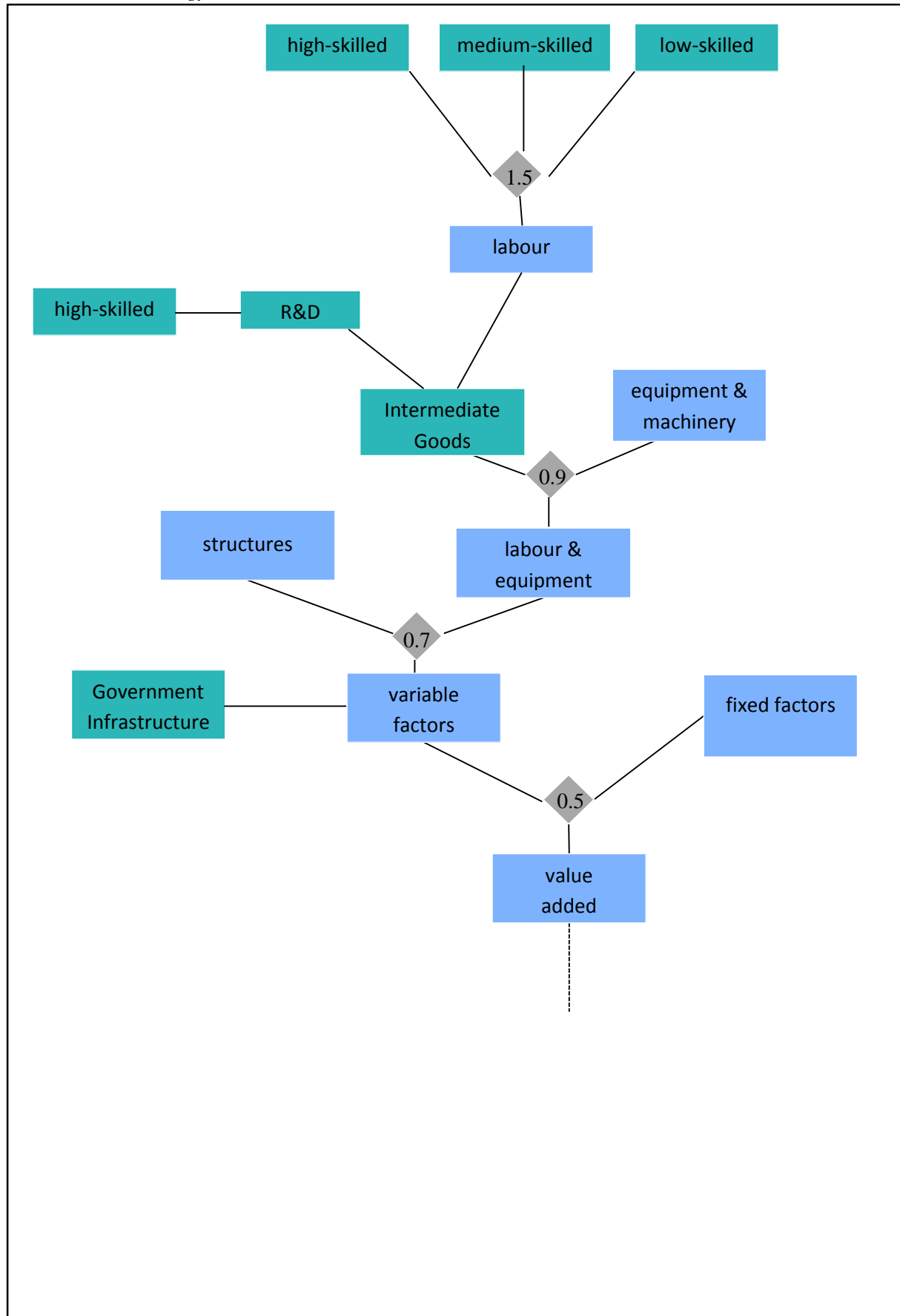
Higher education attainment leads to more favourable labour market outcomes since more educated individuals have: higher participation rates, lower unemployment rates, have greater productivity and work higher hours on average (e.g. more likely to be employed full time). The first three effects are allowed for in the extended Macro Model through the addition of heterogeneous labour. A boost to the number of university educated individuals lead to an increase in the number of high-skilled labour. In the Macro Model high skilled labour have higher participation rates, a lower sustainable rate of unemployment and are more productive than their counterparts.

The standard version of the model has a single type of labour, while the extended Macro Model features three types of labour, high-skilled, medium-skilled and low-skilled labour. The labour types are based on an aggregation of the ABS occupation classification (ANZSCO).

As noted earlier, a boost in the education attainment of the population leads to a lift in the supply of high-skilled workers. The channels through which this occurs are now discussed.

The projection of population by education attainment is converted into a projection of labour force by education attainment by modelling the participation rate for each education attainment level using an error correction model.

Production technology in the extended Macro Model



The labour force by education attainment projection is then converted to a labour force by occupation measure using a matrix of occupation proportions for each education attainment. This assumes that the relationship between education and occupations is fixed. Other approaches allow for some flexibility in the mapping between education and occupations. However, for simplicity that approach is not pursued here.

Notably, the majority of university-qualified individuals go on to high-skilled jobs. While the majority of VET-qualified individuals go on to medium-skilled jobs, a substantial proportion also fills low-skilled jobs.

On the demand side, firms demand each of the three types of workers and combine them into a labour bundle using CES production technology. Thus, the three types of workers are not perfectly substitutable for one another, even after allowing for productivity differences between them.

In the short term, demand for a particular type of labour or occupation depends on that occupation's relative wage and the pattern of industry demand. For example, high-skilled workers are an important input into the Government Services industry, making up approximately 50% of all employment in this industry. A boost in government spending would increase the size of the Government Services industry and hence demand for high-skilled workers. Over time, wages adjust to clear the labour market and the level of employment in each occupation is driven by supply-side factors such as the pattern of education attainment of the labour force. The wage adjustment for each type of labour is modelled as an augmented Phillips curve, while the adjustment from actual to equilibrium labour demand is modelled as an error correction model.

A.2.2 Research & Development

To introduce endogenous growth from R&D into the Macro Model, we broadly follow the semi-endogenous growth approach used by Varga & Veld (2011). This involves extending the model to include a monopolistically competitive “intermediate goods” sector and a R&D sector, which then interact with the labour and machinery & equipment “nest” of the standard Macro Model. The new sectors are discussed in this subsection.

Extended labour and machinery & equipment nest

The labour and machinery & equipment nest now becomes an intermediate goods and machinery & equipment nest. There is a spectrum of differentiated intermediate goods, which are not perfectly substitutable. The number of intermediate goods is determined by the number of patents produced by the R&D sector.

Intermediate goods sector

A spectrum of intermediate goods firms purchase a patent from the R&D sector and then use a unit of the labour bundle to produce a unit of the intermediate good. Since these firms produce a differentiated product that are not perfect substitutes, rents are able to be extracted when they sell the intermediate good to firms in the machinery and equipment nest. Intermediate goods firms are constrained by a production technology where a unit of the labour bundle is used to produce a unit of the intermediate good.

Free entry into the intermediate goods industry drives profits to zero. This implies that the price of a patent is the discounted present value of the monopolistic producers profit flow.

Research & Development sector

This sector uses high-skilled labour to produce patents that are then used by the intermediate goods sector.

In the short to medium term, the profit maximising decisions of firms determine the pace of technological progress. However, in the long term, the pace of growth is determined by growth in the labour supply and growth in the stock of knowledge in the rest of the world, both of which are taken to be exogenous.

This setup is similar to that used by other large scale models to introduce endogenous growth. The Macro Model's approach differs in the following respects. Firstly, other models generally have a single aggregated industry and hence a single R&D sector. In contrast, the Macro Model has five industries which utilise labour and each has its own R&D sector. It is assumed that there are no spillovers across industries. Secondly, the production technology in the Macro Model uses a detailed nested CES structure, while other models use a Cobb-Douglas technology. Balanced growth in a model using the CES production technology requires that innovations are labour augmenting (i.e. Harrod-neutral technical progress).

A.2.3 Government Investment in infrastructure

The standard version of the Macro Model treats the effects of a rise in general government consumption and general government investment in broadly the same manner. That is, general government investment does not result in an increase in the capital stock of the economy. This assumption is relaxed in the extended macro model. Government investment in infrastructure such as transport is capitalised and is incorporated into each firm's production function. In addition, economies of scale in government infrastructure are allowed for by incorporating the presence of fixed costs.

Government infrastructure is introduced in this nesting because it has similar production characteristics to structures and structures forms part of the variable factors bundle. Notably, the chosen production technology means that there are still constant returns to scale in the private factors; a relatively strong assumption. This implementation was chosen because it is one of the more straightforward methods of incorporating the presence of fixed costs and follows the approach used by Ratto et.al. (2008) to allow for overhead labour costs.