Chapter 3

Trade, Employment and Structural Change: The Australian Experience

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International trade produces income gains across the world by facilitating an efficient allocation of production among trading countries. However, increased trade exposure also creates some challenges, and there are adjustment costs associated with changing trade patterns. Effective complementary policies, by promoting flexibility and adaptation within economies, can reduce adjustment costs associated with increased trade, and therefore ensure the benefits are maximised. This paper highlights these issues with reference to recent experience in Australia. Computable General Equilibrium modelling shows how the recent improvement in Australia's terms of trade is likely to have increased incomes and that the magnitude of these gains is directly linked to the degree of flexibility of the economy.

3.1. Introduction

International trade produces income gains that accrue across nations by facilitating an efficient allocation of production across the world.[1] However, communities and policy makers are often concerned about the effect that international trade might have on particular *domestic* industries, and the amount of employment. Traditionally, the debate has focused on the potential loss of domestic jobs in import-competing industries following trade liberalisation. But similar considerations arise when a country is already open to international trade, and the forces for structural adjustment stem from changes in world prices.

Trade and trade policy have not, of themselves, been found to have significant effects on employment in aggregate. Essentially trade policy allows a country to move along its production frontier to maximise returns from international exchange. As Krugman (1993) notes:

… the level of employment is a macroeconomic issue, depending in the short run on aggregate demand and depending in the long run on the natural rate of unemployment, with microeconomic policies like tariffs having little net effect. (p. 25)

That said, if trade openness were to promote increased national aggregate productivity, it could expand a country's production frontier. Interactions between trade shocks and labour market settings also have possible implications for aggregate employment. There is the potential for complementary policies (such as policies relating to the labour market) to affect the outcome of trade policies across several dimensions, but especially with regard to associated adjustment costs.

Openness to international trade in Australia has been increased by reducing barriers to imports while simultaneously implementing a range of competition-enhancing reforms domestically. Australia's trade intensity has nearly doubled over the past 50 years through increased integration with trading partners. Reforms have contributed to growth in real incomes, and international trade has been an important contributor to Australian income growth, most recently through an improvement in terms of trade.

At the same time, increased trade exposure and external shocks have created some challenges. Large changes in the relative prices of exports and imports are responsible for some recent adjustment pressures.

The purpose of this paper is to illustrate the mechanisms that link trade, income and employment in Australia. A framework section is followed by an overview of the Australian experience. Various modelling approaches have been used to estimate the likely contribution of liberalisation, and of the recent rise in Australia's terms of trade, to incomes and sectoral employment changes, and the role of flexibility in facilitating the structural changes required to reap the benefits of trade. Computable General Equilibrium (CGE) modelling – including a study developed for this paper – shows how the recent improvement in Australia's terms of trade is likely to have increased incomes and that the magnitude of these gains is directly linked to the flexibility of the economy.

3.2   Links between trade and employment – framework

Trade allows countries to specialise in the areas in which they have a comparative advantage – that is, where the opportunity costs of resources are lowest. Specialisation leads to an increase in activity and employment in the export sector. At the same time, consumers can purchase imported commodities at lower prices than if trade were restricted.

Trade liberalisation triggers a restructuring process, which causes some jobs to be lost, and new ones to be created (ILO and WTO, 2007). Specialising in the areas of comparative advantage shifts resources to their most productive use, increasing the value of aggregate production and incomes. Openness to trade (and competition from foreign firms) also encourages producers to search for more efficient production processes, and can improve their future prospects.

A reduction in import price and an increase in export prices both contribute to increasing real incomes, although they can require significant adjustments. Notwithstanding the benefits of liberalisation and of terms of trade improvements, the induced contraction of some sectors and the expansion of others in response to price signals involve adjustments (Box 3.1). Factors of production such as buildings and machinery either need to be put to other uses or written off. Workers who become unemployed need to be able to move to other jobs. That said, trade is not the only cause of structural change – improvements in technology, changes in demography and consumer tastes, etc also contribute to continuous structural change.

Box 3.1. Income and adjustment effects of a mining boom

The recent expansion in Australian mining activity has revived interest in the sectoral and employment effects of growth in export industries. In an early contribution, Gregory (1976) examined the effect of new mineral discoveries on a 'traditional' (rural) export sector and an import competing sector. Work in this area was extended by Snape (1977), Corden and Neary (1982) and Cook and Sieper (1984), among others, and is relevant to the analysis of the effects of new mineral discoveries, as well as of changes in the terms of trade.

The forces behind the structural adjustment to a resource boom can be reduced to expenditure and resource reallocation effects, which are effected via changes in real exchange rate and relative price signals:

- The expenditure effect arises from the increase in real income due to the new discovery or terms of trade improvement. Some increased income is directed to expenditure on non-traded goods. As a consequence, the real exchange rate appreciates and puts pressure on the other parts of the economy, especially the non-booming traded sector.

- The resource movement effect arises from resources (labour and capital) moving into the mining sector in response to increased returns in that sector and into the non-traded sector as a result of its expansion.

The contraction in non-mineral exports and import-competing industries is often referred to as the "Gregory thesis", "de-industrialisation", or "Dutch Disease" (named after the perceived effects on manufacturing in the Netherlands following the discovery of North Sea gas in the 1970s).

In practice, structural adjustment takes time and is not costless. Many factors can hinder labour mobility, particularly in the short run. These can include various barriers to geographic mobility (for example, relocation costs) or limited transferability of skills across and within sectors (resulting in re-training costs). Inflexible or distorted prices can also affect the speed and degree of adjustment, by preventing prices from transmitting vital signals to buyers and sellers. In turn, this hinders the ability of resources to move to areas in which they can be used most productively, reducing efficiency and the potential gains from trade.

3.3   The Australian experience

Increased 'interconnectedness', decreasing transport costs and trade and travel market liberalisation have all contributed to opening of the Australian economy, and led to significant changes in the structure of its trade, output and employment.

Trade: volumes, assistance and prices

Australia's linkages with overseas economies have steadily increased (Figure 3.1). Over the past 50 years, Australia's trade intensity (the ratio of exports and imports to GDP) has nearly doubled, increasing from around 25% of GDP in 1975 to over 45% by 2010.

Figure 3.1. Australia's trade in goods and services, 1976–2010
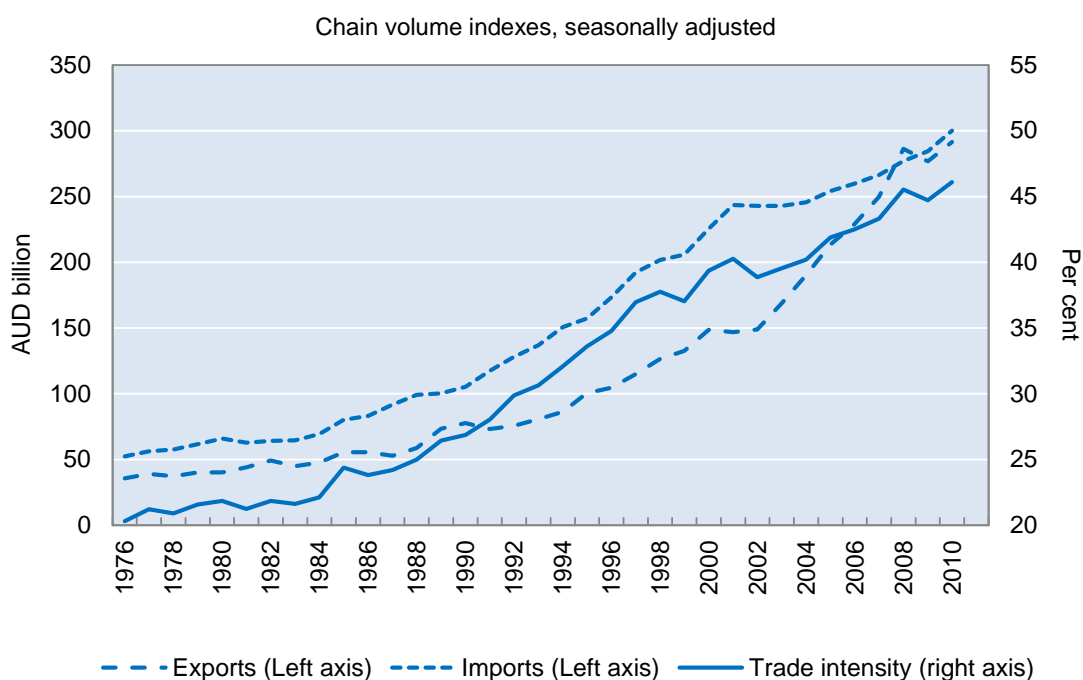
Chain volume indexes, seasonally adjusted

Source: ABS (Balance of Payments and International Investment Position, Australia, Cat. no. 5302.0); ABS (Australian System of National Accounts, Cat. no. 5204.0); World Bank (2011).

Unilateral liberalisation

Australia's trading system in the immediate post-Second World War era was one of high regulation, involving the use of policy tools such as tariffs, quotas, price controls, and production subsidies to protect import-competing firms from international competition (Snape, Gropp and Luttrell 1998).

In July 1973, a 25% tariff reduction across the board marked the beginning of a move to a more liberal trading regime. While followed by some reinstatement of support to certain industries, the trend towards liberalisation and deregulation resumed in the 1980s, with sustained reductions in effective rates of assistance for manufacturing and agriculture (Figure 3.2).

Figure 3.2. Effective rates of assistance[a,b], 1970-71 to 2009-10

Percentages
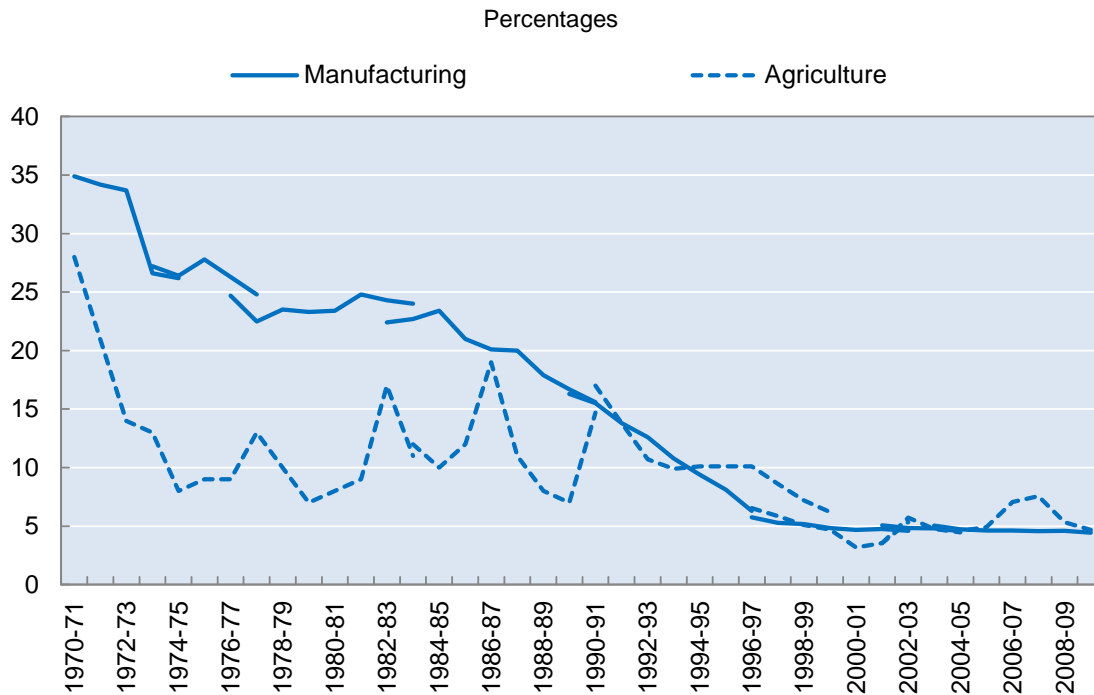
a) The effective rate of assistance is defined as the net assistance received per dollar of value added.
b) Overlapping observations arise from revisions to industry input and output measures used to estimate effective rates.

*Source*: PC (2011).

Terms of trade: recent improvements

A great deal of attention in Australia has focused on the recent expansion in mining activity brought about largely by China's growth. This has been associated with a large rise in Australia's terms of trade, to historically high levels, driven by increases in demand for exports (combined with a slow supply response), and decreasing import prices. The terms of trade improvements are larger than many other external shocks experienced post WWII, such as previous commodity price booms, the Asian Crisis in 1997, and the 2008 Global Financial Crisis (Figure 3.3).

Since 2004, there has been a sustained increase in the prices of Australian minerals. The prices of many Australian consumer imports have also declined over the past ten years (Figure 3.4). The "China effect" – the combined increase in demand for Australian exports and decrease in the cost of Australian imports – has been a major source of change in the structure of prices for Australian producers and consumers: the price of exports increased nearly 20%, and the price of imports fell nearly 10% (adding up to a 30% improvement in the terms of trade).

Figure 3.3. Australia's terms of trade, export and import prices, 1959 to 2011

Goods and services, seasonally adjusted, 2008-09 = 100

Panel A. Terms of trade
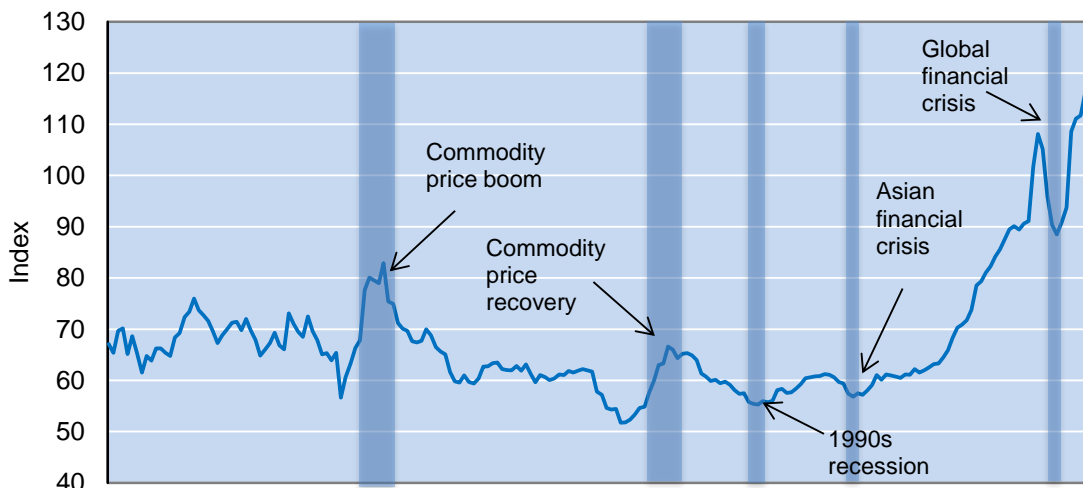
Panel B. Import and export prices
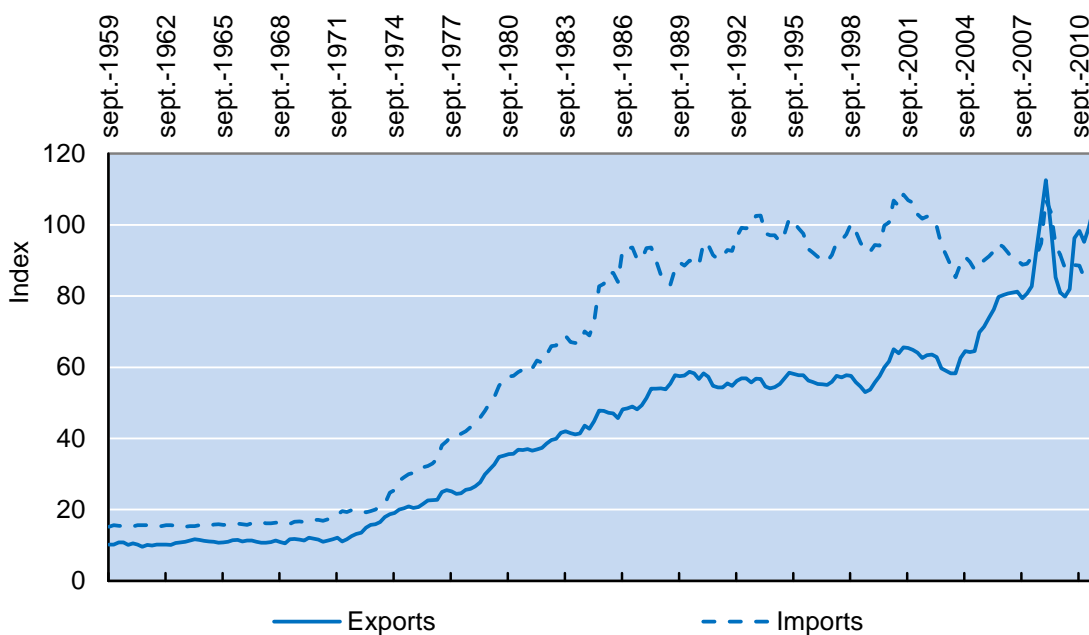
Source: ABS (*Australian National Accounts: National Income, Expenditure and Product*, Cat. no. 5206.0) and Treasury (2002).

Figure 3.4. Selected export and import prices, Sep 1974 to Mar 2011

2008-09 = 100

Panel A. Export prices

Panel B. Import prices

Source: ABS (*Balance of Payments and International Investment Position, Australia*, Cat. no. 5302.0).

Employment and wages

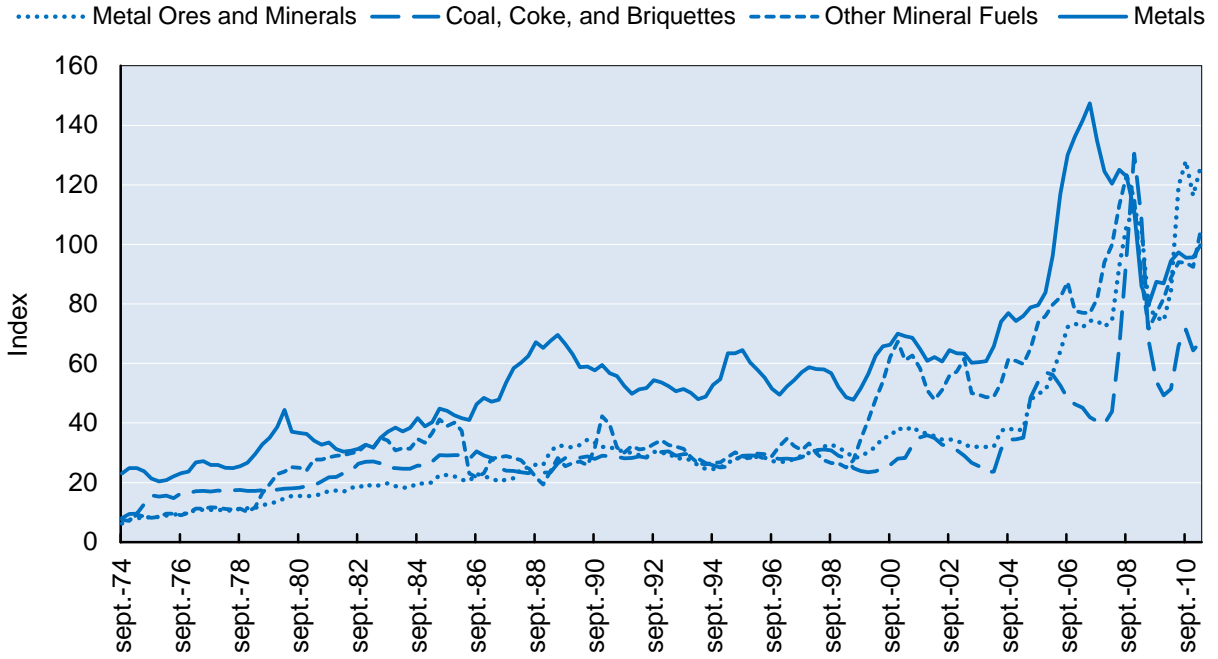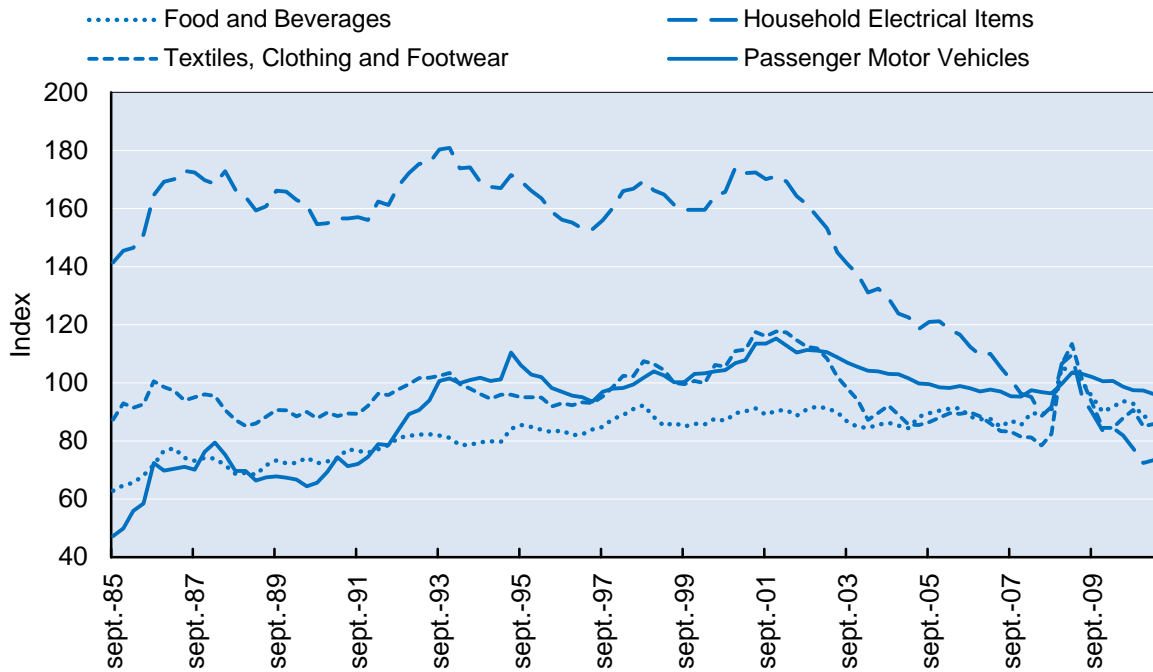Over the liberalisation period, aggregate employment has grown, and the structure of employment has changed (Figure 3.5, Panel A). Since 1984, employment has declined by around 10% in manufacturing, has more than doubled in mining, and has increased by 40% in services, which now accounts for over 80% of Australia's total employment.[2]

Since 2005-06, real wages have grown about 3% annually in mining, and more slowly in manufacturing and services (about 0.5% annually; Figure 3.5, Panel B).

3.4. Structural change and flexibility

The composition of the Australian economy has changed markedly over the past century. In the early decades of the twentieth century, more than 20% of Australian workers worked in the agricultural sector of the economy (Figure 3.6), another 20% were employed in the production of manufactures, and about half were employed in services.

As Australia's economy has developed and incomes have grown, services have become a greater part of the consumption bundle and a greater source of employment. At the same time, the share of agricultural employment has declined. Post WWII to the late 1960s, the share of manufacturing employment was roughly stable. Since the early 1970s, the share of manufacturing employment has been on a downward trend. Today, services account for the overwhelming majority of jobs. Similar trends are observed in relation to the contribution of the various sectors of the economy to total output (Figure 3.6). The rising importance of services in the economy and the relative decline of other sectors is a natural consequence of generally rising incomes, an experience shared by many other economies in the OECD (Görg, 2011).

Indicators of structural adjustments and mechanisms by which these occur include:

- Each year around 300 000 new businesses are created, and a similar number cease to exist (ABS, 2010a).

- As at February 2010, nearly two million workers (or almost 20% of a workforce of around 11 million) had been with their current employer or worked in their current business for less than 12 months; of those, almost 550 000 had changed the industry in which they worked relative to their previous job (ABS, 2010b).

Noting these data, the Secretary of the Australian Treasury observed:

Just as Australia is an economy in transition, the business and people who succeed are those that embrace and adapt to changing circumstances (Parkinson, 2011, p. 24).

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2. Part of the reduction in employment in manufacturing is attributable to a statistical artefact linked to increased outsourcing since the 1990s. For example, prior to the 1990s, many manufacturing firms employed accountants who were counted as part of manufacturing employment. Since then, many manufacturing firms have outsourced their accounting to external accounting firms whose employees are counted as part of the services sector. A similar trend has occurred for many other functions including logistics, warehousing and engineering.

Figure 3.5. Employment and real wages, by sector, Australia, 1994-95 to 2010-11[a]

Total employed persons

Panel A. Employment

Panel B. Real wages[a]
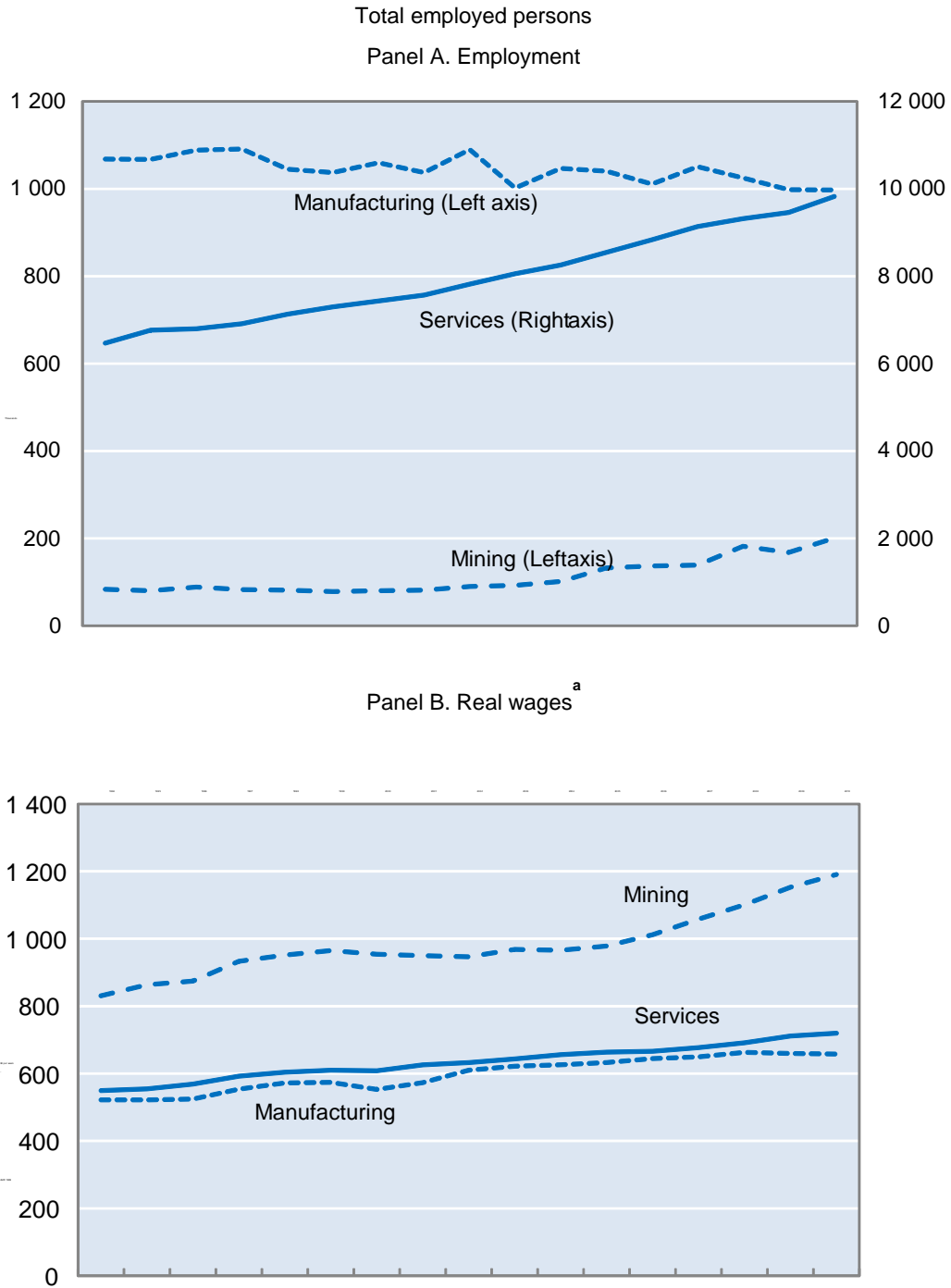
a) Average weekly adult ordinary time earnings deflated by the consumer price index. Average across 16 service industries.

Sources: ABS (*Labour Force, Australia, Detailed, Quarterly*, Cat. no. 6291.0.55.003); ABS *(Average Weekly Earnings, Australia*, Cat. no. 6302.0; *Consumer Price Index, Australia*, Cat. no. 6401.0).

Figure 3.6. Composition of Australian employment and output, 1962-63 to 2010-11

Sectoral shares of total employment and output [b, c]

Panel A. Employment [a]

Panel B. Output [b,c]

■ Agriculture   ■ Mining   ■ Manufacturing   □ Services
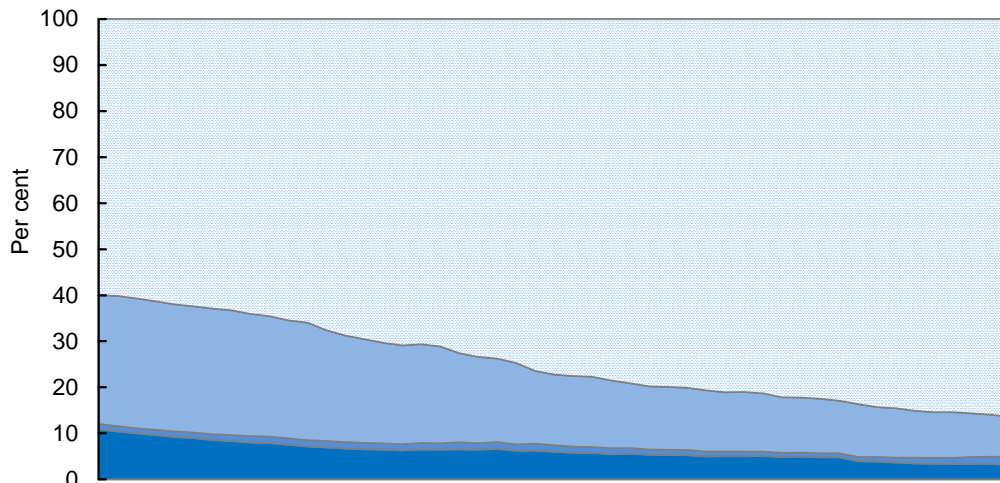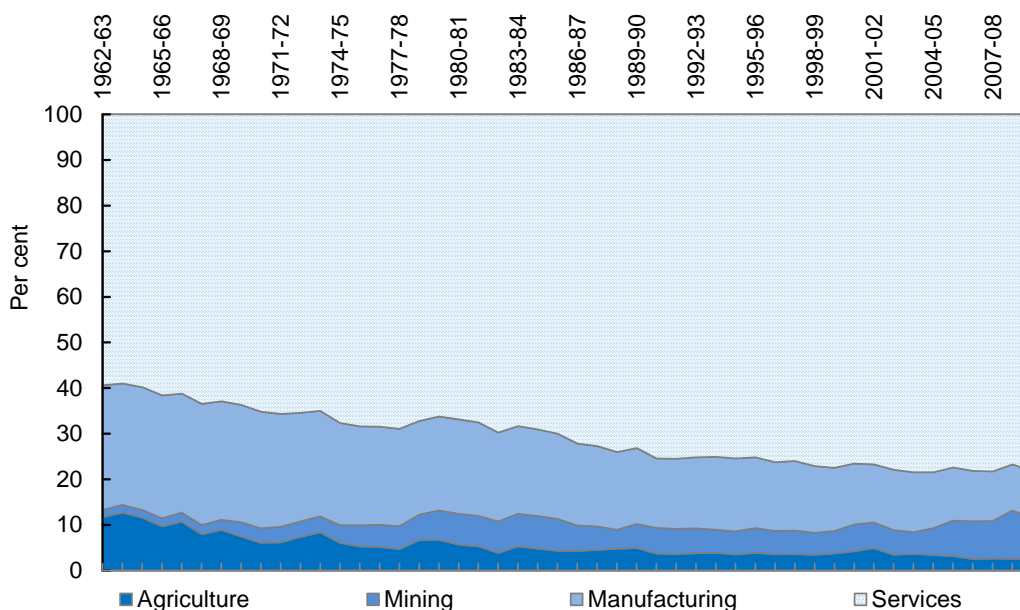
a) Data from 1962-63 to 1980-81 based on Withers, *et al.* (1985); for 1981-82 to 1984-85, data based on Foster (1996); from 1985-86, annual averages from ABS.

b) Share of sectoral value added in GDP less ownership of dwellings and taxes and subsidies, current prices.

c) Data from 1962-63 to 1988-89 based on Foster (1996); from 1989-90 onwards, based on ABS.

Sources: ABS (*Australian System of National Accounts*, cat. no. 5204.0); ABS (*Labour Force, Australia, Detailed, Quarterly*, Cat. no. 6291.0.55.003); Foster (1996); Withers, *et al.* (1985).

Facilitating structural change and minimising adjustment costs

When resources are reallocated according to market price signals, they are directed to their most highly valued activities, yielding income gains to an economy. However, structural adjustment can be costly, requiring substantial retraining, relocation, and administrative costs (Francois *et al.,* 2011). Flexibility in prices and resource movements can minimise the costs of adjustment.

The wide-ranging program of economic reform in Australia in the 1980s and 1990s included the floating of the dollar in 1983, deregulation of the banking sector, phased reductions in tariffs and other industry assistance, reforms of government business enterprises and deregulation of the labour market (IC, 1998). These reforms enhanced the flexibility and dynamism of the Australian economy and improved its ability to adapt to change (Downes and Stoeckel, 2006).

Labour can be limited in its ability to move between sectors and regions, incurring adjustment costs as it moves across the economy. Costs are associated with acquiring new skills and qualifications, relocation, and finding new employment. Sometimes, displaced workers take on lower paid jobs as they move across sectors, particularly if the cost of moving to another jurisdiction is high.

Some costs are inherent to structural adjustment and largely unavoidable. For example, there are always costs associated with relocating. Well-designed labour market policies can facilitate adjustment by reducing the costs of labour mobility, both across occupations and regions (Francois *et al.,* 2011). Efforts have been made to reduce inherent costs associated with adjustment, for example training and adjustment assistance, and policies designed to help the unemployed find work (Box 3.2).

Further efforts have been made to reduce policy-related labour market rigidities. In Australia, reforms encouraging wage flexibility, and addressing impediments associated with in regulatory arrangements, have reduced such adjustment costs.

Box 3.2. Unemployment services in Australia

In Australia, subsidised employment services are provided to the unemployed to help them find work. These services are particularly targeted at disadvantaged groups. Up until 1998, this service was provided by the Commonwealth Employment Service, a government agency. This service is now funded through Job Services Australia and for-profit, not-for-profit, and potentially, government owned agencies can compete for contracts. Centrelink, which also manages welfare benefits, was established as the government agency responsible for administering the system.

The Productivity Commission found that the 'purchaser-provider' model reduced the cost of service without affecting client outcomes. The network provides incentives for providers to match clients with suitable employment and training.

Source: Department of Education Employment and Workplace Relations 2011, PC 2002.

Policy settings in the current mining boom

The current mining boom in Australia has seen Australia's nominal exchange rate appreciate considerably as higher demand for exports puts pressure on the real exchange rate to appreciate. Flexibility of the exchange rate and in wages during this boom have contributed to lessening some of the adjustment costs relative to those experienced in previous booms.

As Battelino (2010) and Banks (2011) have observed, in earlier mining booms (in the 1960s and 1970s), the required appreciation of the real exchange rate occurred via an increase in domestic prices. Increasing prices reduced the competitiveness of Australian goods, reducing net

exports until a new equilibrium was attained. Labour and other resources were reallocated to expanding sectors, even though the wage setting system was much less flexible than it is today, and wages could not vary as easily across industries, occupations and time. With fixed nominal exchange rates and relatively constrained nominal wage adjustments, short-term adjustments were magnified. There were large expansions of the sectors participating in the booms, and correspondingly large contractions of others, which ultimately were partly reversed by increases in Australian domestic prices. Flexible exchange rates, by directly changing the relative prices of traded and non-traded goods and services, better facilitate the efficient movement of resources across sectors, avoiding magnified short-run responses and consequent readjustments.

A more flexible wage system has facilitated the movement of labour to expanding sectors. Connolly and Orsmond (2011) argue:

> *The consequences of the mining booms in the 1970s and early 1980s for inflation were magnified by the wage fixing system, which tended to transmit demand pressures in one sector to wages across the economy through the principle of comparative wage justice ... In contrast, the replacement of the centralised wage system with more deregulated wage structures has enabled a rise in mining industry wages in the 2000s to be contained from the wage structure across the economy. ... the economic reforms undertaken by Australian Governments since the 1970s to deregulate product markets have improved the ability of the economy to flexibly respond to mining booms and relative prices more broadly ... lower trade barriers have given households and businesses greater access to global markets to satisfy the extra demand generated by the mining boom. (pp. 37–38).*

Labour market flexibility has been associated with increased employment, hours worked and labour productivity. Changes in external conditions have increased the interest of employers in market and regulatory structures that enabled them to make differentiated labour market responses (Wooden, 2001). These changes have not been associated with declines in job security. Wooden (1998) found that in 1998 on average, workers had been in their current job longer and the proportion of persons in short-term jobs had declined relative to 1975.

Greater flexibility in foreign exchange, labour, and product markets have therefore enabled Australia to better capture benefits from the boom while avoiding some of the adjustments that have arisen in the past.

The benefits afforded by flexibility are not limited to events such as mining booms and terms of trade increases. It can improve the ability of the economy to respond to shocks – positive and negative – from other sources. The Reserve Bank of Australia's Assistant Governor, has attributed part of Australia's success during the Global Financial Crisis to the flexibility built in the Australian economy:

> *When demand weakened, many firms and their employees agreed to reduce working hours as a way of preserving jobs. And in other cases, wage rises were reduced or delayed as a way of avoiding layoffs. These responses helped limit the rise in the unemployment rate. (Lowe 2010, p. 2).*

Structural adjustment and "Dutch disease"

Some argue that, although the mining boom offers Australia an opportunity to enjoy higher real incomes, it has detrimental long-term effects on industries, such as manufacturing, that are adversely affected by the real appreciation. That is, Australia might be afflicted by "Dutch disease". Dutch disease refers to the possibility of a diminished role for manufacturing in a country following the discovery of, or increased demand for, a country's natural resources. However, as Banks (2011) has observed:

> *... if and when the mining boom comes to an end, there will be forces within our economy that will automatically favour other traded industries again. (p. 11)*

For example, were demands for Australia's mining commodities to fall in the future, the exchange rate would depreciate, and other export industries and import-competing industries would experience an increase in their competitiveness. The varied nature of the Australian manufacturing sector means that even in the event of certain industries disappearing entirely, other industries in the manufacturing sector could expand in response to those terms of trade movements. Flexibility would be important in responding to such a development – ensuring that resources could easily be directed to alternative uses, allowing for a smooth transition to new production and employment activities.

It has also been argued that due to the ephemeral nature of sudden increases in demand, the manufacturing sector needs to be protected to prevent major capital shedding (both in terms of physical and human capital), enabling the industry to return to previous levels of output when the boom recedes. However, it could also be argued that a better approach would be to remove barriers that limit productivity and the movement of factors, and implement policies that minimise the adjustments associated with the structural changes that are required to adapt to the changes in economic environment.

Attempting to limit Dutch Disease

Attempting to prevent the movement of resources towards mining and related activities – where they are currently highly valued – has the potential to be costly. It would require Australia to forgo part of the increases in aggregate income.

The increase in income as a result of the resource boom provides scope for redistribution through the tax system. Increased labour and capital income throughout the economy increases government revenues, through income taxes and taxes that relate to economic activity (such as goods and services taxes). In Australia, given significant foreign ownership in the mining sector, taxes on mining incomes are an important means of increasing national income. Additional tax revenue allows increased government expenditure; some of which (for example education and health expenditure) has strong redistributive characteristics.

Holding resources in industries under threat from import competition comes at the cost of foregoing the benefits that arise from the reallocation of resources toward expanding sectors.[3] This is in addition to costs such as higher consumer prices for imported goods, and possible longer-term effects such as reduced incentives for innovation due to weaker exposure to competition.

3.5. Links between trade and employment - evidence

This section draws on various studies – including one developed for this paper – that use modelling techniques to explain the likely influence of trade on employment outcomes, income and the structure of the economy. The studies are divided into two types: econometric studies that identify statistical associations that confirm theoretical hypotheses and CGE studies that make strong assumptions about economic structure and behaviour to explain the likely links between trade, income and employment. The CGE studies are also used to illustrate the

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[3]. This analysis is complicated if there are varying degrees of foreign ownership across industries. Given the relatively small deviations between industries in the share of factor incomes that flow to foreigners, this impact is likely to be small.

importance of flexibility, particularly in labour markets, in maximising the benefits flowing from changes in external conditions.

Import competition, trade and employment

Gaston (1998) used a regression framework to estimate how reductions in assistance to manufacturing have affected employment in the sector. Using data for twelve manufacturing industries for the period 1973-74 to 1991-92, Gaston estimated that a 10% reduction in the effective rate of protection was associated with a 1% reduction in manufacturing employment.

The Productivity Commission (2003) used Gaston's parameters to estimate the effects of trade on manufacturing employment over a longer timeframe. The overall effect of trade on employment was computed as the sum of effects from export and import growth and from reductions in the effective rate of assistance.[4] These changes were estimated to reduce manufacturing employment by around 20% from 1969-70 to 2001-02. The bulk of this was attributable to a growth in imports mainly due to decreases in import prices, rather than through reduced assistance.

Felbermayr *et al.* (2009) seek to answer whether trade openness affects the long run rate of unemployment. They conclude that openness to trade is associated with a lower rate of structural unemployment. In the preferred regression, a 10% increase in trade openness is associated with a one percentage point reduction in the unemployment rate.

This result is consistent with the possibility that trade openness lowers unemployment via productivity improvement. If greater exposure to trade induces low-productivity import-competing firms to shut down and high-productivity firms to expand, economy-wide productivity will increase, raising the incentive for firms to increase hiring. Recent theoretical work supports the link between trade and productivity. For example, in the Melitz (2003) model of firm heterogeneity, trade exposure eliminates low-productivity firms and induces high-productive firms in an industry to export. These reallocations lead to industry-wide productivity growth.

Gaston and Rajaguru (2011) relate changes in unemployment to changes in the terms of trade, controlling for other factors, using annual Australian data from 1960 to 2008. They find a 10% improvement in the terms of trade is associated with a fall in the unemployment rate of approximately one percentage point. Though it might be tempting to interpret this as a direct link between trade and aggregate employment, labour market settings are likely to have contributed to this result.

Trade and structural adjustment

Dixon and McDonald (1993) investigated the causes of structural change in the Australian economy between 1986-87 and 1990-91, some way into the program of liberalisation. Their analysis supports the hypothesis that trade contributed a significant proportion of structural change in Australia over the period. The authors used the ORANI model of the Australian economy to attribute changes in the economy to a dozen sets of potential influences, such as changes in productivity and in consumer preferences,[5] changes in tariffs and other forms of assistance and changes in external conditions (foreign demands and supplies). The contributions

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4. The inclusion of trade flows and protection measures in the regression is justified on the basis that changes in protection may have effects on employment other than those occurring directly through trade flows.

5. These changes represent changes in demand and supplies that cannot be accounted for by observed changes in prices, incomes, etc and the algebraic and data structure of the model.

of the latter to changes in sectoral outputs experienced during the period are summarised in the first column of Table 3.1. The other influences are aggregated in the second column.

Between 1986-87 and 1990-91, changes in foreign demands and supplies – that is, shifts in export demands and import supplies – are estimated to have contributed to reducing output in the agricultural, transport equipment, textiles, clothing and footwear industries. Changes in foreign demands and supplies are estimated to have contributed to the growth of construction and other services.

Table 3.1. The contribution of trade to structural change

Sectoral output, percentage changes, 1986–87 to 1990–91

Sector	Shifts in foreign demands and supplies	Other influences [a]	Total change
Agriculture, forestry, fishing	-24.2	28.9	4.7
Mining	7.0	23.5	30.5
Food processing	1.4	3.9	5.2
Textiles, clothing, footwear	-12.7	8.2	-4.5
Wood products	7.0	3.7	10.7
Chemicals, oil	-2.3	12.5	10.2
Non-metal manufactures	5.5	-11.4	-5.9
Metal manufactures	5.4	5.6	11.0
Transport equipment	-19.4	12.3	-7.1
Other machinery	-0.9	8.2	7.4
Other manufacturing	-0.6	7.0	6.4
Utilities	4.9	13.4	18.3
Construction	6.3	-3.7	2.6
Trade, transport, communication	7.2	7.7	14.9
Services	6.4	6.5	13.0
Total	3.4	8.8	12.2

a) "Other influences" includes changes in: consumer preferences and productivity, industry assistance and compositional changes in exports and agriculture.

Source: Dixon and McDonald 1993.

Modelling the recent terms of trade improvements

Several recent studies have used the Monash Multi-Regional Forecasting (MMRF) model (Box 3.3) to estimate the likely impacts on the Australian economy of the recent terms of trade improvement. The modelling isolates the effects of the changes in the terms of trade from any other effects, such as economic and population growth, or changes in technology or productivity that are not related to the modelled changes, for example. The modelled changes can be interpreted as the contribution of the changes in the terms of trade to the observed economic outcomes, as in Dixon and McDonald (1993).

In most applications presented in this section, the MMRF model is used in 'dynamic' mode. However, the results are interpreted as the effects of the modelled changes under different assumptions about adjustments, especially in labour markets. In particular, results labelled 'short run' are interpreted as the effects of the modelled shocks in an environment in which wages cannot adjust quickly and adjustments to capital stocks are not completed. Conversely, results

labelled 'long run' are interpreted as the effects of the modelled changes when there are few impediments to adjustments in capital stocks and to changes in real wages.

Box 3.3. The MMRF model

The MMRF model was developed by the Centre of Policy Studies at Monash University. It is used by many organisations and academics in Australia.

The MMRF model is a computable general equilibrium model of the Australian economy. The model treats each of the six states and two territories as a separate economy, linked by inter-regional trade matrixes. It is a 'bottom-up' model, which includes a range of industries, commodities and labour types, aggregated to produce macroeconomic results. The model includes a representative household and government in each region, as well as the Australian government. Foreign demands are represented by downward sloping export demand curves, and import prices are given. MMRF also accounts for state and territory taxes, including income and payroll taxes, the GST, excise and other commodity specific taxes and tariffs.

The version of MMRF used in this project includes 58 industries, 63 commodities and nine labour types. The model was run in dynamic mode and the reported effects are in terms of percentage deviations relative to a baseline. The main dynamic adjustment mechanisms are that:

- Real wages are sticky in the short run and adjust through a partial adjustment mechanism to bring long-run employment back to base over a 10 year period.

- Capital stocks grow in line with expected rates of return, and investment demand is driven by the change in capital stock (allowing for depreciation). An adjustment process allows for short-run disequilibrium in the rate of return on capital.

The original database (2004-05) was updated to 2009-10 using a range of data sources (for example, employment data, gross state products, and industry shares).

The equations used in Adams (2010) were modified.

- To model changes in the price of exports individually, individual export demand curves were allowed to move in response to observed changes in export prices.

- Movements in foreign and inter-regional migration were also included. Foreign migration was connected to movements in the real wage, and interstate migration driven by the difference between region-specific real wages (which move with the level of state and territory employment) and the national, average real wage. These population movements were linked to movements of the regional labour supply.

Scenarios with limited labour market flexibility were also examined by constraining movements in foreign and inter-regional migration additions.

Source: Appendix 3.A1.

The simulations reported below model various versions of the recent terms or trade improvement. The main difference between them is in the degree of flexibility allowed for resources to adjust to the modelled shocks. The simulations do not produce forecasts, but are rather experiments designed to isolate the effects of the modelled shocks under various assumptions about the environment in which they are assumed to occur.

Fixed resources at the industry and regional level (Assumption 1)

The Victorian Department of Treasury and Finance (2006) modelled the short-run effects of an expansion in the demand for Australian resource exports with the MMRF model. The modelling assumed that industry-specific capital, regional labour supplies, and regional real wages were fixed. Labour outcomes were determined by movements in unemployment.

This simulation isolates the effects of a terms of trade movement assuming extreme rigidity in the economy: neither labour nor capital can be reallocated to the industries or regions where

they are valued most highly. This set of assumptions produces decreases in projected real GDP, exports, and employment relative to the base case. The immobility of factors prevents the reallocation of resources toward export intensive industries, and non-commodity export industries are unable to reduce their production and employment in response to the exchange rate appreciation. The inability of exports to expand reduces the potential for income increases.

More flexibility (Assumption 2)

McKissack *et al.* (2008) used MMRF to illustrate the short-run impacts of a rise in the terms of trade on the domestic economy, fixing aggregate labour supply by region, and keeping capital stocks fixed within each region.

Under these more flexible labour market assumptions, the simulated 20% improvement in the terms of trade raises GDP by approximately 0.3%.

Because the simulation involved modelling an increase in coal and iron ore prices, these two industries expand, as does domestic income. The construction industry also expands, because (i) it is an input into iron and coal production, (ii) it is an important input to investment in these expanding sectors, and (iii) increased domestic incomes drive increases in consumption. The retail sector expands in several states – generally those where mining is concentrated – and contracts in others, where income effects are projected to be smaller, and from which workers migrate to the mining states. In this simulation, the manufacturing sector was projected to decline as fixed national resources were reallocated to other sectors.

Impact of labour mobility

In its Review of Mutual Recognition Schemes (PC 2009) the Productivity Commission used CGE modelling to illustrate the potential benefits of labour flexibility in the context of a hypothetical improvement in the terms of trade. The exercise involved two simulations. In the first, a 10% increase in export prices of mining commodities was applied to an economy in which all labour was perfectly mobile. In the second simulation, labour in several skilled occupations was prevented from moving across jurisdictions.[6] The modelled increase in commodity prices produced larger increases in GDP and average real wages when labour was fully mobile. Labour mobility also played an important role in distributing the benefits of the resource boom across Australia, moderating the growth in wages in booming jurisdictions, and increasing it elsewhere (PC 2009).

Unpacking flexibility assumptions (Assumption 3 and Assumption 4)

In the context of this project, the MMRF model was used to illustrate the short- and long-run effects of the observed behaviour of export and import prices from 2006 to 2010 on the Australian economy. Specifically, the impact of the equivalent of a 30% increase in the terms of trade on short- and long-run incomes and employment was modelled. Table 3.2 summarises the inputs used. Appendix 3.A1 contains a description of the version of the MMRF model and of the shocks used, and a detailed description of model results.

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[6]. This barrier to cross-border mobility was assumed to simulate the absence of mutual recognition of some registered occupations by Australian jurisdictions.

Table 3.2. Summary of shares and modelled changes in export and import prices[a]

% and percentage changes

Sector	Exports		Imports	
	Share	Price change	Share	Price change
Agriculture	25.2	-2.4	6.3	23.1
Mining	56.4	42.3	7.7	15.7
Manufacturing	18.4	-16.3	86.0	-12.6

a) Aggregated to broad sectors. Shocks were applied at the commodity level. See Appendix 3.A1.

Source: Commission estimates.

The improvement in the terms of trade is projected to increase domestic incomes. In the short run, the expansion in the output of exporting industries increases employment without a significant effect on wages due to assumed short run wage stickiness. Labour moves to regions and industries where it is most highly valued, principally exporting industries. This is driven in particular by expansions in construction, as resources projects enter the construction phase to accommodate the required expansion of the mining sector. Employment increases by 225 000 full-time equivalent workers, and domestic incomes rise by approximately 6% (Figure 3.7). In the long run, wages increase and employment returns to its long-run level. Real wages increase by over 10%, and the shares of both mining and services in the Australian economy increase. The increases in labour income drive increases in tax revenue collections, resulting in an increase in the government net operating balance. The employment share of services in the economy increases, driven principally by health, education and personal services. Traded services, such as tourism, contract as a share of total employment as a result of the terms of trade movement.

Figure 3.7. Labour market outcomes

Percentage changes relative to base
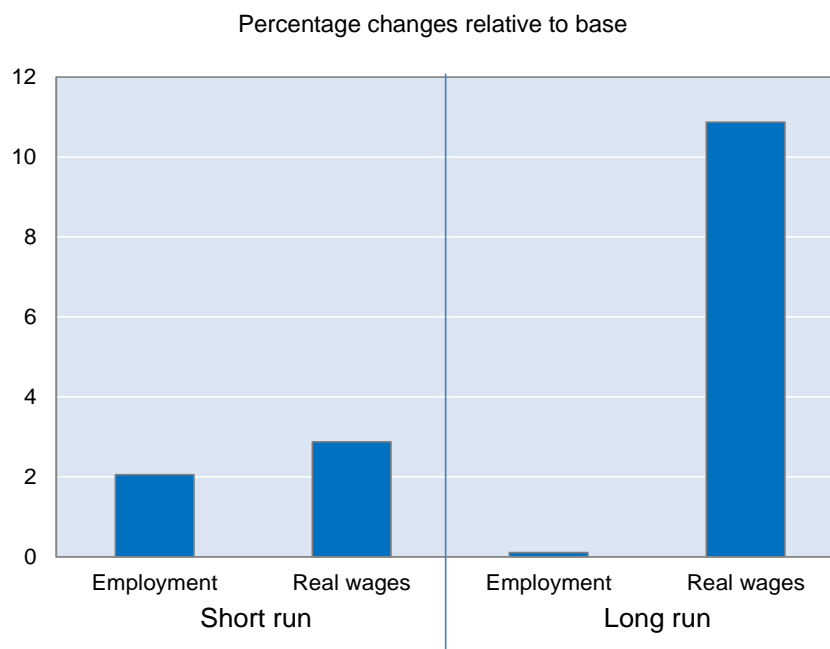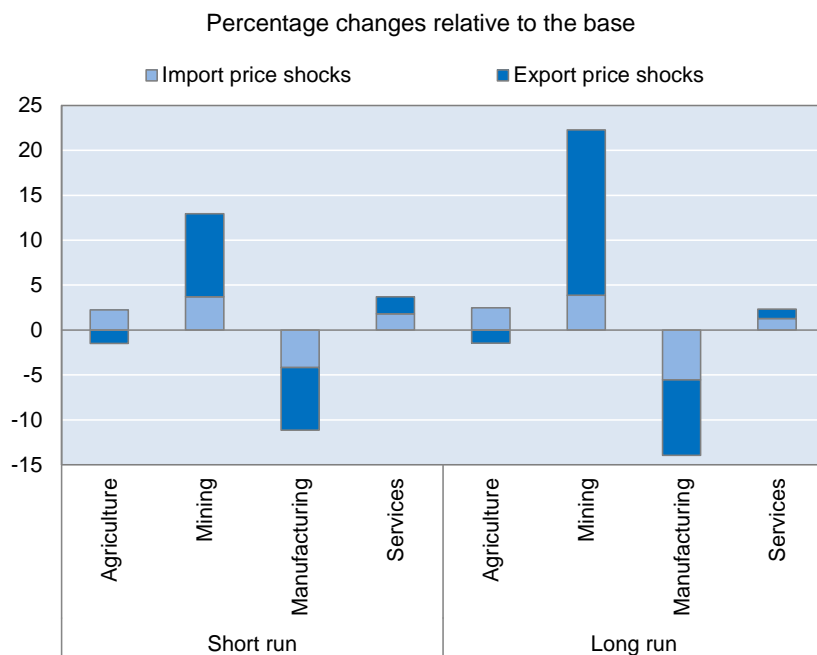

Source: Commission estimates.

The structural adjustment resulting from the modelled terms of trade improvement was split according to the effects of export and import prices (Figure 3.8).

- Agricultural employment increases as a result of the modelled increase in agricultural import prices, but declines as a result of the modelled decrease in agricultural export prices.

- Mining benefits from both strong growth in export demand and a decrease in the prices of some inputs to production.

- Manufacturing employment contracts in both simulations, crowded out by cheaper imports and increased demands for labour in mining and services.

- Employment in services increases: increased domestic income increases the consumption of services; and increased mining activity drives increases in investment, which increases demand for services such as construction.

The terms of trade shocks have made a significant contribution to the structural changes observed over 2006-2010 (Table 3.3). This table is analogous to Table 3.1, with the last column representing changes in employment as reported by the ABS and the first column reporting the effects of the simulation; however, in this case, the second column is derived as the difference between the two column, and not all influences have been modelled as in Dixon and McDonald (1993).

- Over the period, mining employment is measured to have expanded about 7.5%, while the modelled changes account for a 13% increase in employment in mining. This suggests that other factors account for a reduction in employment of around 5.5%.

- In services, the shocks account for practically all the measured increase in employment in the sector. Thus the net effect of all other influences is small.

Figure 3.8. Changes in sectoral employment resulting from a 20% increase in export prices and a 10% decrease in import prices

Percentage changes relative to the base

Source: Commission estimates.

Table 3.3. Contribution of terms of trade to observed structural change in employment

Persons employed, percentage changes, 2006-10

	Changes attributable to:		Total change [c]
	Terms of trade shock [a]	Other contributors [b]	
Agriculture	0.75	-1.27	-0.52
Mining	12.94	-5.52	7.42
Manufacturing	-11.15	8.95	-2.20
Services	3.71	0.30	4.00

a) 30% improvement in terms of trade.

b) Cumulative effects of all other influences, see note in Table 3.1. Calculated as the difference between observed changes in sectoral employment and modelled changes in sectoral employment.

c) Observed changes in employment as reported by ABS.

Source: ABS (*Labour Force, Australia, Detailed, Quarterly*, Cat. no. 6291.0.55.003); Commission estimates.

The terms of trade improvement causes a large expansion in the services sector. This expansion comes from two sources: the mining boom requires a range of services as inputs, especially construction services in the investment phase; and households increase their demand for services, including construction, as incomes increase. The composition of the structural change has a significant impact on the sources of expenditure within the domestic economy (Figure 3.9).

In the short run, the expansion of the resources sector causes a significant increase in investment. This increase in investment drives an increase in demand for a range of domestic goods and services. Construction expands particularly strongly, as it is a necessary input to the investment required by the resource sector, and an input to dwellings and accommodation. In the long run, increases in disposable income cause demand for services in consumption to increase, particular entertainment and health-related services,[7] public services (including education and health), and financial services (Figure 3.10).

The gains linked to increased export demand for minerals are concentrated in export intensive regions, the Northern Territory and Western Australia in particular.

That said, incomes increase across all regions: some regions supply inputs into the mining regions, increased tax incomes affect incomes across regions and decreased prices of imports increase real incomes across the country. The larger states – NSW and Victoria in particular – benefit most from increases in domestic consumption, due to the concentration of services in those states. Figure 3.11 shows the short- and long-run impact of an improvement in the terms of trade on labour incomes across regions.

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7.   Entertainment and health-related services are included in the "other services" industry of Commission's version of the MMRF model.

**Figure 3.9. Changes in real expenditure resulting from a 20% increase in export prices
and a 10% decrease in import prices**

Percentage changes relative to the base
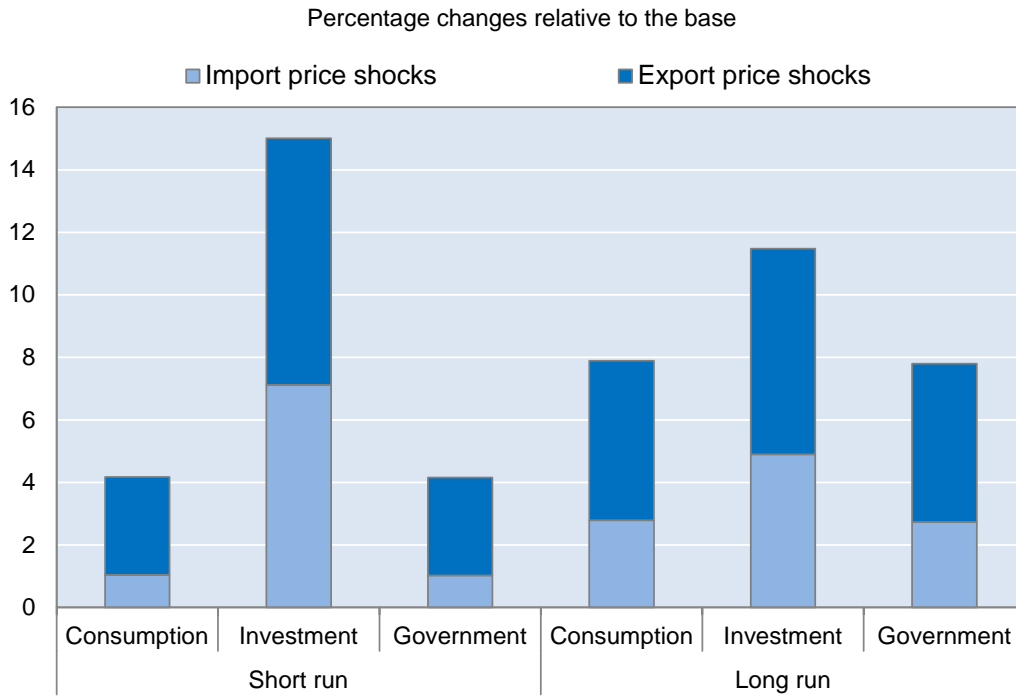
Source: Commission estimates.

Figure 3.10. Share of output used in consumption, investment and intermediate inputs[a]

Percentage changes relative to the base, five industries
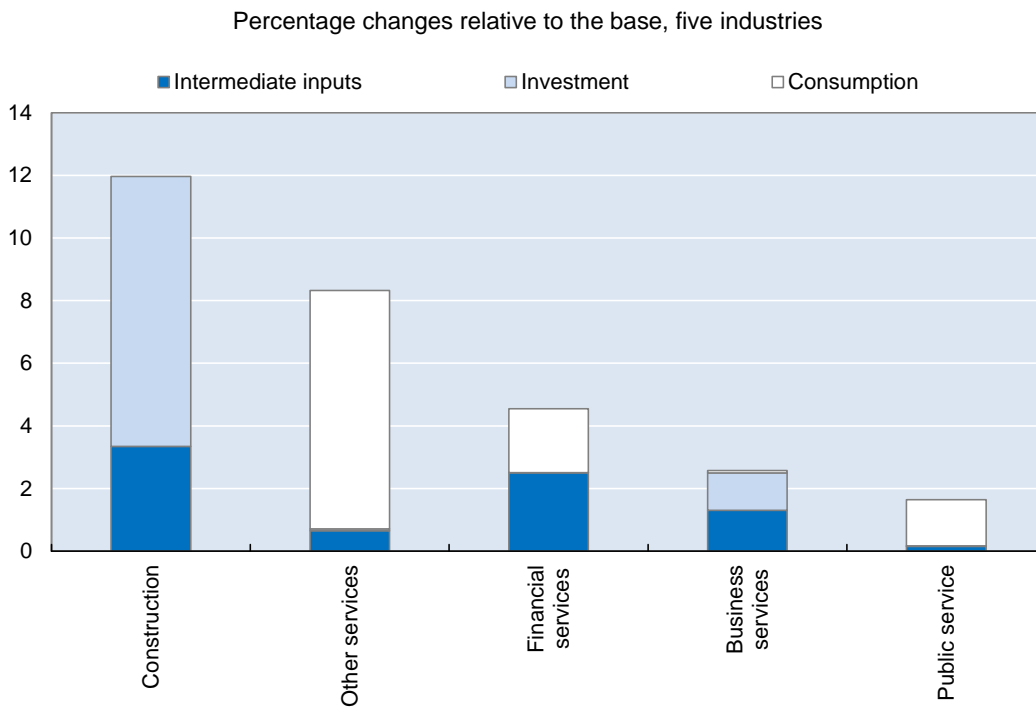
a) Abstracts from output used in exports, government current consumption, margin services and inventories.

Source: Commission estimates.

Figure 3.11. Changes in labour incomes from a 20% increase in export prices and a 10% decrease in import prices

Percentage changes relative to the base
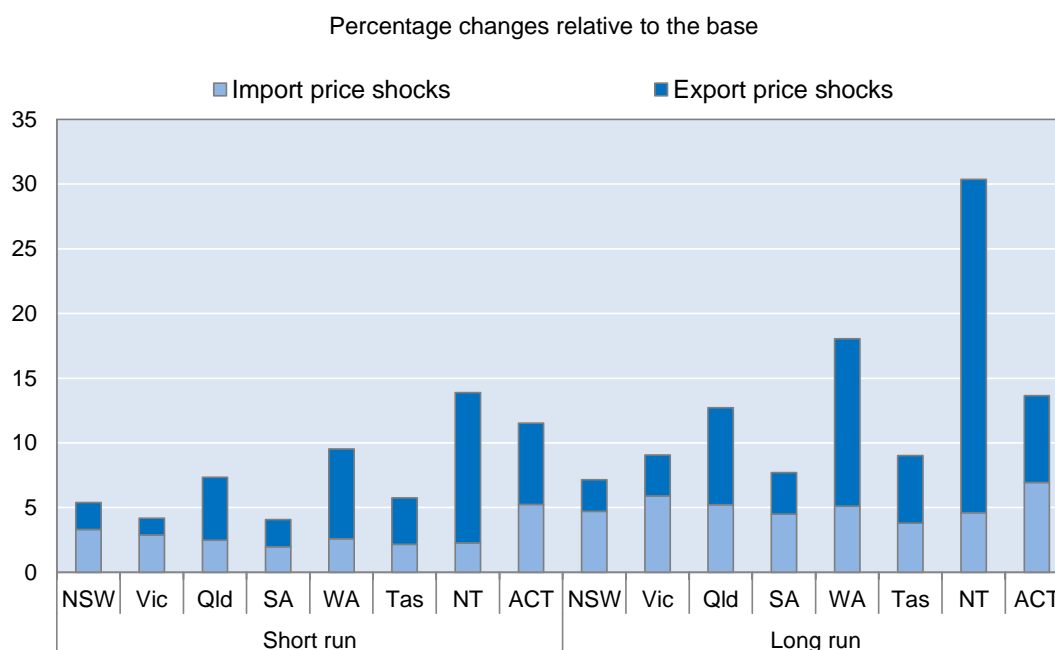
Source: Commission estimates.

An additional simulation, in which the movements of labour across regions and internationally are constrained, illustrates how this type of impediment can constrain the gains from reallocating labour across the economy.[8] Limiting inter-regional and international migration reduces the short run income gains to labour supply to 4% in the short run (Assumption 3b), and to 9% in the long run (Assumption 4b). At the aggregate level, this causes GDP to grow by nearly 1% less than when labour is fully mobile.

Effects of limiting flexibility

Table 3.4 provides a comparison of the simulations discussed above. With extreme constraints on resource movements as in Assumption 1, the modelled shocks produce a decrease in output and a corresponding reduction in employment. Under Assumption 2, the assumed impediments to the movement of capital across regions limit the ability to take advantage of the modelled improvements in export prices. Under Assumptions 3 and 4, short-term (labour movement) and long-term flexibility (wage movement) allow the benefits of the modelled increases in export and decreases in import prices to be captured. Under Assumption 3, wage stickiness means that initially real wages fall in expanding sectors, allowing employment to increase. Under Assumption 4, wages adjust, and employment returns to the long-run level. Assumptions 3b and 4b indicating how limitations on labour mobility constrain the scenarios.

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[8]   Labour is surprisingly mobile across industries and occupations and international migration can be responsive to demand shocks in certain sectors. Anecdotal evidence points to agricultural workers moving into mining, especially as equipment operators and truck drivers; shortages of teachers and clerks are reported as they too take on jobs in the mining sector. Although immigration procedures can be lengthy, they have been shortened for some skilled jobs.

Table 3.4. Projected effects of terms of trade improvements on employment and GDP

Percentage changes relative to base

	Shock	Assumptions	Employment	GDP
Assumption 1	Increase in export prices (8%-40%, increase in export demands for in resource commodities)	Labour and capital fixed in industry and regions	-0.33	-0.22
Assumption 2	20% terms of trade improvement (coal and iron ore demand)	Labour mobile across industries and regions; capital fixed within each region	0.00	0.30
Assumption 3 (short run)	30% terms of trade improvement (export demand, import prices)	Employment flexible; wages sticky; capital reallocates slowly	2.05	1.46
Assumption 3b (short run)	Same as Assumption 3	Same as Assumption 3 Constrained migration	1.51	1.26
Assumption 4 (long run)	Same as Assumption 3	Labour supply flexible wages flexible; capital reallocated	0.11	3.41
Assumption 4b (long run)	Same as Assumption 3	Same as Assumption 4 Constrained migration	0.08	2.48

Sources: Department of Treasury and Finance (Victoria) (2006); McKissack *et al.* (2008); Commission estimates.

3.6. Conclusions

Since the 1980s, trade liberalisation and other microeconomic reforms have contributed to significant structural change throughout the Australian economy. The contribution of services and mining activity has increased further, while manufacturing has contracted. This has been accompanied by a significant increase in Australia's trade intensity. The recent effects of a 30% improvement in the terms of trade are leading to significant further structural adjustments, not unlike those experienced as a result of trade liberalisation undertaken earlier.

Australian residents benefit from improvements in the terms of trade. Economic modelling indicates that increases in Australian incomes flow across the economy. When export demand increases and responses are constrained, incomes increase through the increase in export prices. The same applies to increased competition from reductions in import prices.

The greatest increases in income involve some structural adjustment, as labour and capital move to the industries and regions where their use is most highly valued. Maximising the benefits and minimising the adjustments costs associated with changes requires a flexible economy that enables resources to move relatively freely across sectors and regions.

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Appendix 3.A1.

The Monash Multi-Regional Forecasting model

The Monash Multi-Regional Forecasting (MMRF) model is a detailed model of the Australian economy developed by the Centre of Policy Studies (CoPS) at Monash University (Adams *et al.*, 2011). The version of MMRF used by in this paper includes 58 industries, 63 goods and services, nine occupational types of labour, and provides results for all eight states and territories of Australia. The model includes a representative consumer and government demand in each region, as well as a Federal Government demand. It is a dynamic model of the Australian economy, employing recursive mechanisms to explain adjustments over time.

MMRF determines regional supplies and demands of commodities through optimising behaviour of agents in competitive markets. Optimising behaviour also determines industry demands for labour and capital. Labour supply at the national level is determined by demographic factors, while national capital supply responds to rates of return. Labour and capital can cross regional borders so that each region's stock of productive resources reflects regional employment opportunities and relative rates of return.

All markets clear, other than the labour market (where excess supply conditions can hold, allowing for unemployment). A range of taxes are incorporated in the model including income and payroll taxes, company taxes, the GST, and a range of commodity and factor-specific taxes and tariffs.

Australian exports face a downward-sloping demand curve. A shock that improves the price competitiveness of an export sector will result in increased export volume, but at a lower world price.

Calculating the shocks for the modelling

In order to implement detailed price shocks to the traded commodities in the model, disaggregated data on export and import prices were required. The data used for this purpose were the SITC export and import price indices measured by the ABS. Each goods trading sector of MMRF was matched with two-digit SITC price data. Where more than one index was applicable to an MMRF sector, a composite price index was derived by calculating a weighted sum of prices based on all 2-digit SITC sectors relevant to the MMRF sector in question. (A brief description of the 2-digit SITC sectors is provided in Appendix Table 3.A1.2).

The shocks imposed on the model (Appendix Table 3.A1.1) were based on the two-year geometric growth rate of the relevant price index between June 2006 and December 2010, for a total terms of trade change of 30%. The changes in export and import prices were split across two years of the model, to clearly demonstrate the effects of the shocks on employment and other variables, rather than spreading the shocks across a greater number of years and diluting their impact.

The overall change in import prices implied by the SITC indices was smaller than that recorded by the implicit price deflator for imports between June 2006 and December 2010. Hence, the import price changes derived from SITC indices were scaled by a factor of 1.8 in order to result in a general movement in import prices approximately of the same order as that

indicated by the implicit price deflator for imports. No such adjustment was required for export prices.

For some two-digit SITC sectors, export and import price indices were not available (typically because of small recorded trade volumes). Where a single two-digit SITC sector was matched with a single sector of MMRF, the absence of a price index meant that no shock was applied to the sector.

The changes in import prices were imposed on the model by directly altering the price of the imported commodities in question in MMRF. A different process, however, was used to enter the export price shocks into the model. In the MMRF model, each exported commodity has an exogenously specified, downward-sloping demand curve with an elasticity of -5. As a result of this structure, directly shocking individual export prices would have implied large quantity changes that were inconsistent with observed data. In turn, this would have resulted in unrealistic movements in the output and employment levels of industries producing exported commodities.

As a result, the export simulations were implemented in the model using two mechanisms. An aggregate export price change of 10% was imposed in 2010 and 2011, in accordance with the increase in the aggregate export price deflator of 20% between June 2006 and December 2010. In order to ensure that the aggregate export price change was appropriately divided across exported commodities, export demand curves were allowed to shift up (down) to reflect increases (decreases) in the observed prices of exports. Each individual export demand shift variable was given a weighting in accordance with the observed changes in commodity prices.

International and interregional domestic migration were included in the modelling. International migration to all states and territories in Australia was linked to the national real wage. This was based on the assumption that a foreign migrant is more likely to choose Australia as a migration destination based on national wage (and other, non-financial) considerations without specifically targeting a state or territory. Regional choice is largely driven by local policies and social factors, and would be included in the interregional domestic migration impacts. The responsiveness of foreign migration to changes in the real wage was based on observed data.

Interregional domestic migration was driven by the real wage differential between states. States and territories with real wages above (below) the national average real wage experience increases (decreases) in the number of interregional migrants. This was specified such that the aggregation of all interregional migration within Australia summed to zero. The degree of migration caused by changes in the relative real wage was based on observed data.

Both of these additions were coupled with region-specific real wages. The real wage in each region was allowed to adjust with local labour market conditions, allowing the region-specific real wage to influence population movements.

Table 3.A1.1. MMRF and SITC concordance, and annual price shocks

MMRF sector	SITC 2-digit sector	Export price shock	Import price shock
Sheep and Cattle	00	19.05	n/a
Dairy	02	14.90	24.74
Other Animals	03	-0.09	-2.63
Grains	04,08	5.93	n/a
Other Agriculture	05, 06, 21, 22	-11.59	-9.94
Forestry	24	6.04	7.47
Coal	32	11.34	n/a
Oil	33	-6.43	-7.48
Gas	34	37.67	n/a
Iron Ore	28	21.81	n/a
Non-iron Ore	28	21.81	n/a
Other Mining	27	23.99	83.30
Meat Products	01	12.11	n/a
Other Food	07, 09, 11, 12, 41, 42	-19.50	25.54
Textiles, Clothing, and Footwear	26, 61, 65, 84, 85	-19.62	-1.01
Wood Products	63	n/a	11.71
Paper Products	25, 64	4.12	-16.39
Printing	64	4.12	-9.56
Chemicals	51, 52, 53, 54, 55, 56, 59	-11.09	3.00
Rubber and Plastics	23, 57, 58, 62	-14.44	1.00
Non-metal commodities	65	n/a	1.98
Cement	66	-12.97	-10.67
Steel	67	4.60	13.58
Alumina	28	21.81	n/a
Aluminium	68	-11.39	-4.24
Other Metals	69	n/a	-1.82
Metal Products	69	n/a	-1.82
Motor Vehicles and Parts	78	-5.85	-0.80
Other Manufacturing	71, 72, 74, 75, 76, 77, 79, 81, 82, 83, 87, 88, 89	-18.38	-19.00

Table 3.A1.2. SITC 2-digit sectors

2-digit sector	Description
00	Live animals other than animals of division 03
01	Meat and meat preparations
02	Dairy products and birds' eggs
03	Fish, crustaceans, molluscs and aquatic invertebrates and preparations thereof
04	Cereals and cereal preparations
05	Vegetables and fruit
06	Sugars, sugar preparations and honey
07	Coffee, tea, cocoa, spices and manufactures thereof
08	Feeding stuff for animals (not including unmilled cereals)
09	Miscellaneous edible products and preparations
11	Beverages
12	Tobacco
21	Hides, skins and furskins, raw
22	Oil seeds and oleaginous fruits
23	Crude rubber
24	Cork and wood
25	Pulp and Waste Paper
26	Textile fibres and their wastes
27	Crude fertilisers, other than those of division 56, and crude minerals (excluding coal, petroleum)
28	Metalliferous ores and metal scrap
32	Coal, coke and briquettes
33	Petroleum, petroleum products and related materials
34	Gas, natural and manufactured
41	Animal oils and fats
42	Fixed vegetable fats and oils
51	Organic chemicals
52	Inorganic chemicals
53	Dyeing and colouring materials
54	Medicinal products
55	Essential oils etc
56	Fertilisers (excluding crude)
57	Plastics in primary forms
58	Plastics in non-primary forms
59	Chemical materials and products, n.e.s.
61	Leather and leather manufactures
62	Rubber manufactures n.e.s.
63	Cork and wood manufactures
64	Paper, paperboard and articles of paper pulp, of paper or of paperboard

Table 3.A1.2. SITC 2-digit sectors (*continued*)

2-digit sector	Description
65	Textile yarn, fabrics, made-up articles, n.e.s., and related products
66	Non-metallic mineral manufactures
67	Iron and steel
68	Non-ferrous metals
69	Manufactures of metals, n.e.s.
71	Power generating machinery and equipment
72	Machinery specialised for particular industries
74	General industrial machinery and equipment, n.e.s., and machine parts, n.e.s.
75	Office machines and ADP machines
76	Telecommunications and sound recording equipment and reproducing apparatus and equipment
77	Electrical machinery, etc. and parts thereof
78	Road vehicles (incl. air–cushion vehicles)
79	Other transport equipment
81	Prefabricated buildings and fixtures n.e.s.
82	Furniture and parts thereof
83	Travel goods and handbags
84	Articles of apparel and clothing
85	Footwear
87	Professional, scientific and controlling instruments and apparatus, n.e.s.
88	Photographic and optical goods
89	Miscellaneous manufactured articles, n.e.s.
97	Gold, non-monetary