The national and regional economic impacts of closing down Australia's motor vehicle industry

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Executive summary

Over the past few years, a substantial appreciation of the Australian dollar in the wake of the mining boom has reduced the competitiveness of many industries, including the car industry. As part of negotiations to keep foreign investment in cars in Australia, domestic car manufacturers receive subsidies in excess of $500 million per annum.

In this study, the dynamic multi-regional model, TERM, is used to examine the impacts of Australia's car industry closing completely over a period from 2017 to 2018. A shock of this magnitude has marked short-term negative effects on the economy. National job losses reach over 95,000 in 2018 before falling real wages take effect. Real GDP in 2018 is $10.6 billion below forecast. Real aggregate private plus public consumption is $10.5 billion below forecast in 2018, and real private investment $3.7 billion below forecast. That real consumption falls more than real GDP in dollar terms reflects the impact of falling terms-of-trade on Australia's spending power in the wake of the initial shock. In 2018, the terms-of-trade spending power loss equals $3.9 billion.

The assumption of sticky wages (i.e., slowly adjusting real wages), combined with falling terms-of-trade, are responsible for job losses beyond those arising directly from the closure of the car industry. Real wages fall for several years in response to the closure of the car industry. This in turn brings employment back towards and above forecast levels, as the economy adjusts to a new industrial composition over time.

The adjustment costs to the Australian economy are substantial. The net present value of the welfare loss arising from the closure of the car industry is around $23 billion. This is driven substantially by terms-of-trade losses in the years of and following the closure of the industry. Although private and public consumption rise above forecast eventually, later years make little contribution to the welfare calculation, which is based on deviations from forecast discounted back to the initial year of the scenario.

Introduction

Australia's car industry has been subjected to increasing international competition for decades. In the 1980s and 1990s, there was much concern within the industry about the lowering of import tariffs and removal of import quotas. In that era, the Australian dollar was relatively weak. Now the international car market is different. The soaring Australian has reduced the competitiveness of the domestic industry, while the car manufacturing base of low wages nations such as China and Thailand has grown. Australia's car industry is substantially owned by foreigners. This raises the question of how much it would matter if the domestic car industry closed down. This study examines the impact of the closure of Australia's domestic motor vehicle assembly plants. A key assumption in the scenario is that the closure of the industry is relatively rapid, so that a significant quantity of foreign-owned capital becomes idle.

The model

This study uses dynamic TERM, a multi-regional computable general equilibrium (CGE) model of the Australian economy. The model follows the theory of the national dynamic model, MONASH (Dixon and Rimmer, 2002). However, there are five bottom-up regions instead of one as in the national model. These regions are Melbourne, Rest of Victoria, Adelaide, Rest of South Australia and Rest of Australia. Industries in each region have their own production functions. Each region has its own representative household. The sub-national regions are linked by inter-regional trade matrices. There is also provision for international exports and imports in each region.

Labour and capital markets

Each region has its own labour market, in which workers respond to the real wage rate. The separate regional labour markets are linked by inter-regional migration in response to changing real wage differentials.

Dynamic TERM allows for short run differences between actual and required rates of return on capital stocks. Industries respond to such differences with increases/decreases in investment as actual rates of return increase/decrease relative to required rates of return. Adjustments to capital stocks via investment reduce these differences over time.

The database of the model

The input-output database that is the foundation of the multi-regional CGE database is based on 2010-11 data. The 2005-06 input-output database published by ABS has been updated, based on national accounts data and international merchandise trade data. This national database has been split into regions using ABS 2011 census data on employment and supplementary data such as agricultural census data.

Base case forecasts

Relatively bland national macroeconomic forecasts are imposed on the model for the years 2012 to 2031. Primary factor productivity growth is also imposed on each industry in forecast. In the

context of the present study, the most important detail of the base case year-by-year forecast is that the price of imported motor vehicles falls over time relative to the price of domestically produced vehicles. This implies that as sales of motor vehicles increases with growing incomes over time, the domestic share of such sales shrinks.

The consumption function

A consumption function in each region links nominal household spending to nominal regional income. Being a dynamic model, TERM links stocks of net foreign debt to flows of interest payments to foreigners. Such payments reduce the amount of nominal income available for consumption. As the model does not contain details on foreign investment, foreign debt is used a proxy. The implication of this in the present study is that when the motor vehicle industry closes and foreign-owned capital is scrapped, it is appropriate to reduce foreign debt by the residual dollar value of the scrapped capital. This in turn reduces the payments from GDP that go to foreigners after the industry closes.

At present, the motor vehicle industry received subsidies exceeding $500 million per annum. When the motor vehicle industry closes, these subsidies cease. To model this, the consumption function in each region is moved outwards. That is, the proportion of GDP that is consumed in each region increases when the subsidies cease.

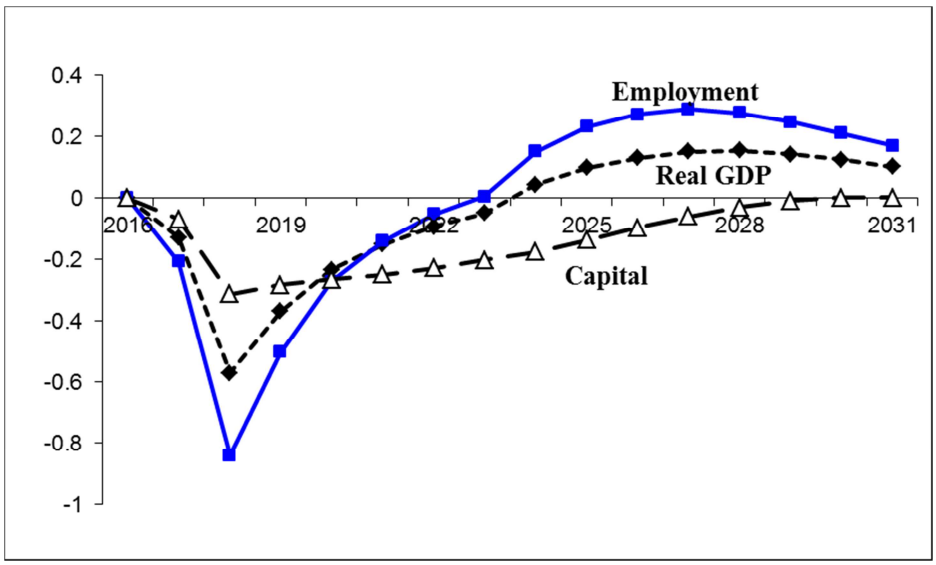
The scenario

The closedown of the motor vehicle industry proceeds over two years from 2017 to 2018. No judgment is made as to the sequence of the closedown by region. That is, all regions close by the same percentages in each of 2017 and 2018.

The national macro results

We start by examining the national macro impacts

Figure 1: National GDP, employment and capital stocks (% deviation from forecast)



GDP impact

At the national macroeconomic level, we first define the impact on income-side GDP (excluding land, indirect taxes and technological change):

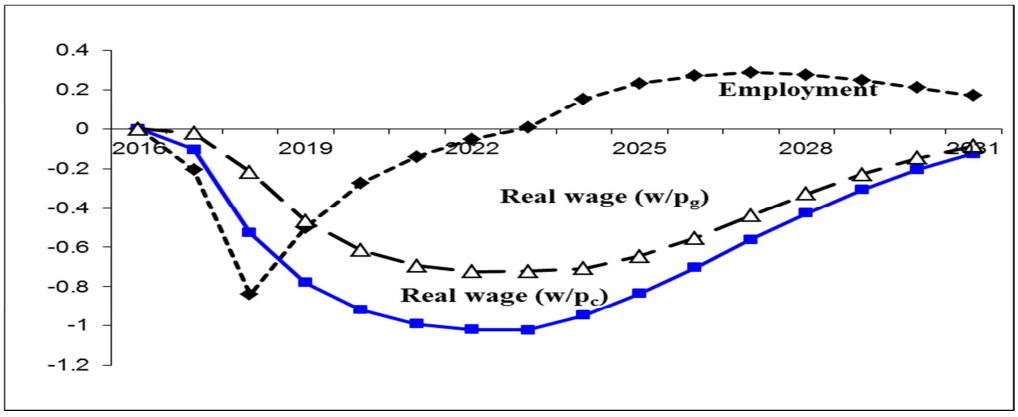
$$\text{GDP} = F(\text{K},\text{L}) \quad (1)$$

where capital (K) other than motor vehicle assembly capital is relatively fixed in the short term, and sticky wages apply in the labour market.[1] That is, in this scenario, in which a sudden loss of productive capital weakens the labour market, short-run adjustment is borne mainly by changes in employment levels rather than falling real wages (figure 2). Over time, real wages bear more of the adjustment. In the short term, sticky wages ensure that both capital and labour make negative contributions to GDP. In 2018, by which time the motor vehicle industry has closed, national capital stocks have fallen by 0.31% relative to forecast and employment by 0.84%.

Capital accounts for 37% of income-side GDP and labour for 52%. A back-of-the-envelope calculation is that GDP should fall by 0.55% (=[0.37 x -0.31] +[0.52 x -0.84] relative to forecast in 2018. The modelled GDP loss is 0.57%, slightly greater due to contributions from indirect taxes and the impact of compositional changes (i.e., changes in industry outputs) on the contributions of underlying technological change to GDP.

Figure 3 shows the impact of falling real wages, arising from the weakened national labour market, on the real exchange rate. By 2018, the real exchange rate has fallen almost 3% relative to forecast. Since the competitiveness of trade-exposed sectors other than the motor vehicle industry is enhanced in the scenario, there is a movement of labour in the short term and capital in the longer term into export-oriented sectors. This increases the volume of exports and results in a balance of trade surplus relative to forecast (figure 4). Since exporters face down-sloping export demand curves, the price of exports fall. By assumption, Australia's imports are not of a sufficient volume to affect international prices, so that the price of imports is unchanged relative to forecast. Therefore, the terms-of-trade (i.e., the ratio of export to import prices) decline in the short to medium term.

Figure 2: National labour market (% deviation from forecast)



[1] A technology term (1/A) has been omitted from the above expression as technology is assumed to be unchanged by the scenario.

Figure 3: National real exchange rate and terms of trade (% deviation from forecast)

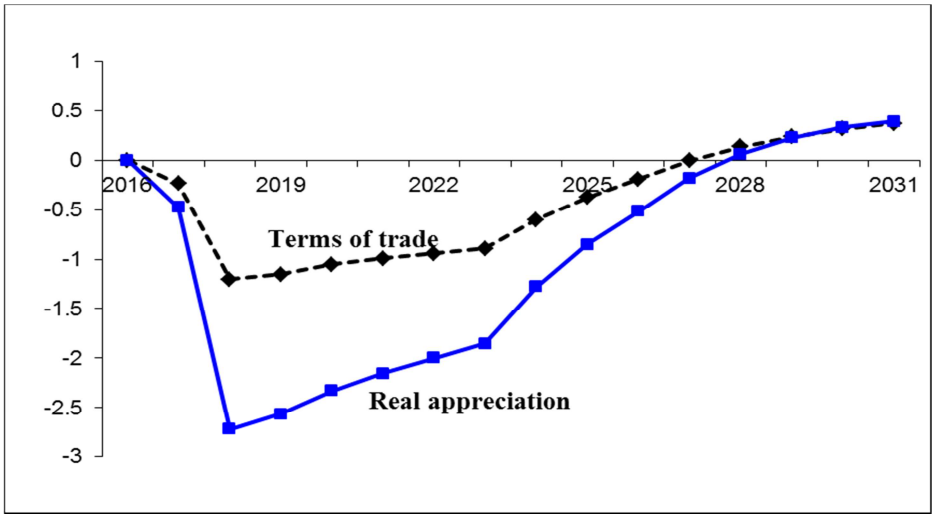
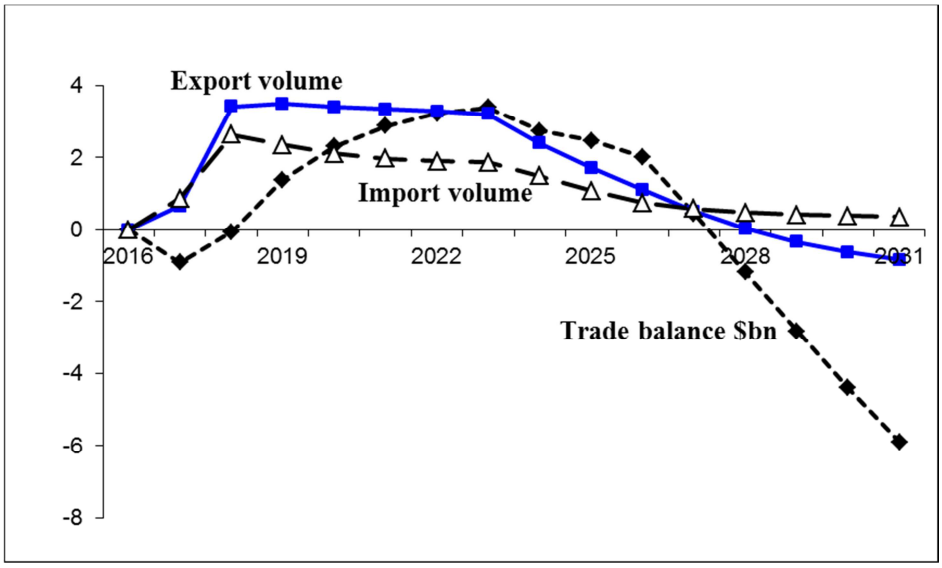


Figure 4: National export and import volumes (%), and trade balance ($bn) (deviation from forecast)



Employment

To explain the short-run impact on the labour market, we examine the marginal product of labour (MP_L) given by

$$MP_L(K/L)=(w/p_c).(p_c/p_g) = \quad (2)$$

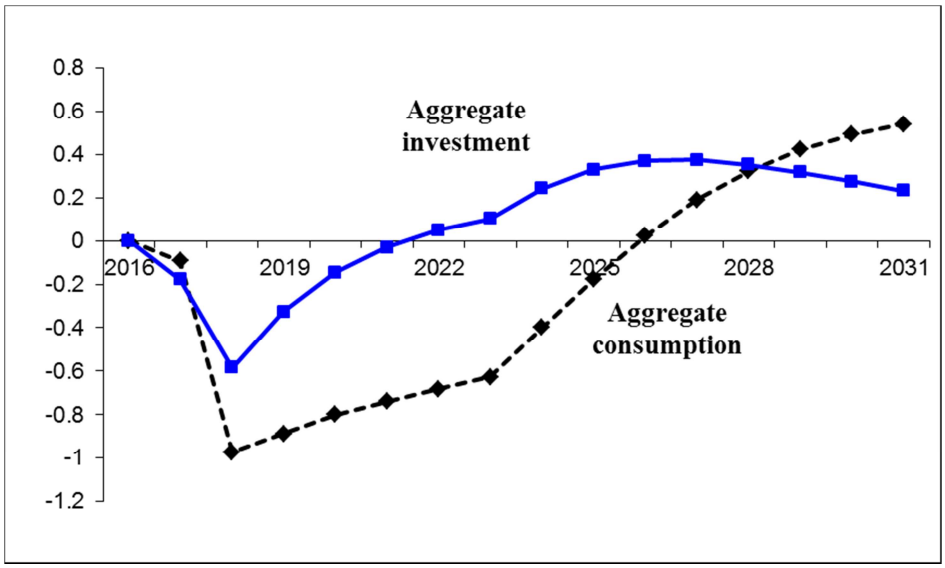
where w is nominal wage, p_g the producer price level proxied by the economy-wide GDP deflator and p_c the consumer price. In (2), the marginal product of labour as given by w/p_g is divided into two components, w/p_c, the sticky real wage as faced by consumers, and p_c/p_g, the ratio of consumer prices to the GDP deflator. We have established that the terms-of-trade worsen in the early years of the scenario (figure 3). Since consumption includes imports but not exports,

and GDP includes exports but not imports, a decline in the terms-of-trade implies that p_c/p_g must rise. This is evident in figure 2, in which nominal wages are deflated more by p_c than p_g in the years of and following the closure of the domestic car industry. With w/p_c fixed or adjusting only slightly in the short term and p_c/p_g rising, the marginal product of labour must rise. As this is a function of the capital-to-labour ratio (K/L) and K is already falling due to scrapping of capital in the domestic motor vehicle industry, employment must fall by a larger percentage than capital in line with equation (2) (that is, K/L must rise). This is so in 2018 when capital stocks fall by 0.31% and employment by 0.84% as noted above.

After 2018, the real wage has fallen sufficiently that aggregate employment starts moving back towards forecast. Beyond 2020, the capital-to-labour ratio rises above forecast (i.e.; in figure 1, the deviations in capital and employment cross over in 2020), even with a persistent terms-of-trade decline, because wages adjustment substantially offsets the negative impact of the terms-of-trade decline on employment. In 2021, for example, despite the remainder of the domestic car industry closing in 2018, capital stocks have fallen to 0.25% below forecast, while employment is only 0.14% below forecast – implying a decrease in K/L relative to forecast. Real consumer wages in 2021 are 0.99% below forecast whereas in 2018, they were only 0.53% below forecast.

Expenditure-side impacts

Figure 5: National aggregate consumption and investment (% deviation from forecast)



The sharp terms-of-trade decline has a marked impact on aggregate consumption (figures 5 and 6). In 2018, aggregate private consumption is $9.0 billion below forecast. Aggregate consumption, counting both private and public consumption, is $11.8 billion below forecast (see table 2). The contribution of the terms-of-trade decline in 2018 is around $3.9 billion (the export price index has fallen 1.2% relative to forecast, and the export base in 2018 is $325 billion in 2012 dollars, implying 325x0.012=$3.9 billion).

Since housing has a relatively high expenditure elasticity, but at the same time consists entirely of capital, the first impact on the sector of depressed aggregate consumption will be a sharp

decrease in housing investment (see figure 8). This will eventually translate into decreased housing output, as adjustments in investment alter the capital stock of housing.

Sectoral outputs

Various services sectors fare badly in the years during and after the motor vehicle industry closure. Other business services are relatively income elastic and suffer from the decline in aggregate consumption before a later recovery.

Figure 6: National aggregate consumption and investment ($bn deviation from forecast)

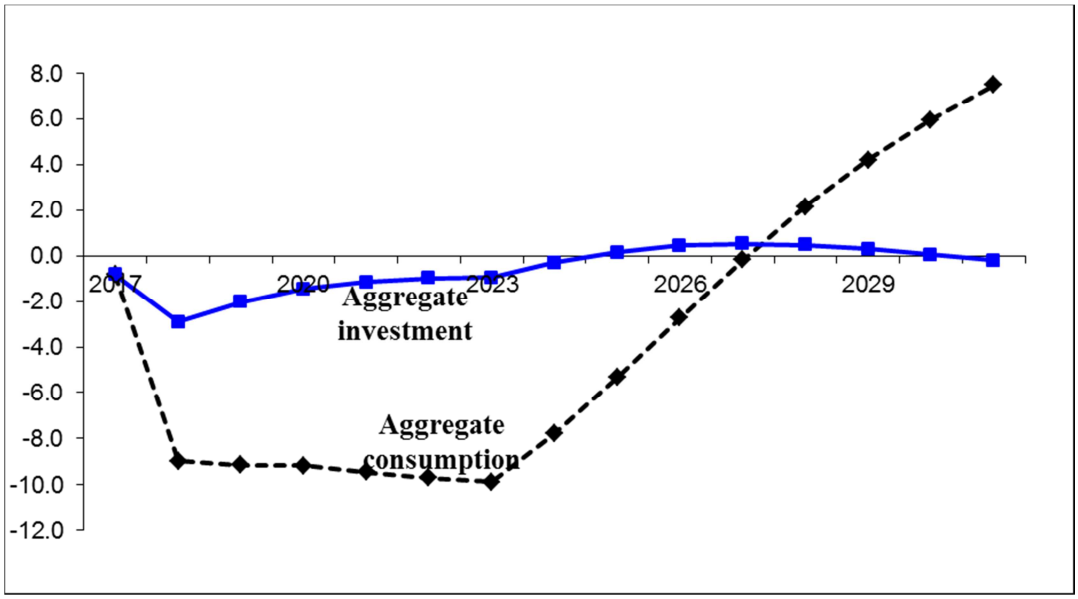


Figure 7: Broad sector value-added ($bn deviation from forecast)

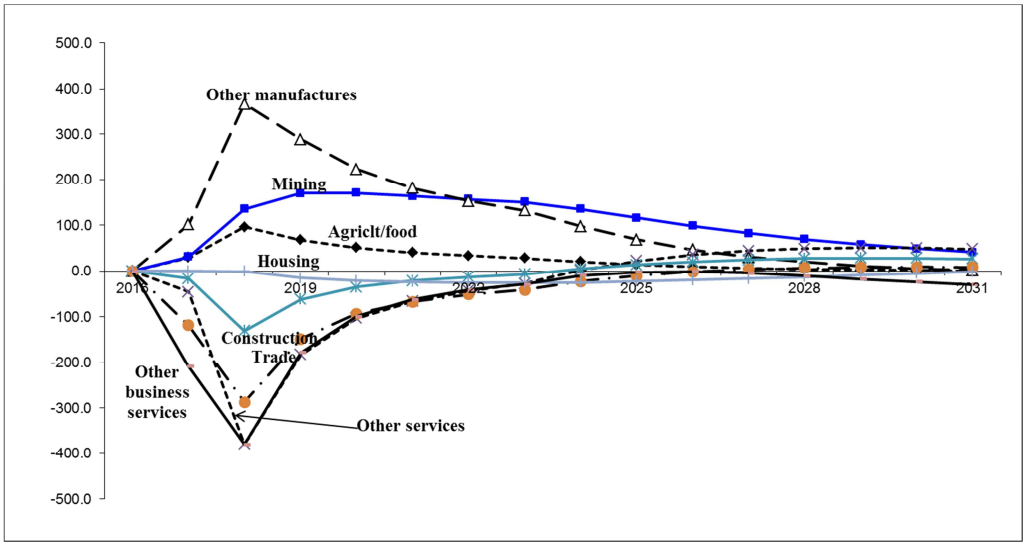
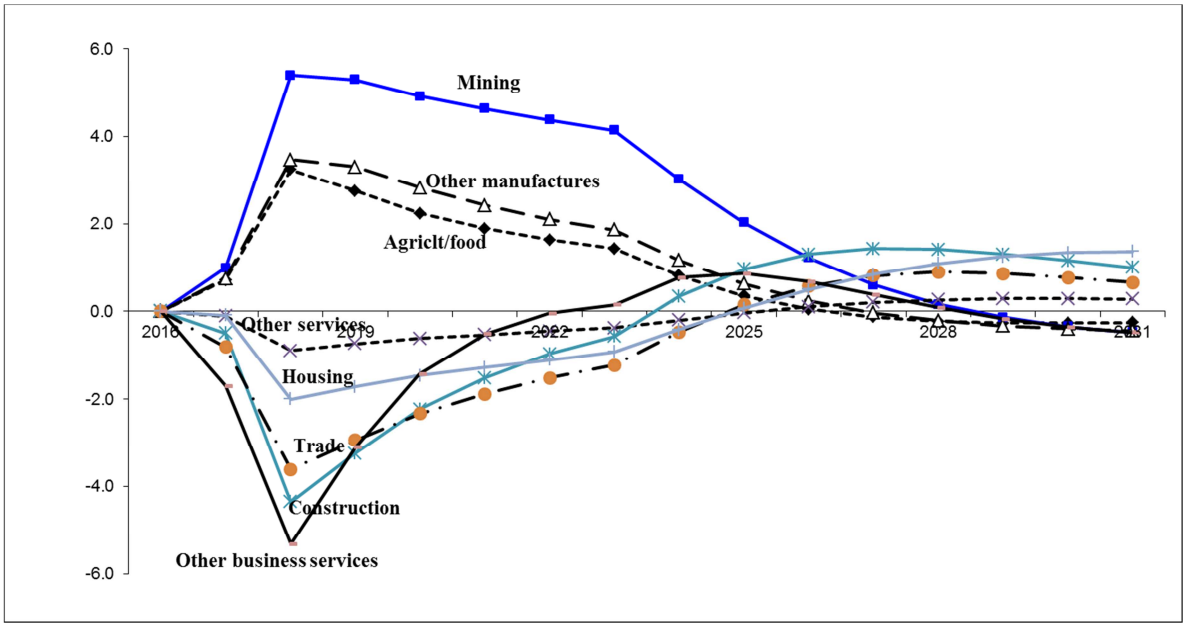


Figure 8: Broad sector national investment (% deviation from forecast)



In the short run, labour moves from the motor vehicle industry into export-oriented industries such as agricultural & food products and mining. The pattern of investment (figure 8) portends the compositional change in the economy that eventuates from ending motor vehicle operations. Over time, capital also moves into export sectors, namely agriculture, food, mining and other manufactures. These sectors expand in the medium term (figure 7).

The economy recovers as the compositional change proceeds. The impact of lower real wages in the medium term is to raise both employment and GDP above forecast at the national level. Real wages start moving back towards control after 2023. Employment, which moved above forecast during the process of recovery as lower real wages persisted, in turn back towards forecast in the later years.

National welfare outcome

Although falling real wages and the associated depreciation of the real exchange rate lead to an increase in export-oriented activity, and, after many years, an increase in employment and real GDP relative to forecast, the Australian economy suffers losses in income and real current consumption for a number of years after the motor vehicle closure. Following the method shown in appendix A, the discounted net present value of welfare losses arising in the scenario is $23 billion. In the discounted series, the early years make a relatively large contribution to the welfare outcome, while the later years, when current real consumption rises above forecast, make relatively small contributions. The overall welfare loss is driven substantially by terms-of-trade losses. For example, the discounted contribution of the terms-of-trade loss in 2018 alone (recalling the earlier calculation of a terms-of-trade loss in 2018 of $3.9 billion) exceeds $3 billion.

Regional outcomes

We turn to the bottom-up results for Melbourne and Adelaide. Since each city has a larger share of motor vehicle activity in GDP than the national share of the industry in GDP, the closure of the industry hits the two cities harder in percentage terms than the national economy. By 2018, Melbourne's job losses have fallen to 1.9% or 36,000 jobs below forecast. In Adelaide, the corresponding job losses are 1.3% or 7,300 jobs (table 1). Unlike the national economy, in which real GDP rises above forecast from 2024 on, real GDP in each city persists below forecast, even as employment temporarily rises above forecast. This reflects a smaller proportional switch to export-oriented activities than occurs at the national level.

Figure 9: Melbourne's real GDP, employment and capital stocks (% deviation from forecast)

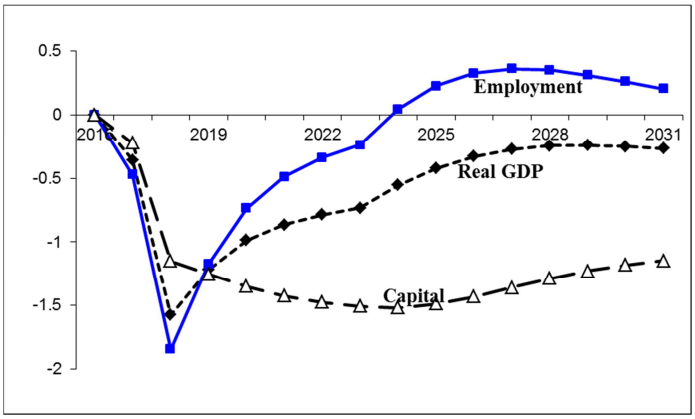
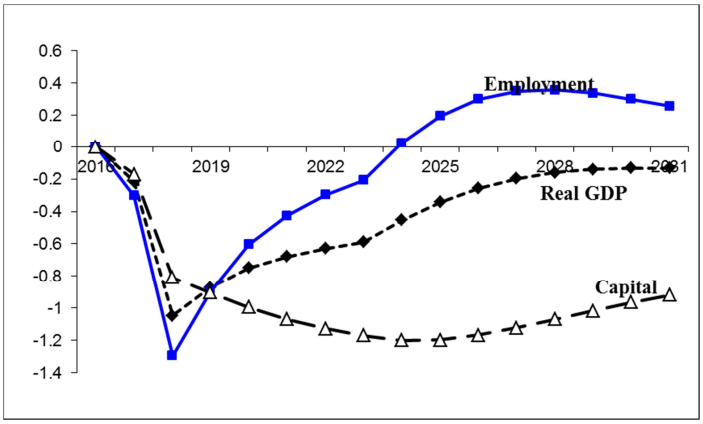


Figure 10: Adelaide's real GDP, employment and capital stocks (% deviation from forecast)



The real wage in each city as faced by consumers (w/p_c) bottoms out at around 2% below forecast compared with around 1% below forecast at the national level. The weakened labour market in each city reduces the regional labour supply (i.e., the share of the national labour market pool). Since employment is still above the labour supply in 2031, real wages are still rising. They will flatten out within the theory of the model once labour supply equals labour demand (employment) at the regional level (figures 11 and 12).

Figure 11: Melbourne's labour market (% deviation from forecast)

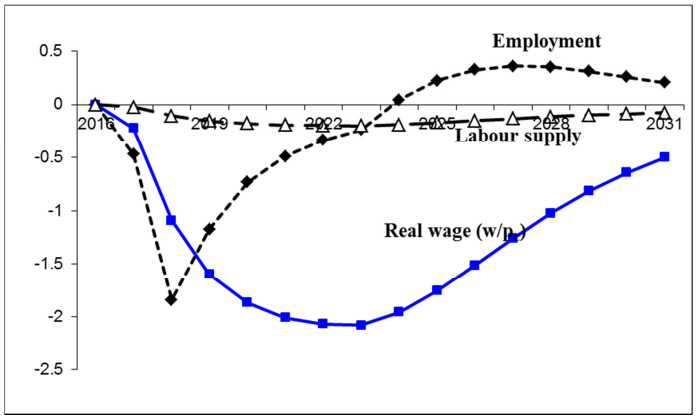


Figure 12: Adelaide's labour market (% deviation from forecast)

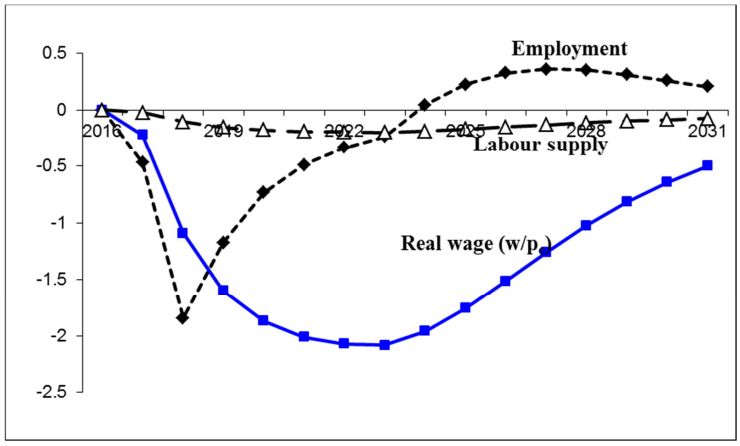


Figure 13: Melbourne's aggregate consumption and investment (% deviation from forecast)

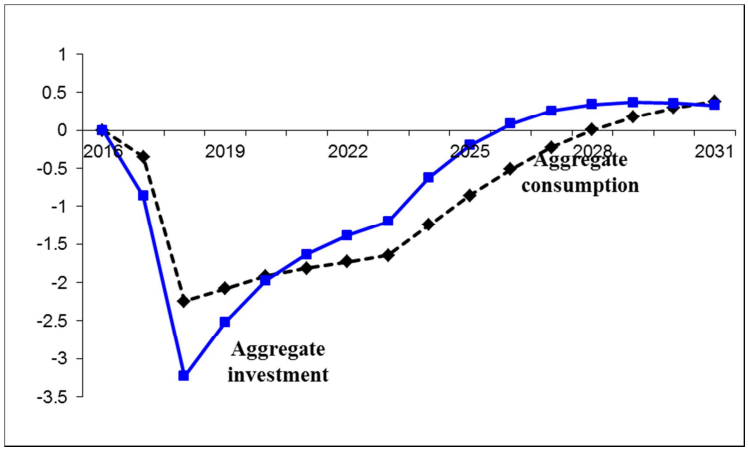
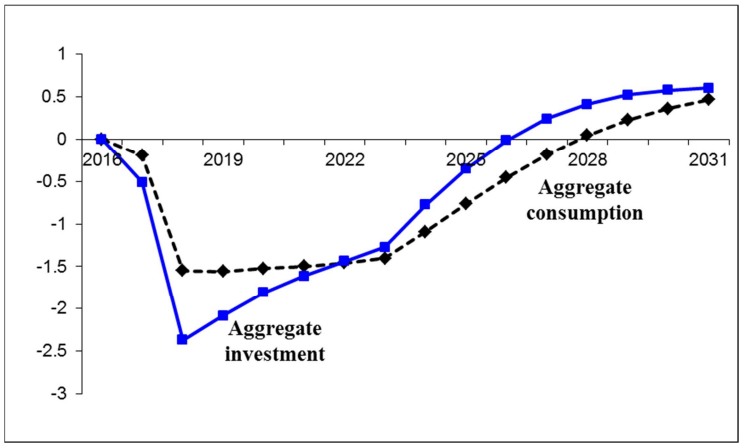


Figure 14: Adelaide's aggregate consumption and investment (% deviation from forecast)



On the expenditure side, aggregate consumption is hit much harder in Melbourne or Adelaide than at the national level. Aggregate consumption falls to 2% below forecast in Melbourne in 2018, and 1.6% below forecast in Adelaide. Public and private consumption fall by $4.2 billion in Melbourne and $1.3 billion in Adelaide in 2018 relative to forecast (table 2).

Figure 15: Melbourne's terms-of-trade and real appreciation (% deviation from forecast)

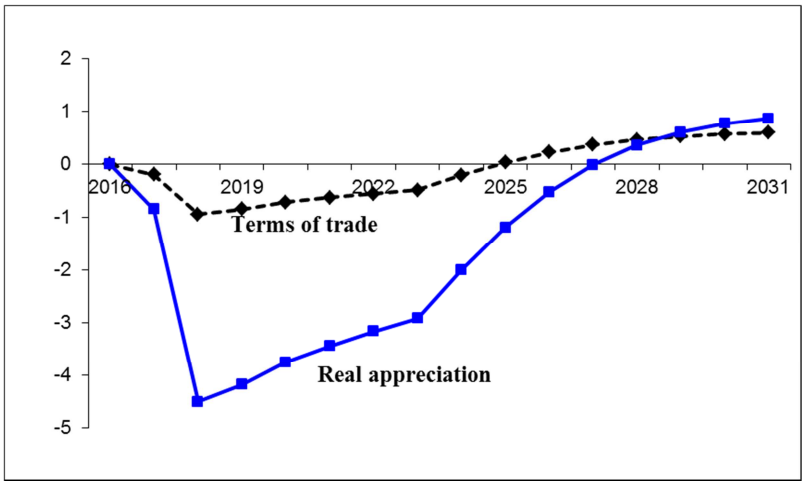
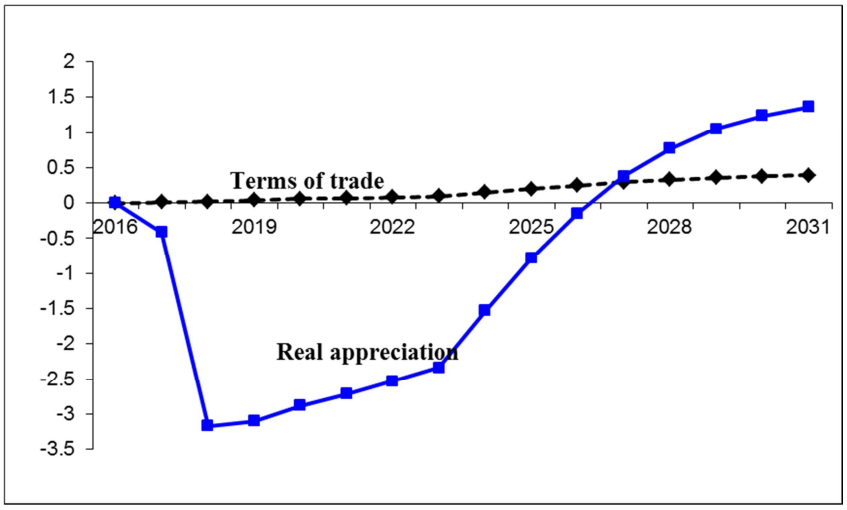


Figure 16: Adelaide's terms-of-trade and real appreciation (% deviation from forecast)



The terms-of-trade impact in Melbourne is weaker than that nationally, and barely deviates from forecast in Adelaide. Yet at the same time, the real depreciation (as measured by the price of local production relative to that of other Australian regions and imports) in each region is larger than the national impact. The terms-of-trade impacts are smaller because there is less movement of factors into trade-oriented sectors in these two cities than at the national level. The larger than national real depreciation in each city reflects the impact of falling housing rentals, depressed by falling aggregate consumption, on the general price level in the two cities (figure 17).

Figure 17: Housing rentals (% deviation from forecast)

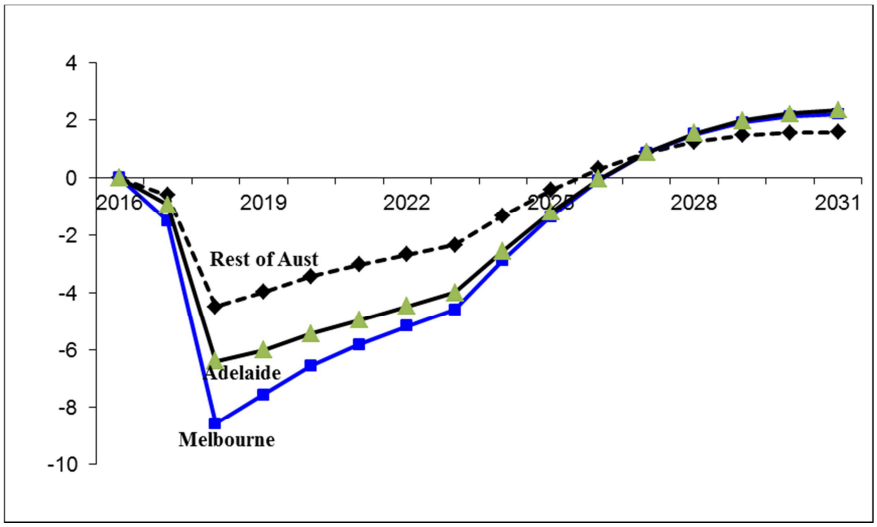


Table 1: Employment numbers (thousands of FTEs) relative to forecast by region

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Melbourne	0	-9.1	-36.1	-23.3	-14.7	-9.9	-6.9	-5.0	0.9	4.8	7.0	7.8	7.7	6.9	5.8	4.6
RoVic	0	-2.1	-8.7	-5.4	-3.1	-1.8	-0.9	-0.4	1.3	2.3	2.9	3.1	2.9	2.6	2.3	1.9
AdelaideSA	0	-1.7	-7.3	-5.1	-3.5	-2.5	-1.8	-1.2	0.2	1.2	1.8	2.2	2.3	2.1	1.9	1.7
RoSA	0	-0.4	-1.5	-0.9	-0.5	-0.2	0.0	0.1	0.4	0.5	0.7	0.7	0.6	0.6	0.5	0.4
RoAust	0	-9.9	-41.6	-23.6	-11.2	-3.7	1.4	4.9	13.2	18.6	21.4	22.1	21.0	18.9	16.2	13.4
National	0	-23.2	-95.2	-58.2	-32.9	-18.1	-8.2	-1.6	15.9	27.4	33.8	35.8	34.6	31.1	26.7	22.0

Table 2: Real aggregate private + public consumption relative to forecast by region ($m)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Melbourne	0	-655	-4236	-4008	-3805	-3719	-3643	-3567	-2775	-1970	-1212	-544	9	446	784	1042
RoVic	0	29	-1021	-900	-772	-688	-606	-522	-140	241	595	905	1161	1366	1529	1659
AdelaideSA	0	-155	-1259	-1286	-1295	-1314	-1318	-1307	-1047	-757	-464	-191	48	248	413	548
RoSA	0	47	-260	-220	-180	-152	-121	-88	41	175	304	420	517	597	660	711
RoAust	0	-212	-3713	-3370	-3036	-2819	-2592	-2346	-1244	-99	1011	2010	2854	3533	4063	4469
National	0	-946	-10490	-9784	-9088	-8692	-8280	-7831	-5166	-2410	234	2599	4589	6190	7449	8429

Table 3: Real investment relative to forecast by region ($m)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Melbourne	0	-436	-1724	-1441	-1224	-1097	-1003	-933	-519	-181	84	275	397	462	487	486
RoVic	0	-171	-577	-362	-179	-54	39	105	315	454	528	547	527	482	427	371
AdelaideSA	0	-258	-1266	-1191	-1121	-1083	-1040	-992	-649	-322	-15	255	476	649	779	876
RoSA	0	-58	-103	21	118	192	249	291	367	412	424	407	368	315	257	200
RoAust	0	-21	-29	66	135	193	241	281	341	386	413	418	406	380	346	309
National	0	-943	-3698	-2908	-2270	-1848	-1515	-1248	-144	750	1433	1902	2174	2289	2297	2242

Table 4: Real GDP relative to forecast by region ($m)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Melbourne	0	-673	-3022	-2393	-2011	-1826	-1719	-1656	-1295	-1024	-830	-713	-666	-677	-728	-805
RoVic	0	-333	-1477	-1026	-715	-527	-390	-284	0	212	355	431	451	426	372	301
AdelaideSA	0	-92	-454	-385	-342	-322	-308	-299	-239	-188	-147	-117	-99	-90	-88	-91
RoSA	0	-61	-252	-152	-81	-34	3	33	90	133	162	176	177	167	150	129
RoAust	0	-821	-3809	-2023	-752	95	760	1304	2280	3016	3517	3788	3851	3746	3520	3221
National	0	-1980	-9014	-5978	-3901	-2614	-1654	-901	837	2150	3056	3566	3714	3572	3226	2755

Top-down results

The version of dynamic TERM used in this study contains 205 top-down regions, mainly at the statistical sub-division level. The 20 regions with the biggest employment losses in 2018 relative to forecast and the corresponding 20 biggest gains are shown in table 5.

A way of explaining the regional outcomes is to regress employment on industry composition. In region *r*, let e_r be the deviation in employment relative to forecast. In the base year, MV/GD_r is the share of motor vehicle value-added in GDP divided by the national share of motor vehicle value-added in GDP. $EXPORT/GDP_r$ is the corresponding ratio for the share of export oriented industries (mining, agriculture, food processing and other manufactures) in GDP and $OthBus/GDP_r$ the ratio for the share of other business services in GDP. In year 2018, we obtain:

$$e_r = -0.463 - 0.230.(MV/GD_r x100) + 0.297.EXPORT/GDP_r x100) - 0.299.(OthBus/GDP_r x100)$$
$$R^2_{adj} = 0.916 \qquad (4)$$

This implies that regions with a relatively large share of motor vehicle and other business services activity suffer job losses, with a positive impact arising in regions with a relatively higher representation of export-oriented industries. A region with sectoral activities shares equal to the national average would suffer a 0.69% loss in employment (i.e., from (4), -0.463-0.230+0.297-0.299=-0.694), comparable with the national modelled job outcome of -0.84%.

Table 5: Ranking the 20 largest short-term losers and winners (2018), based on the deviation in employment relative to forecast (%)

Losers	2016	2017	**2018**	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
GrtDandeVic	0.00	-0.79	**-2.77**	-1.96	-1.43	-1.15	-0.97	-0.87	-0.49	-0.23	-0.06	0.02	0.04	0.01	-0.04	-0.09
BallaratVic	0.00	-0.62	**-2.71**	-2.08	-1.61	-1.35	-1.16	-1.04	-0.56	-0.19	0.06	0.21	0.29	0.31	0.29	0.26
HumeVic	0.00	-0.67	**-2.54**	-1.78	-1.28	-0.99	-0.82	-0.70	-0.32	-0.06	0.11	0.19	0.22	0.20	0.15	0.10
GrtGeeloVic	0.00	-0.55	**-2.33**	-1.72	-1.29	-1.04	-0.87	-0.76	-0.35	-0.05	0.15	0.27	0.31	0.31	0.29	0.25
SthEMlbVic	0.00	-0.56	**-2.15**	-1.46	-1.00	-0.75	-0.59	-0.49	-0.17	0.05	0.18	0.25	0.26	0.23	0.19	0.14
MeltnWyndVic	0.00	-0.54	**-2.12**	-1.43	-0.97	-0.71	-0.55	-0.45	-0.12	0.10	0.23	0.30	0.31	0.28	0.24	0.18
FrankstonVic	0.00	-0.56	**-2.06**	-1.33	-0.86	-0.60	-0.44	-0.33	-0.04	0.16	0.26	0.30	0.29	0.25	0.19	0.13
NthOtrMlbVic	0.00	-0.53	**-2.06**	-1.37	-0.91	-0.66	-0.50	-0.40	-0.08	0.13	0.26	0.32	0.32	0.29	0.25	0.20
SthLoddonVic	0.00	-0.50	**-2.02**	-1.39	-0.96	-0.71	-0.55	-0.44	-0.10	0.14	0.27	0.33	0.33	0.29	0.24	0.19
WBarwonVic	0.00	-0.49	**-2.00**	-1.41	-1.00	-0.77	-0.62	-0.52	-0.18	0.06	0.21	0.29	0.31	0.29	0.25	0.20
SWGoulbuVic	0.00	-0.47	**-1.97**	-1.39	-0.98	-0.75	-0.60	-0.49	-0.15	0.09	0.24	0.32	0.34	0.32	0.28	0.24
WMlbrnVic	0.00	-0.47	**-1.93**	-1.30	-0.87	-0.63	-0.48	-0.38	-0.07	0.14	0.27	0.33	0.34	0.32	0.28	0.24
YarraRngVic	0.00	-0.51	**-1.90**	-1.19	-0.73	-0.47	-0.31	-0.21	0.07	0.24	0.34	0.36	0.35	0.30	0.24	0.18
NthAdelaidSA	0.00	-0.46	**-1.90**	-1.45	-1.12	-0.91	-0.76	-0.65	-0.33	-0.07	0.10	0.21	0.26	0.27	0.25	0.22
BarossaSA	0.00	-0.44	**-1.84**	-1.45	-1.16	-0.99	-0.87	-0.79	-0.47	-0.21	-0.02	0.10	0.16	0.19	0.18	0.16
ECentrlHLVic	0.00	-0.45	**-1.83**	-1.24	-0.83	-0.60	-0.45	-0.35	-0.03	0.18	0.30	0.35	0.35	0.31	0.27	0.21
EBarwonVic	0.00	-0.41	**-1.72**	-1.16	-0.77	-0.54	-0.39	-0.30	0.01	0.21	0.32	0.37	0.37	0.34	0.29	0.24
AlburyNSW	0.00	-0.42	**-1.68**	-1.33	-1.07	-0.92	-0.83	-0.76	-0.47	-0.25	-0.09	0.02	0.08	0.10	0.10	0.08
EOtrMlbVic	0.00	-0.43	**-1.66**	-1.00	-0.58	-0.34	-0.20	-0.11	0.14	0.29	0.37	0.39	0.36	0.32	0.26	0.20
MorelandVic	0.00	-0.42	**-1.65**	-0.99	-0.56	-0.32	-0.17	-0.08	0.18	0.34	0.42	0.43	0.41	0.36	0.30	0.25
Winners																
GrenghRivWA	0.00	-0.04	**-0.05**	0.21	0.38	0.48	0.54	0.58	0.61	0.60	0.57	0.52	0.46	0.40	0.33	0.27
SouthWQld	0.00	-0.01	**-0.05**	0.12	0.22	0.27	0.30	0.31	0.33	0.33	0.32	0.30	0.27	0.24	0.21	0.17
BlackwdWA	0.00	-0.02	**-0.04**	0.19	0.33	0.42	0.47	0.50	0.52	0.51	0.48	0.43	0.38	0.32	0.26	0.21
NCentralNSW	0.00	-0.04	**-0.03**	0.19	0.31	0.37	0.41	0.42	0.42	0.39	0.35	0.30	0.24	0.19	0.13	0.09
BarklyNT	0.00	-0.02	**0.01**	0.24	0.39	0.48	0.53	0.56	0.57	0.55	0.49	0.43	0.36	0.30	0.24	0.19
GladstoneQld	0.00	-0.02	**0.03**	0.25	0.37	0.44	0.48	0.50	0.50	0.47	0.43	0.38	0.32	0.26	0.20	0.14
FarNorthSA	0.00	-0.03	**0.06**	0.36	0.55	0.67	0.75	0.80	0.79	0.74	0.67	0.59	0.51	0.42	0.35	0.28
AlligatorNT	0.00	0.00	**0.06**	0.33	0.50	0.61	0.69	0.73	0.73	0.70	0.64	0.57	0.50	0.42	0.36	0.29
CarpentarQld	0.00	0.00	**0.09**	0.27	0.37	0.42	0.45	0.46	0.45	0.41	0.37	0.32	0.27	0.23	0.18	0.14
UpDarlingNSW	0.00	0.00	**0.09**	0.31	0.43	0.50	0.54	0.56	0.54	0.50	0.44	0.37	0.31	0.25	0.19	0.14
FinnissNT	0.00	0.01	**0.13**	0.37	0.50	0.58	0.63	0.66	0.65	0.61	0.55	0.48	0.41	0.34	0.27	0.22
FitzryBalQld	0.00	0.01	**0.21**	0.46	0.61	0.70	0.75	0.78	0.74	0.68	0.60	0.52	0.44	0.36	0.29	0.22
MackayBalQld	0.00	0.02	**0.31**	0.57	0.72	0.81	0.86	0.88	0.82	0.74	0.64	0.54	0.45	0.36	0.28	0.21
LefroyWA	0.00	0.01	**0.32**	0.62	0.80	0.91	0.97	1.01	0.96	0.87	0.76	0.64	0.53	0.42	0.33	0.25
KalgrlieBWA	0.00	0.05	**0.33**	0.59	0.75	0.85	0.92	0.96	0.92	0.85	0.76	0.67	0.58	0.49	0.42	0.35
PrestonWA	0.00	0.06	**0.45**	0.68	0.80	0.87	0.91	0.93	0.86	0.77	0.67	0.57	0.48	0.39	0.31	0.24
EArnhemNT	0.00	0.07	**0.52**	0.69	0.76	0.79	0.80	0.79	0.71	0.61	0.51	0.41	0.32	0.24	0.17	0.11
FortescueWA	0.00	0.09	**0.56**	0.81	0.96	1.06	1.12	1.15	1.08	0.99	0.88	0.76	0.65	0.55	0.45	0.37
DeGreyWA	0.00	0.10	**0.63**	0.89	1.04	1.13	1.19	1.23	1.15	1.04	0.91	0.78	0.66	0.54	0.44	0.35
CarnegieWA	0.00	0.09	**0.70**	1.02	1.21	1.32	1.39	1.43	1.33	1.18	1.01	0.85	0.70	0.56	0.45	0.35

The biggest loser in 2018 among the statistical sub-divisions is Greater Dandenong, with a modelled employment outcome of -2.77%. The fit to the regression in (4) for the region is -3.33%. The region with the biggest employment gain in 2018 is Carnegie in Western Australia, a mining region. Its employment gain is 0.70%, compared with a fit to (4) of 0.12%. The fit for the second largest winner, DeGrey (which includes the Pilbara), is better: the modelled employment

outcome is 0.63% and the fit to (4) is 0.52%. This is sufficient to indicate that a selection of sectoral weights explains much of the employment outcome in the short term.

As adjustments take place over time, including a downward movement in wages, a restoration of aggregate consumption, a recovery in national employment and a larger compositional change in the economy, the fit of employment outcomes to base year industry weights deteriorates. Repeating the regression for 2031 gives $R^2_{adj} = 0.112$.

References

Dixon P.B. and Rimmer, M.T. (2002). *Dynamic General Equilibrium Modelling for Forecasting and Policy: a Practical Guide and Documentation of MONASH.* Contributions to Economic Analysis 256, North-Holland Publishing Company, Amsterdam.

Appendix A: calculating welfare in dynamic TERM

A consumption function links household expenditure to regional income GDP in region (*d*):

$$CON(d) = GDP(d) * APC(d) * (1+SAPC(d)) \quad \text{(A1)}$$

where CON(*d*) is the regional aggregate household consumption;

APC*(d)* is the average propensity to consume; and

SAPC*(d)* is a shifter on the average propensity to consume.

In measuring welfare at the national level, we account for the policy impact on net foreign liabilities with a terminal calculation of the deviation in welfare (dWELF):

$$dWELF = \sum_d \sum_t \frac{dCON(d,t) + dGOV(d,t)}{(1-r)^t} - \frac{dNFL(z)}{(1-r)^z} \quad \text{(A2)}$$

where dCON and dGOV are the deviations in real household and government spending in region *d* and year *t*;

dNFL is the deviation in real net foreign liabilities in the final year (*z*) of the simulation; and

r is the discount rate.