Population Changes and the Impacts on Tourism

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Summary of Results

The combined effects of a low level of fertility and increasing life expectancy are shifting the mean age of Australia's population higher over time, implying an ageing population. This will put increasing pressure on labour supply in the State and Territory economies. As labour supply determines real wages and the competitiveness of State exports, an ageing population will have implications for State and Territory inbound and domestic tourism.

Changes in the supply of labour as a result of an ageing population are further complicated by changes in net overseas migration and in net regional migration. The Australian Bureau of Statistics (ABS) has generated a range of scenarios for changes to the size of State and Territory populations based on assumptions for the fertility rate, life expectancy at birth, net overseas migration and net regional migration. Among these, the ABS selects Series A, B and C to represent the high, medium and low scenarios of population changes over the period from now until 2056 for all States and Territories. Series B incorporates current trends in fertility rates, life expectancy at birth and net overseas migration. Series A and C provide upper and lower bounds for the ABS assumptions.

This report uses the ABS Series A, B and C projections to analyse the impact of population changes on tourism in all States and Territories over the period 2005 to 2050. The medium Series B is used as the base scenario, against which the impact of population in the high (Series A) and the low (Series C) scenarios on the tourism sector in each State can be measured. In particular, the base case scenario projects the economies of all States and Territories using the ABS population projection Series B and tourism forecasts from Tourism Research Australia (TRA). The report then assesses the impacts on State and Territory tourism sectors should population grow faster than the base case scenario, as indicated in Series A, and the impact of a rate of population growth lower than the base case, as represented under Series C.

The results show that net overseas migration has significant implications for tourism at the State and Territory level. A high rate of population growth under Series A alleviates the pressure of the ageing population on the labour market in all States and Territories, stimulating demand for inbound tourism and also other exports. Additional income from exports and a larger population size also stimulates domestic tourism.

By contrast, if the lower, Series C population projections are adopted, the increased pressure on labour supply with increases in wage rates across all States and Territories will lead to reduced demand for both inbound and domestic tourism across Australia.

The impacts on regions can be grouped into two clusters. The most resilient States are New South Wales, Victoria and South Australia. Impacts on their tourism sectors fall within a relatively small range and, more importantly, the impacts occur more gradually over time. In contrast, the impacts on all other regions occur more rapidly, and with a wider range of outcomes.

Among the three tourism sectors examined in this report (inbound, inter-state and intra-state tourism), the inbound tourism sector is much more responsive to the ageing population than the aggregate exports of a State. In favourable conditions, it grows faster than most other exporting sectors in the economy; in adverse conditions, it contracts more than all the others. The regions affected the most include the Australian Capital Territory, the Northern Territory and Tasmania.

Intra-state tourism is affected differentially across Australian States and Territories and is mainly driven by the level of income and number of people (population) in a State or Territory. Overall, the pattern of changes to intra-state tourism demand is very similar to the pattern of household consumption across States.

Impacts on inter-state tourism, on the other hand, seem to be relatively uniform across States and Territories. This is mainly because the demand for inter-state tourism is driven by the level of income in the origin region. It appears that when income effects become dominant, they are the main driver of the spread of impacts of inter-state tourism across State and Territory economies. However, when increases in income are less pronounced and undifferentiated across regions, price effects play an important role in determining the destinations of inter-state tourism.

Introduction

The Australian economy faces an ageing population due to its low level of fertility combined with increasing life expectancy at birth. Thus the size of the population and subsequently the labour supply for each region will change over time. This situation is expected to continue in the future. The median age of the population is moving from 36.8 years to a range of between 38.7 and 40.7 years by 2026, and between 41.9 and 45.2 years in 2056 (ABS, 2008, p 4). The changes in the composition of the population structure and in population growth rates have important implications for the economy as a whole and for industries or sectors individually. This is due to an increasing constraint on the labour supply side, and at the same time, changes to domestic demand from the consumption side. The impacts of such combined effects at the State and Territory level are further affected and complicated by net inter-state migration and net overseas migration. The reasons for both of these types of migration are not well understood or easily predicted. Inter-state migration could occur for a range of reasons that might not be necessarily related to economic conditions in the states concerned. Similarly, the level of net overseas migration depends largely on government policies which could change over time.

As tourism is comprised of a wide range of goods and services consumed by domestic tourists, as well as overseas visitors, the ageing population will certainly have an impact on domestic industries and subsequently on the tourism sector. This report will focus on the impacts of the ageing population on the tourism sector explicitly.

The Base Model

The work in this project is based on the Monash Multi-Regional Forecasting (MMRF) model (Adams, 2008) with specific application to the tourism sector. The MMRF model is a fully bottom-up dynamic Computable General Equilibrium (CGE) model of all of the Australian State and Territory economies. The model description is well documented in Adams (2008), the main features of the MMRF model include:

- Households maximising utility by choosing the cheapest source for their purchases;
- Firms maximising profits by sourcing intermediate inputs from the cheapest source;
- Firms also choosing the right mix of labour, capital and land to reduce the cost of primary inputs by a substitution among these primary inputs based on individual cost factors;
- Strong responses by firms to large changes in input prices by undertaking technological innovation;
- Domestic producers facing a downward sloping export demand curve to reflect an assumption of a small open economy;

- Investors being cautious in their investment decisions. For every subsequent increment in capital growth, investors require a higher rate of return to supply the same amount of additional investment; and
- Investors also minimising their costs by choosing the cheapest source as do producers, except that investment activity does not require primary inputs.

The conventional CGE database does not present tourism expenditure data explicitly. Domestic tourism expenditure is embedded in household final consumption and overseas tourism expenditure is included in the export vector. In other words, final demand data in the CGE database include both tourism and non-tourism data for the same final demand category. As a result, the conventional CGE database will not be able to capture the impact of changes on the tourism sector explicitly, or cannot capture the impact of non-tourism consumption on tourism consumption for the same commodity, and vice versa.

The tourism sector has been incorporated more explicitly into the CGE framework in Australia in recent years due to: the importance of tourism to the economy; the ability for impact analysis that a CGE model can offer; and the availability of Tourism Satellite Account (TSA) data for the Australian States and Territories (Pham, Simmons and Spurr 2010; Dwyer Forsyth, Spurr and Ho, 2003; and, Madden and Thapa, 2000). Using the approach in Pham *et al.* (2010), tourism expenditure data were incorporated into the MMRF database to present four different tourism sectors, namely inter-state tourism, intra-state tourism, outbound tourism and inbound tourism. The first three tourism sectors come from final household demand while the inbound tourism sector comes from the overseas export demand vector. The derivation of all tourism sectors was based on TRA tourism expenditure data (TRA, 2010).

Final household consumption by commodities is broken down into tourism and non-tourism parts, and the tourism parts are relocated to the intermediate quadrant to represent the domestic tourism suppliers. Similarly, commodities of inbound tourism are relocated in the intermediate quadrant to represent the domestic supplier of inbound tourism demand. All tourism sectors do not require primary inputs. They act as a middle man to select all goods and services for tourism activity, and then sell all tourism services to the corresponding tourists. This follows closely the approach adopted in the construction of the Tourism Satellite Account (Pham, Dwyer and Spurr, 2009), where the tourism sector is not a commodity or industry per se, as tourists consume a wide range of commodities and services for their tourism activity. Output of each tourism sector is not purchased by any users in the economy other than a specific tourism sector associated with it. For example, output of the inbound tourism sector is only consumed by international tourists and located in the export category. Similarly, outputs of all domestic tourism sectors are not purchased by any industries or any other final demands except the specific components assigned in the household demand vector as the corresponding domestic tourism activities. To some extent, the treatment here reflects exactly how loosely defined the tourism sector is in reality in relation to goods and service markets.

Apart from having four explicit tourism sectors added to the commodity set for each State and Territory, all equations remain unchanged. Appendix A further describes the mechanism of the base model.

Population Projections

Overall condition

The ABS produces population projections in its publication series catalogue ABS 3222.0 (ABS, 2008). The ABS states that the projections are not intended to be predictions or forecasts but they are rather intended as illustrations of a range of population growth outcomes if certain assumptions were to prevail over the projection timeframe. The assumptions focus on four specific areas, namely fertility, mortality, internal migration and overseas migration. The projection incorporates recent trends of the increase in fertility and net overseas migration for Australia. It is noted that ABS assumptions do not allow for non-demographic factors *such as major government policy decisions, economic factors, catastrophes, wars, epidemics or significant health treatment improvements, which may affect future demographic behaviour or outcomes* (ABS, 2008, p. 8). The combination of assumptions generates 72 possible individual projections. The ABS presents only three series for all eight States and Territories, as well as Australia as a whole. Table 1 reproduces the main assumptions adopted by the ABS for the three series identified as A, B and C.

Series B incorporates conditions of the recent trends in fertility, mortality, net overseas migration and net inter-state migration. Series A and C reflect the high and low bounds of variables used in the projection, respectively.

The proportion of people aged 65 years and over is projected to be larger in 2056 (23 to 25 per cent) than in 2007 (13 per cent), and even larger in 2101 (25 to 28 per cent). In contrast, the proportion of people aged under 15 years will be reduced from 19 per cent (2007) to 15 to 18 per cent in 2056 and even lower (14 to 17 per cent) in 2101.

While Series A, B and C for Australia is projected to 2101, these Series are only projected to 2056 for States and Territories. The timeframe in this project is consequently set for 2005–06 to 2049–50, reflecting the timeframe for which the population projections are available for the States and Territories.

Table 1: Main projection series, Australia

	Assumptions				Projected population at 30 June	
			Life expectancy at birth (a)			
	Total fertility rate (b)	Net overseas migration (c)	Males	Females	2056	2101
	Babies per woman	Persons	Years	Years	Million	Million
Series A	2	220,000	93.9	96.1	42.5	62.2
Series B	1.8	180,000	85	88	35.5	44.7
Series C	1.6	140,000	85	88	30.9	33.7

Source: ABS, 2008, p. 3

Notes:

(a) from 2056

(b) from 2021

(c) from 2010–11 in Series A and C; from 2007–08 in Series B

Table 2: Observed net overseas migration (NOM) and assumed regional shares of NOM

Year ended June	NSW	Vic	Qld	SA	WA	Tas	NT	ACT	Australia
				Number of people					
2005	47,428	37,785	26,795	8,455	19,193	1,224	965	764	142,612
2006	53,512	45,084	32,884	11,318	25,642	1,338	656	1,251	171,686
2007	54,891	47,153	33,536	13,146	25,519	1,252	1,321	799	177,617
				Per cent					
2008	31.1	26.5	18.9	7.2	14.4	0.7	0.7	0.5	
2009	31.2	26.5	18.9	7.0	14.4	0.8	0.7	0.5	
2010	31.3	26.5	19.0	6.7	14.5	0.8	0.6	0.6	
2011–2056	31.5	26.5	19.0	6.5	14.5	0.8	0.6	0.6	

Source: ABS, Cat. No. 3222.0, pp. 28–29

States and Territories' condition

Given the assumptions on the levels of fertility and life expectancy at birth, Net Overseas Migration (NOM) at the national level in Table 1 is broken down by State and Territory and added to the Net Inter-state Migration (NIM) to determine the projections of population at the regional level.

Table 2 shows the regional composition of the observed NOM over the last three years. Given a limited number of historical data for the NOM, it was not possible for ABS to estimate a long-term trend of NOM. Therefore, an average of the three years was applied as indicated in the second half of Table 2. All those fixed regional shares of NOM were applied to Series A, B and C. It was acknowledged by ABS that the fixed shares do not reflect possible changes in the future composition of NOM among States and Territories.

Table 3: Observed and assumed net inter-state migration (NIM)

Year ended June	NSW	Vic	Qld	SA	WA	Tas	NT	ACT
				Persons ('000)				
Observed								
1988–2007	-20.5	-7.9	31.2	-2.6	1.6	-1.0	-0.8	0.1
1998–2007	-22.4	0.5	26.0	-2.4	0.5	-0.9	-1.0	-0.3
2003–2007	-28.6	-2.2	31.5	-2.7	2.1	0.9	-0.8	-0.2
2005–2007	-26.4	-2.4	28.0	-3.2	3.5	-0.1	0.1	0.4
Assumed								
				Large interstate flows assumption (Series A)				
2008	-25	-4	26.5	-4.5	4.5	1	1	0.5
2009	-27	-10	34	-5	5	1	1	1
2010–2056	-29	-13	38	-5	5.5	1	1	1.5
				Medium interstate flows assumption (Series B)				
2008	-22.5	-3	24.5	-4	4	0.5	0.5	0
2009	-21.5	-5	26.5	-3.5	3.5	0	0	0
2010–2056	-20	-6	27.5	-3	2.5	-0.5	-0.5	0
				Small interstate flows assumption (Series C)				
2008	-20	-1.5	22.5	-3	3	0	0	-1.0
2009	-18	1	21	-2	1.5	-1	-1	-1.5
2010–2056	-13	2	18	-1	-0.5	-2	-2	-1.5

Source: ABS, Cat. No. 3222.0, pp. 32 and 34

Table 3 shows the observed NIM and the assumed NIM levels for Series A, B and C. It should be noted that the large flow assumption refers to large changes of migration in absolute terms. Thus, this large flow assumption actually results in a large net loss of population to States such as New South Wales or Victoria, and consequently lower growth of population. The small flows assumption results in a larger growth of population for these States. In contrast, the large flow assumption results in higher growth of population in other States such as Queensland and Western Australia.

Table 4 summarises the projections of regional population by giving two point estimates of the projected population in 2026 and 2056. Overall, Queensland and Western Australia are projected to have the strongest growth of population over the whole timeframe. Within the medium to high range (Series B and A respectively), both States are projected to grow from double to more than double their population by 2056. In particular, Queensland is projected to replace Victoria as the second most populous region of Australia by 2056. In contrast, South Australia and Tasmania are projected to grow very modestly. In the extreme case of Series C, Tasmania might face a decline in population.

Table 4: Regional population projection

	June 2007 (a)	At 30 June 2026			At 30 June 2056		
States		Series A	Series B	Series C	Series A	Series B	Series C
		Population ('000)					
New South Wales	6,888	8,677	8,395	8,139	11,789	10,210	9,211
Victoria	5,205	6,898	6,662	6,498	9,850	8,538	7,844
Queensland	4,181	6,553	6,038	5,595	10,921	8,739	7,235
South Australia	1,584	1,942	1,884	1,843	2,540	2,205	2,030
Western Australia	2,106	3,252	3,001	2,773	5,372	4,293	3,518
Tasmania	493	605	552	506	778	571	427
Northern Territory	215	329	285	243	573	402	264
Australian Capital Territory	340	463	417	373	683	509	374
		Index (derived from the above)					
New South Wales	1	1.26	1.22	1.18	1.71	1.48	1.34
Victoria	1	1.33	1.28	1.25	1.89	1.64	1.51
Queensland	1	1.57	1.44	1.34	2.61	2.09	1.73
South Australia	1	1.23	1.19	1.16	1.60	1.39	1.28
Western Australia	1	1.54	1.42	1.32	2.55	2.04	1.67
Tasmania	1	1.23	1.12	1.02	1.58	1.16	0.86
Northern Territory	1	1.53	1.33	1.13	2.67	1.87	1.23
Australian Capital Territory	1	1.36	1.23	1.10	2.01	1.50	1.10

Source: ABS, Cat. No. 3222.0, p. 53

(a) Earlier estimates of the regional population in 2007

Although New South Wales remains the most populous State in Australia, its share in the national population is reduced from 33 per cent in 2007 to 29 or 30 per cent in 2056 (Series B and C respectively). Victoria also has a declining population share in the national total. Queensland's population share in the national total is projected to increase significantly from 20 per cent in 2007 to around 25–26 per cent in 2056. Western Australia's population share increases by a smaller magnitude, from 10 per cent in 2007 to around 12–13 per cent in 2056.

The implication of low levels of fertility and an increase in life expectancy at birth result in a shift in the median age over time, and the longer the projection period, the older the median age becomes for all States and Territories. Table 5 indicates that Tasmania is likely to have a much older population in 2056 compared to all other States and Territories in Australia. Also, the higher the population growth (see Table 4), the younger the population in a region will be.

Table 5: Median age

	2006(a)	2007(b)	At 30 June 2026			At 30 June 2056		
	Observed		A	B	C	A	B	C
New South Wales	36.8	36.9	39.1	39.8	40.8	42.5	42.8	45.5
Victoria	36.7	36.9	38.8	39.5	40.5	42.1	42.5	45.1
Queensland	36.0	36.2	37.9	38.9	40.3	41.3	42.1	45.0
South Australia	38.8	38.9	40.8	41.4	42.4	43.8	43.9	46.6
Western Australia	36.2	36.4	38.1	39.2	40.5	41.4	42.1	45.0
Tasmania	38.8	39.1	41.5	42.9	44.7	44.9	45.7	50.0
Northern Territory	30.9	31.1	32.6	33.3	34.2	33.6	34.5	36.6
Australian Capital Territory	34.4	34.5	36.5	37.5	39.0	39.0	39.8	43.0
Australia (c)	36.6	36.8	38.7	39.5	40.7	41.9	42.4	45.2

Source: ABS, Cat. No. 3222.0, p.56

(a) final estimate

(b) preliminary estimated resident population, base population

(c) Includes other Territories

In this section, we have highlighted the ABS analysis on the projection of regional population. Such projections are likely to have two major impacts on the economy. In the first instance, at the aggregate level, changes to the size of the population will affect total aggregate household consumption. Secondly, the ageing population will lead to changes in labour supply across all States and Territories over time. These effects become the main drivers of the results in this report.

Simulation Assumptions

For impact analysis using the dynamic MMRF model, two series of simulations are required to evaluate the impacts of a policy scenario. The first series of simulations is often referred to as a baseline scenario (or sometimes also referred to as the base case). The baseline projects the development of the State and Territory economies on a path that will be used as a benchmark against which the impacts of the population changes can be measured. By their nature, dynamic CGE models do not generate forecasts for macro economic variables such as gross domestic product (GDP) or gross state product (GSP), total exports, total household consumption and population. Instead, dynamic CGE models adopt those macro forecasts from macro models and produce forecasts for variables at the industry level such as industry output, exports by commodity etc. Data included in the baseline for this project are listed in Table 6. While the foundation of the baseline projection is inherited from the Centre of Policy Studies (CoPS) at Monash University, the specific projections for population and tourism demand of this project are obtained from ABS and TRA.

Table 6: Baseline information

Projection variables	Sources	Dimension	
GSP growth rates	CoPS	State	
Household taste change[1]	CoPS	National	Commodity
Technology change	CoPS	National	Industry
Population growth rates	ABS	State	
Labour participation rates	CoPS	State	
Working age population to total population ratios	CoPS	State	
Hours worked per person	CoPS	National	
Domestic tourism projection	TRA	State	
Inbound tourism projection	TRA	State	

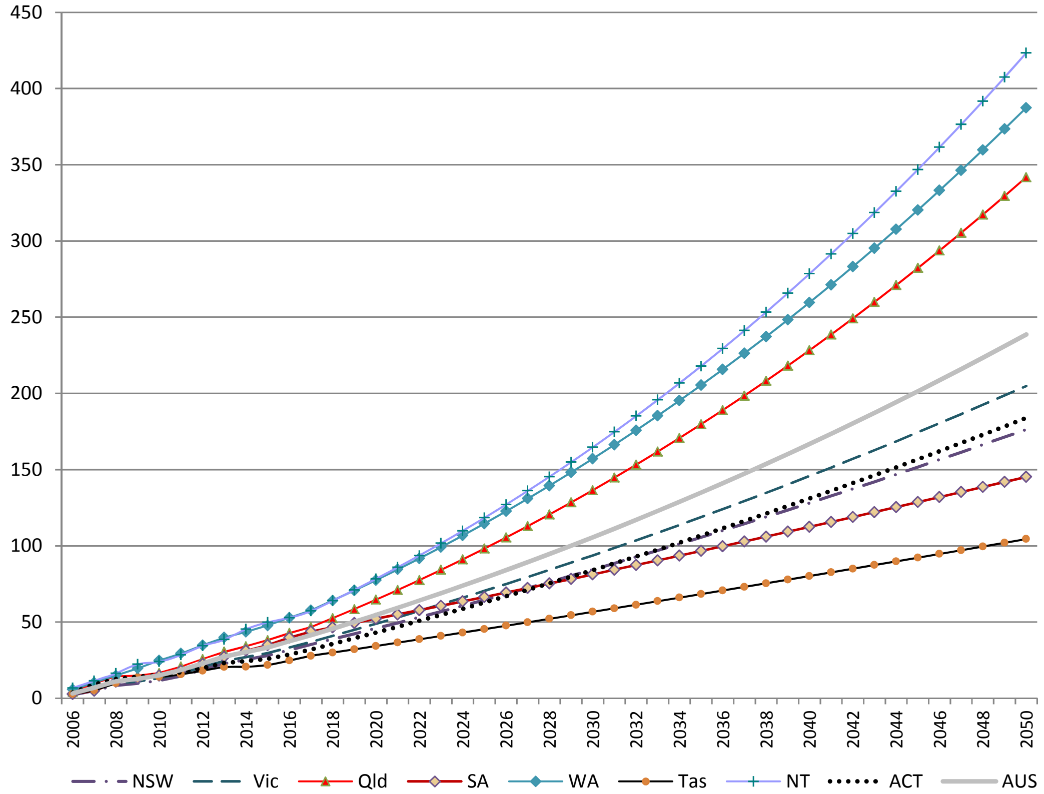
GSP projection

Chart 1 presents GSP growth rates over the period 2005–06 to 2049–50. The projection was implemented in simulations in the form of actual GSP growth rates from the previous year, but Chart 1 presents the projection in the form of cumulative growth over time so that the growth paths of GSP projection of regions can be seen more clearly. The calculation of the cumulative growth of GSP is explained in Box 1.

[1] Household taste change reflects changes in household demands that are not driven by price signals as indicated in the model, but rather mainly by changes in preferences of consumption by the household sector.

The projection of GSP is characterised by higher growth rates in States that experience strong mining exports, such as Northern Territory, Queensland and Western Australia. It should be noted that Northern Territory has a lower base of mining exports than the other two States. The implied stronger mining export growth does not, therefore, mean mining exports from Northern Territory will be larger than mining exports from Queensland and Western Australia in absolute terms. As seen in Chart 1, the growth paths of these three States are projected to be stronger than the GDP growth path at the national level. GSP growth paths for all other States are projected to be below the GDP growth path.

Chart 1: GSP projections 2006-2050 (cumulative growth[2])



Source: Data are inherited from the Centre for Policy Studies, Monash University

[2] For more information about the base case cumulative growth, please see Box 1

Taste change and productivity change

Data for technology and taste changes are a typical output of the MONASH model in the historical simulation (Giesecke and Madden, 2006). As adopted from MMRF's approach, these changes are set to the national historical level across all States.

Labour market

Labour participation rates are assumed to decline, but the annual rate of reduction reduces over time. This assumption of declining labour participation rates is consistent with the ABS analysis of an ageing population. In addition to the changes in labour participation rates, the baseline of MMRF also provides a rich picture of the labour market in the years to come. First of all, it assumes that the ratio of working age population to total population increases over the projection period. However, the ratio increases only *marginally*, and relatively more strongly over the period 2010–11 to 2015–16, than in the subsequent period. This reflects an implied assumption that recent policy could encourage workers to remain job active for a few more years beyond the current retirement age to soften the impact of the ageing population on the labour market. However, the ratio of hours worked per person is assumed to decline to reflect the fact that as workers are getting older, they try to achieve a better work-life balance by choosing to work fewer hours and remain in employment longer.

Population projection

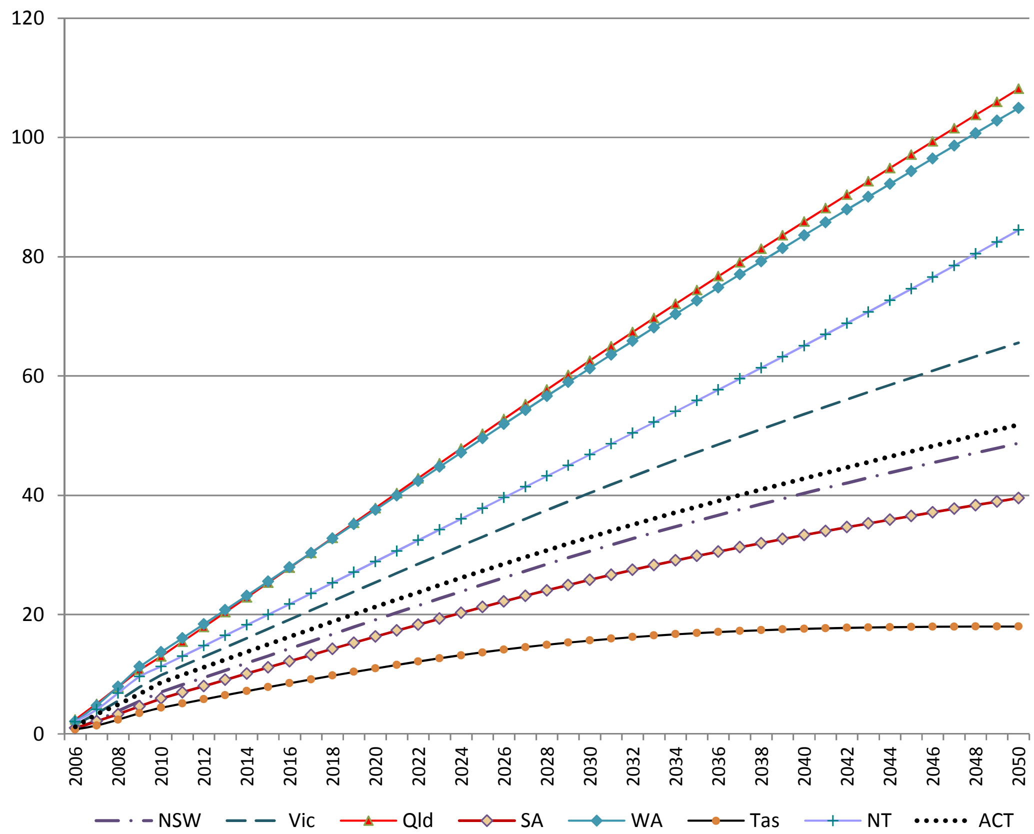
Among the three population projection series, Series B reflects closely the current trends in fertility, life expectancy at birth, net overseas migration and net inter-state migration. Series B is the medium scenario among the three Series. It is thus the Series that is deemed to be most suitable for our baseline scenario of the population. Chart 2 presents the projection path of the population for all States and Territories over the period 2005–06 to 2049–50. Again, the form of cumulative growth is adopted to present the projection. Comparing Charts 1 and 2, it shows that the population projection and the GSP projection are consistent, as the projections for both GSP and population are more favourable for the three States that have strong mining export activity. South Australia and Tasmania are the two States with the weakest growth paths in both GSP and population.

Tourism demand projection

The projections for tourism demand (visitor nights) for domestic and inbound tourists are taken from TRA's forecast by States and Territories (TRA, 2010). Data provided by TRA covers the period from 2000 to 2020, over which the historical data cover the period 2000–2010 and the projection covers the period from 2010 to 2020.

In order to fill the whole timeframe set for this project—2005/06 to 2049/50—the projections of tourism demand are extended in this report to cover the period beyond 2020. The growth rates of tourism demand in the extended period are assumed to continue on the forecast trajectory to 2020. Thus both Charts 3 (inbound tourism) and 4 (domestic tourism) show some fluctuations during the historical period up to 2010, then the projections show smooth growth paths afterward.

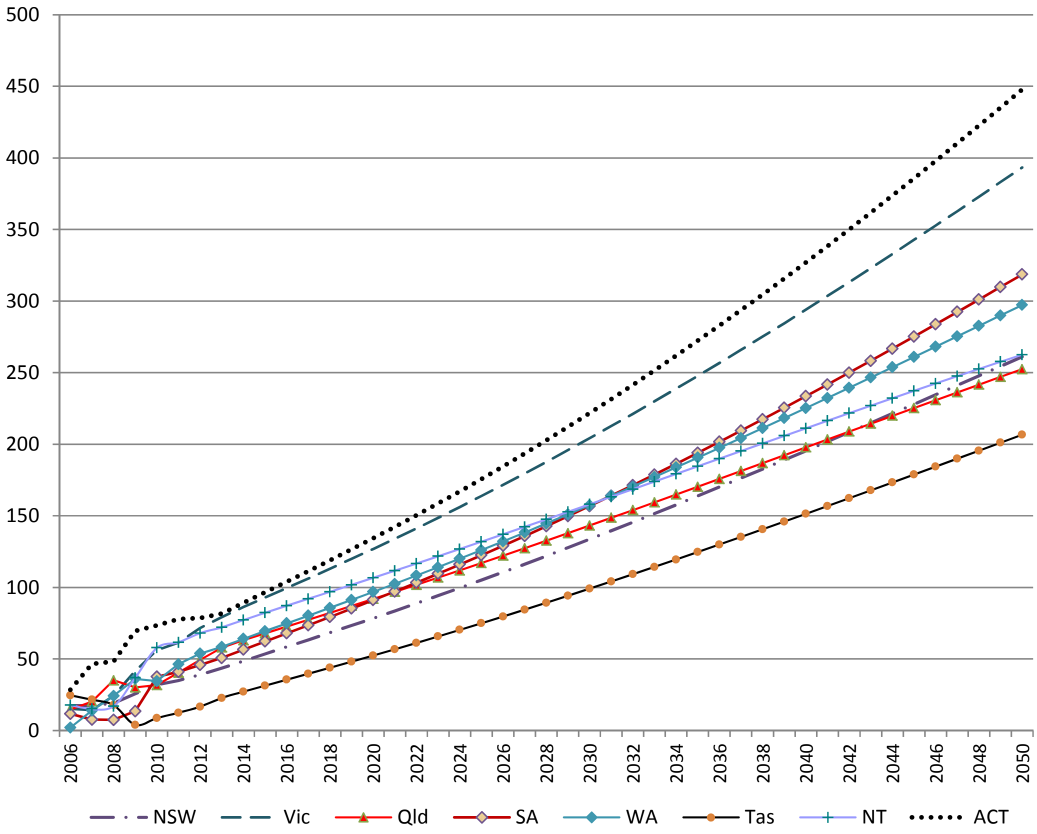
Chart 2: Population projection, Series B (cumulative growth)



Source: Derived from ABS (2008), Cat No. 3222.0.

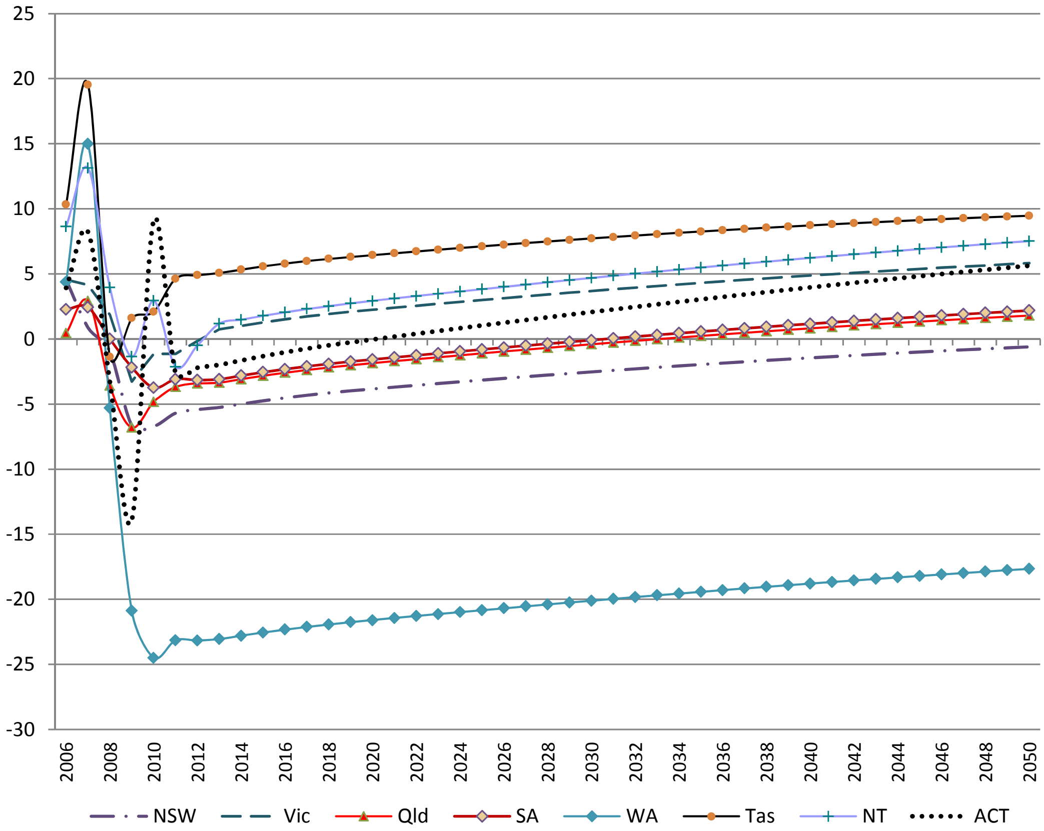
While the projections for inbound tourism (Chart 3) remain strong over the whole projection period for all States and Territories, the projections for domestic demand are not the same. The downturn of the domestic tourism market in 2008, 2009, and even 2010, set the domestic tourism sector back significantly. The projected weak growth rates are not strong enough to bring domestic tourism demand back to the 2006 level, particularly for Western Australia and New South Wales. The domestic projections are applied equally for both inter-state tourism and intra-state tourism in this project. Again, note that while the growth rates in the projection relate to percentage change from the previous year, Charts 3 and 4 are presented to show the cumulative effect of annual growth rates over the whole timeframe.

Chart 3: Projection of inbound tourism by State (cumulative growth)



Source: Derived from TRA (2010a)

Chart 4: Projection of domestic tourism by State (cumulative growth)



Policy shocks

This project aims to measure the impacts of the changing sizes of the population on the tourism sector, for both domestic and inbound tourism. Thus in the policy simulations, tourism demand for both domestic and inbound tourism are determined by the model under the influence of changes to the population. The results are compared with the projected paths in Charts 3 and 4 for the tourism sectors.

Recall that as Series B contains most of the current conditions of the population (fertility, mortality, NOM and NIM), Series B is used as a benchmark for our analysis. Table 4 indicated that Series B is in fact a medium projection for regional population with the upper bound being Series A and the lower bound being Series C.

This project looks at two scenarios and examines the impacts of those scenarios on the tourism sectors. The first scenario examines the impact of a case where the growth of the population projection increases from Series B to Series A. In the second scenario, we examine the case when the growth of population projection contracts and reduces their sizes from Series B down to Series C.

Table 7: Summary of scenarios

	Baseline	Scenario 1 Upper bound	Scenario 2 Lower bound
Population	Series B	Series A	Series C

Model Closure

As previously explained, the regional population projections were already incorporated in net inter-state migration. Thus in the actual simulations, net inter-state migration is not needed. In the standard closure, the labour supply side is assumed to move in line with the population growth. However, in this project, labour supply is also determined by extra shocks related to the ratio of working age population in the total and the labour participation rates. As a result, labour supply in this exercise is effectively determined from exogenous shocks. The real wage rate at the national level is determined by the model in order to reflect changes in demand for labour. At the regional level, nominal wages of regions are set to move in line with the national nominal wage and again determined by the model, this time to reflect changes in demand for labour at the State level. Over the historical period 2005–06 to 2009–10, historical changes in unemployment were fed into the model, then the same unemployment in 2010–11 was maintained over the projection period from 2010–11 to 2049–50. Effectively, labour demand moves in line with labour supply to maintain the same “wedge” of unemployment, given the assumptions of changes to labour participation rates and the working age population to total population ratio.

In dynamic simulations, capital stock available for the production in a year is taken from the capital stock at the end of the previous year. The level of investment during a year depends on the after-tax net rate of return. For every subsequent increment in capital stock, investment is only supplied when investors receive an increase in the expected rate of return. Thus investment growth and capital growth are not following a fixed ratio as often seen in CGE comparative static mode simulations.

Real household consumption of a region is determined by the population and the disposable income generated in the region. Real federal government consumption is tied to real GDP growth rate while State government consumption is linked to GSP growth. In order to generate constant 2004-05 price results over the whole timeframe, national Consumer Price Index (CPI) is used as a base and set at zero while exchange rate is set as a variable within the model. Exogenous CPI does not affect the results for real variables in the simulations.

Modelling Limitations

When we compare scenarios, changes in population projections will generate changes to aggregate household consumption. One particular cost that is often associated with the ageing of the population is the health care costs. Unfortunately, there are no projections of health care costs associated with the changes of population projections by ABS. Thus health care costs are not explicitly identified in this study which may therefore under-estimate the impact of such changes on government expenditure.

It appears that a positive correlation exists between overseas and inter-state migration and tourism. Immigrants will frequently have friends and relatives coming to visit and this will also apply in the case of inter-state migration. Migrants to a new State could also become visitors to their state of origin. Thus changes in the assumptions of net inter-state migration could result in changes for inter-state tourism. However, such correlation is not captured in this modelling exercise as we do not have access to estimates for such a relationship.

Simulation Results

Before we proceed to explain the results, it is necessary to familiarise readers with the way results are presented in a dynamic CGE model using GEMPACK (Harrison and Pearson, 2002) software. Simulations generate results of variables in percentage change form from the previous year. This is often referred to as a year-on-year result. As a dynamic simulation can cover a period of many years it is useful to see the changes of a variable in any specific year in relation to the data-base year. Thus cumulative growth projections can give a good picture of the development path of variables over time. Such cumulative growth projections have already been used in this report in Charts 1, 2, 3 and 4. Occasionally, this *cumulative* form will be used to present results of the baseline and the policy simulations. However, the form of *percentage cumulative deviation* will be used more often in this section to present the impacts as percentage deviation of the policy line from the baseline scenario. Box 1 gives some examples and calculations of cumulative deviation results as compared to year-on-year results.

It is also important to summarise the labour force movements so that the impacts can be visualised easily. It is not the position of each region’s projection of population that drives the outcome of the impacts. The key here is the relative changes in population projections between the two scenarios Series A and Series B, and between Series C and Series B. Table 8 provides the averages of two variables over four different periods of the timeframe. The first half of the table derived the averages from the original values (provided by CoPS) on how the labour participation ratios change with the ageing population assumption. The second half of the Table provides the relative changes of the population projections between the two series A and B. In this section, the period 2006–2010 is a historical period, over which ABS historical data for labour growth were used. Thus there were no differences for this period between the baseline and the policy simulation.

BOX 1: Example of year-on-year and cumulative spreadsheets

To see how these are built up, consider results for a scalar variable x3tot (household consumption) whose percentage-change of the base case and the policy run are presented on rows 1 and 2 for the first 4 years.

Presentations of simulation results

				y1	y2	y3	y4
1	Base case	year-on-year	per cent	2	3	4	5
2	Policy	year-on-year	per cent	3	3.5	4.7	5.8
3	Deviation	year-on-year	percentage point change	1	0.5	0.7	0.8
4	Base case	cumulative	per cent	2	5.06	9.26	14.73
5	Policy	cumulative	per cent	3	6.60	11.62	18.09
6	Deviation	cumulative	per cent	0.98	1.47	2.15	2.93

Deviation year-on-year (row 3) = row 2 – row 1.

y2 0.5 = 3.5 – 3

y3 0.7 = 4.7 – 4

The cumulative results are derived as follows:

Base case cumulative on row 4:

y2 5.06 = 100*(1.02*1.03 – 1) (results on row 1)

y3 9.26 = 100*(1.02*1.03*1.04 – 1) (results on row 1)

Policy cumulative on row 5:

y2 6.60 = 100*(1.03*1.035 – 1) (results on row 2)

y3 11.62 = 100*(1.03*1.035*1.047 – 1) (results on row 2)

Percentage cumulative deviation (row 6)

y1 0.98 = 100*[1.03/1.02 – 1]

y2 1.47 = 100*[1.066/1.0506 – 1]

y3 2.15 = 100*[1.1162/1.0926 – 1]

y4 2.93 = 100*[1.1809/1.1473 – 1]

Source: examples are elaborated from RunDynam online help

Table 8: Labour force movements

Summary of the labour force

Average percentage change of labour participation ratio (per cent) [(a)]

	2006–2010	2011–2020	2021–2030	2031–2040	2041–2050
New South Wales	0.689	-0.188	-0.369	-0.259	-0.203
Victoria	0.646	-0.225	-0.374	-0.261	-0.204
Queensland	0.604	-0.223	-0.384	-0.268	-0.211
South Australia	0.657	-0.231	-0.371	-0.263	-0.205
Western Australia	0.677	-0.255	-0.383	-0.266	-0.208
Tasmania	0.641	-0.220	-0.376	-0.269	-0.206
Northern Territory	0.569	-0.198	-0.365	-0.248	-0.201
Australian Capital Territory	0.726	-0.238	-0.376	-0.258	-0.200

Average percentage point change (difference) between Series A and Series B [(b)]

	2006–2010	2011–2020	2021–2030	2031–2040	2041–2050
New South Wales	0	0.162	0.279	0.345	0.396
Victoria	0	0.174	0.282	0.339	0.383
Queensland	0	0.456	0.473	0.466	0.477
South Australia	0	0.146	0.267	0.348	0.403
Western Australia	0	0.451	0.476	0.475	0.487
Tasmania	0	0.484	0.614	0.700	0.768
Northern Territory	0	0.813	0.782	0.719	0.693
Australian Capital Territory	0	0.573	0.626	0.630	0.637

Sources: (a) Shocks inherited from CoPS

(b) Derived from ABS, Cat No. 3222.0, 2008

Scenario 1: The upper bound population projection – Impacts of Series A

The main difference between the baseline and the policy simulation in this scenario is the projections of population between Series A and Series B. The policy shock of higher population projections generates two effects directly on the economy. The first immediate impact of the higher population growth is an increase in labour supply in all States and Territories (Chart 5). Northern Territory, Australian Capital Territory and Tasmania have the strongest increase in their labour supply due to strong increases in population projections from Series B to Series A (Table 8). Queensland and Western Australia have labour supply increases in the medium range of about 20 per cent higher than the baseline by 2050, while New South Wales, Victoria and South Australia have only around 10 per cent increases in their labour supply by the end of the whole timeframe (Chart 5).

The extra labour in the market softens the demand for labour in all regions thereby reducing the real wages that producers have to pay (Chart 6[3]). But not all regions have the same wage reductions (Table 9). Among them, New South Wales, Victoria and South Australia have modest reductions throughout the whole timeframe. The reductions for these regions in the second period are not as quick compared to other States. The Northern Territory and Tasmania are the two States that have real wages reduced very sharply, and lower than all other States throughout the whole timeframe.

Table 9: Average percentage cumulative deviation of real wages

	2006–2010	2010–2020	2021–2030	2031–2040	2041–2050
NSW	0	-0.373	-1.300	-2.207	-3.134
Vic	0	-0.426	-1.401	-2.331	-3.321
Qld	0	-1.464	-3.598	-4.753	-5.764
SA	0	-0.356	-1.322	-2.455	-3.815
WA	0	-1.386	-3.512	-4.822	-5.912
Tas	0	-1.422	-4.104	-6.371	-8.642
NT	0	-2.771	-5.938	-6.714	-7.081
ACT	0	-1.399	-3.568	-4.741	-5.482
AUS	0	-0.787	-2.194	-3.232	-4.219

[3] Charts show impacts for the whole timeframe 2005–06 to 2049–50. Tables present a summary of the impact by using average over five periods of the whole timeframe.

Lower real wages reduce costs of production, thus stimulating the domestic economy to provide more exports (Chart 7) for all States by the end of 2050. But not all States could expand their exports immediately (see Chart 7 and Table 10 for a summary of these results). We will come back to explain this later, but overall the effect of lower wage rates generates very strong export growth in Tasmania, Northern Territory and Australian Capital Territory. This is mainly due to improved competitiveness of these regions in the world markets. However, these regions do not have large export shares in the national total and the contribution of exports from these regions does not make a significant impact on the Australian economy as a whole. The most significant contribution to the national economy from exports in this case is from Queensland and Western Australia, which account for approximately 24 and 21 per cent of total exports respectively. The reductions in real wages in New South Wales and Victoria seem to keep pace with Queensland and Western Australia from 2031 onwards, thus their change in exports more closely match those of Queensland and Western Australia in the last two periods (Table 10).

Table 10: Average percentage cumulative deviation of real exports

	2006–2010	2010–2020	2021–2030	2031–2040	2041–2050
NSW	0	-0.452	0.561	3.508	7.414
Vic	0	-0.480	0.421	3.075	6.362
Qld	0	0.546	2.653	5.835	9.841
SA	0	-0.555	-0.193	1.866	4.877
WA	0	0.588	2.830	6.229	10.439
Tas	0	0.790	4.439	10.359	17.940
NT	0	2.134	8.165	15.633	23.910
ACT	0	2.598	10.152	18.896	27.984[4]
AUS	0	0.128	1.932	5.293	9.516

[4] It should be noted that the exports of ACT increase significantly compared to all other States, as the initial export value of the region is rather modest. Therefore, a small increase in exports could result in large export growth from the region. The main exports of the region include metal products, business services, education and tourism.

Although the relatively cheaper cost of labour is a favourable condition for the producers, it limits the ability of the household sectors to engage in consumption, as lower wage income per capita will be experienced in the economy. Compared to labour income, capital income increases much more strongly in the policy simulation and contributes significant shares to total income. As the population size in regions increases, the second effect is the higher final demand by regional households. This effect somewhat counters the positive effect of the larger labour supply that has induced real wage reductions, as higher demand from households will push wages up. Without the increase in household demand from a larger population size and also higher export demand, Chart 6 would have had even larger reductions in real wages. The combined effect of real wage changes and the size of population on regional household consumption is given in Chart 8.

The sharp reduction in real wages in Northern Territory, Tasmania and Australian Capital Territory helps regional exports grow faster than exports from other regions. It subsequently increases their regional household consumption significantly above that experienced by other regions in terms of average percentage deviation, as can be seen from Table 11. The gaps in household consumption between Queensland, Western Australia, Tasmania, Northern Territory and Australian Capital Territory are not as large as the gaps in exports in Table 10, except when the reduction in real wages in Northern Territory levels out in the last two periods. At this time, the effect of higher population growth in Northern Territory begins to take effect, as household consumption grows much faster than in other regions.

Table 11: Average percentage cumulative deviation of real household consumption

	2006–2010	2010–2020	2021–2030	2031–2040	2041–2050
NSW	0	0.52	2.24	4.69	7.71
Vic	0	0.56	2.38	4.88	7.90
Qld	0	1.01	4.19	8.24	12.76
SA	0	0.51	2.24	4.71	7.79
WA	0	0.99	4.07	7.96	12.32
Tas	0	1.05	4.42	9.01	14.58
NT	0	1.17	5.89	12.65	20.08
ACT	0	0.85	3.86	8.12	13.16
AUS	0	0.70	3.00	6.13	9.83

The effect of lower real wages in regions makes domestically produced goods cheaper than imported goods, household sectors in all regions substitutes away from imported sources and increases their purchases from the domestic economy. Although the substitution of domestic sources for imported sources occurs, the total demand from the larger size of the household sectors is so dominant that it overrides the substitution effect. So, total imports increase (Chart 9) and the demand for imports follows closely the pattern of total household consumption in Chart 8.

As the relatively higher projection of population could provide more labour available to the economy, making real wages lower than previously, the fall in real wages makes labour relatively cheaper than capital. This effect slightly increases the labour/capital ratio as producers will substitute more labour for capital. Thus, overall capital is still growing more than the base case (Chart 10) but not as strongly as the increase in labour (Chart 5). The demand for capital generates a relatively higher rental to capital and subsequently after-tax rental to capital (after-tax unit income from capital). Given the cheaper cost of goods produced domestically, the cost of investment is now relatively cheaper than previously. Therefore, the higher after-tax income from capital combined with a cheaper cost of investment leads to a significantly higher net rate of return to capital than the base case for investors, which stimulates very strong growth in investment across all regions (Chart 11), even higher than the household consumption growth (compare Tables 11 and 12).

It should be noted that even though taste change and productivity change were implemented in the baseline, as the policy line also inherited the same changes in taste change and productivity, these effects cancel each other out between the baseline and the policy simulation.

Table 12: Average percentage cumulative deviation of real investment

	2006–2010	2010–2020	2021–2030	2031–2040	2041–2050
NSW	0	0.91	3.61	7.01	11.06
Vic	0	0.94	3.64	6.93	10.74
Qld	0	1.91	6.50	11.29	16.35
SA	0	0.83	3.42	6.81	10.93
WA	0	1.30	4.98	9.07	13.68
Tas	0	2.11	7.75	14.53	22.38
NT	0	4.05	13.61	22.80	31.67
ACT	0	2.33	8.55	15.57	22.88
AUS	0	1.28	4.82	8.91	13.51

As the nominal Federal Government consumption is assumed to move in line with national nominal GDP, and similarly the nominal State government consumption moves in line with nominal GSP, cheaper domestic production costs allow both types of real government consumption to increase more strongly than growth in GDP and

GSP respectively. As previously mentioned, information is not available for the projection of health care or any other related costs associated with the ageing population that the public sector has to deal with. In the absence of this information, the assumption here partially caters for the most stringent condition that governments at both levels incur with a larger ageing population. Both levels of government consumption increase more strongly in the policy simulation than in the base and of the two, the State government consumption increases to a larger extent than the Federal Government consumption in each State. Combined government consumption is growing relatively strongly and broadly on the same growth path as investment. For that reason, regional exports increase as expected when cheaper costs of production occurs, but not to the extent that exports could become the main contributor to GSP. Overall, GSP growth rates in all States are above the GSP projection of the baseline in a range of 10 per cent to 30 per cent, depending on the State (Chart 14).

Regional differences

As seen from Table 8, over the period 2010-2020, New South Wales and Northern Territory have the smallest loss of labour participation in the workforce compared to all other States. However, the projection of population for Northern Territory is much stronger than those for other States and around double that of Queensland and Western Australia; the two States that were expected to have the highest GSP growth. In fact, the projection of population and labour supply for Northern Territory remains strong over the whole timeframe. Thus, the evidence of a favourable condition for Northern Territory has been seen throughout the whole timeframe. Following Northern Territory are the other two small regions, Tasmania and Australian Capital Territory. Table 13 summarises labour supply changes between the baseline and the policy simulation for all States.

The middle group includes only Queensland and Western Australia. These two States are quite similar, and projected to have very similar development in population changes (Table 8), as well as labour supply, between the baseline and the policy simulation (Chart 5). This was the main reason for them to have very similar patterns of impacts and why they always occupy the middle ground in terms of changes when compared to all other States.

The last group includes New South Wales, Victoria and South Australia, which have nearly identical changes in labour supply. The impacts of the difference in population projections on these three States are very similar. Table 14 summarises the impacts measured in terms of GSP growth.

Table 13: Average percentage cumulative deviation of labour supply

	2006–2010	2010–2020	2021–2030	2031–2040	2041–2050
NSW	0	0.610	2.860	6.094	10.088
Vic	0	0.672	3.005	6.234	10.122
Qld	0	2.044	6.932	12.041	17.429
SA	0	0.534	2.625	5.795	9.840
WA	0	2.008	6.880	12.049	17.548
Tas	0	2.068	7.825	15.076	23.817
NT	0	3.734	12.414	21.125	29.950
ACT	0	2.547	8.912	15.946	23.509
AUS	0	1.165	4.514	8.628	13.355

Source: Derived from ABS, Cat. No. 3222.0

Table 14: Average percentage cumulative deviation of GSP

	2006–2010	2010–2020	2021–2030	2031–2040	2041–2050
NSW	0	0.412	2.146	4.851	8.319
Vic	0	0.459	2.269	4.963	8.301
Qld	0	1.266	4.874	9.166	13.872
SA	0	0.366	1.969	4.536	7.876
WA	0	1.236	4.772	9.005	13.688
Tas	0	1.385	5.741	11.626	18.806
NT	0	2.371	9.305	17.558	26.236
ACT	0	1.871	7.121	13.459	20.484
AUS	0	0.775	3.358	6.877	11.065

Results of the impacts on the States and Territories seem to fall into three groups and show a degree of correlation between the impacts and the projections of labour supply. The only difference that needs further explanation is the exports of New South Wales, Victoria and South Australia over the period 2011–12 to 2022–23 (Chart 7). While all other States have an increase in exports, these three States suffer weaker export growth rates as compared to their exports in the baseline. The distinct difference between the group of New South Wales, Victoria and South Australia with all other States is that the labour supply in Series A does not increase significantly from Series B as compared to other States. Therefore, while all other States would achieve much lower wage reductions in the policy simulation, the wage reductions in these three States are very modest – to the extent that the reductions are not enough to fully offset the increases in unit cost of capital (rental to capital). Thus export prices from these three States actually increase slightly, resulting in losses in their exports.

Impacts on inbound tourism

Table 15 presents the impacts on inbound tourism under the effect of higher population projections. Results are presented for different periods of the whole timeframe in the form of percentage cumulative deviation.

Just like any other exported goods and services, inbound tourism is driven by the domestic cost of production, which is associated with the region's competitiveness in international markets. As the population projection for Series A is not so much stronger than in Series B for New South Wales, Victoria and South Australia, their real wage reductions could not lower their costs of production compared to the baseline over the period 2010–2020 while the real cost of capital is increasing. Thus their costs of production are slightly above the baseline, resulting in these States being more expensive for overseas visitors to visit. Under this effect, inbound tourism to these regions declines marginally over the period 2010–2020, but bounces back up again by the end of 2050 However, levels will remain significantly below the level of inbound tourism in Queensland by that time.

Table 15: Average percentage cumulative deviation of inbound tourism

	2006–2010	2010–2020	2021–2030	2031–2040	2041–2050
			Per cent		
NSW	0	-0.427	1.298	5.186	9.517
Vic	0	-0.288	1.591	5.535	10.002
Qld	0	1.637	6.142	10.937	15.041
SA	0	-0.431	1.022	4.492	8.416
WA	0	2.652	9.415	16.309	22.288
Tas	0	1.800	8.094	16.626	26.341
NT	0	3.787	11.910	19.216	25.189
ACT	0	2.588	9.972	18.369	26.726

The top group includes Tasmania, Northern Territory and Australian Capital Territory as the cost of visiting these regions becomes cheaper because of an increased supply of labour. This gives them an edge in international competitiveness in terms of a large improvement in their production costs.

Impact on intra-state tourism

Intra-state tourism is modelled very similarly to other commodities consumed by households. Intra-state tourism demand is driven by income, as well as the number of people in a region. As a result, the pattern of intra-state tourism is very similar to the pattern of household consumption that was presented in Table 11.

Table 16: Average percentage cumulative deviation of intra-state tourism

	2006–2010	2010–2020	2021–2030	2031–2040	2041–2050
			Per cent		
NSW	0	0.570	2.219	4.354	6.751
Vic	0	0.603	2.349	4.556	6.932
Qld	0	0.929	3.981	7.758	11.565
SA	0	0.567	2.229	4.400	6.860
WA	0	0.870	3.845	7.659	11.680
Tas	0	0.975	4.155	8.416	13.337
NT	0	1.084	5.979	12.553	19.172
ACT	0	0.588	3.264	7.231	11.626

Inter-state tourism

Bilateral inter-state tourism is driven by two factors; the cost of visiting in a destination region, and the income of the origin region. When income in the origin region increases, tourists from this region will travel more to other regions. But among the destinations, the one that has relatively cheaper costs to visit will attract more tourists than other, more expensive regions. Table 17 shows the changes in total demand for inter-state tourism in destination regions (States and Territories).

During the period 2010–2020, when household income increases are not as strong, the effect of cost differentials among destination regions plays an important role in determining the attraction or competitiveness of domestic tourism destinations. The weak increase in inter-state tourism from other States to New South Wales and Victoria over the period 2010–2020 illustrates this cost differential effect because wage reductions in these regions were not as large as in other States, and the cost of production in these two States increases in the policy simulation[5]. These two States thus appear to be less attractive than other regions while all regions have not achieved strong increases in incomes. However, later when income increases are relatively larger, the income effect appears to be more dominant and increases in inter-state tourism demand in New South Wales and Victoria are broadly the same as in all other regions.

[5] Please refer to the export Chart 7 in which NSW, Vic and SA have export decline over the period 2010–2011 to 2022–23, or Table 11

Table 17: Average percentage deviation of inter-state tourism demand

	2006–2010	2010–2020	2021–2030	2031–2040	2041–2050
			Per cent		
NSW	0	0.582	2.831	6.094	9.982
Vic	0	0.582	2.711	5.794	9.531
Qld	0	0.672	2.719	5.459	8.709
SA	0	0.625	2.873	6.096	9.953
WA	0	0.663	2.841	5.851	9.453
Tas	0	0.652	2.826	5.846	9.455
NT	0	0.656	2.752	5.619	9.048
ACT	0	0.606	2.614	5.417	8.808

Scenario 2: The lower bound population projection – Impacts of Series C

This is an opposite scenario to the previous one. In this scenario, the projection of population is not growing as fast as the population projection in the base case due to a smaller rate of natural increase, smaller net inflows of overseas migration (Table 1), and smaller net inter-state migration (Table 3). The logic of impact analysis in this scenario is very similar to that in the above simulations, except in reverse. Thus, in this section, we provide results of simulations with only a brief explanation where needed.

Changes to the population projection in Series C compared to the benchmark are presented in Table 18. As can be seen from the Table, New South Wales, Victoria and South Australia have the smallest contraction in population compared to all other States while Tasmania, Northern Territory and Australian Capital Territory have the most significant reductions in population compared to all other States. The reason for such dramatic changes to their population sizes follow from the assumption of a smaller rate of natural increase and reduced net overseas migration.

The reason for changes in the relativities of the population sizes is mainly due to the small flows of net inter-state migration. New South Wales no longer loses a large number of residents to Queensland; and Victoria now has a net positive inflow of inter-state migration instead of losing residents to other States in the baseline. In order to compensate for the smaller supply of net outflow of inter-state migration—which used to be mainly from New South Wales—the four regions (Western Australia, Tasmania, Northern Territory and the Australian Capital Territory) lose inter-state migration to Queensland and Victoria.

Table 18: Average percentage cumulative deviation of population projection.

	2006–2010	2010–2020	2021–2030	2031–2040	2041–2050
NSW	0	-0.84	-2.80	-4.85	-7.04
Vic	0	-0.66	-2.29	-4.01	-5.83
Qld	0	-2.33	-6.44	-9.98	-13.23
SA	0	-0.58	-2.07	-3.71	-5.56
WA	0	-2.40	-6.67	-10.42	-13.89
Tas	0	-2.47	-7.47	-12.69	-18.33
NT	0	-4.62	-12.81	-20.13	-26.74
ACT	0	-3.11	-8.95	-14.52	-19.91

Source: ABS, Cat. 3222.0

Changes in population sizes are translated into an overall smaller labour supply in all States (Table 19), which puts higher pressure on the labour market with increases in real wages across all States (Table 20). At the same time, smaller population sizes require less final demand for goods and services in the form of normal household consumption across all States (Table 21). We emphasise at this point that there might be an increase in health care services that an ageing population is likely to demand, but at this stage that demand is not captured in our analysis because of insufficient information on this issue. The increases in real wages have an implication of loss of competitiveness for domestic producers in overseas markets because domestic prices are higher than previously, causing regional exports to grow less in the policy simulation than in the baseline (Table 22) for most periods. Overall, GSP grows less in the policy simulation (due to contracting population sizes) than in the baseline (Table 23).

Table 19: Average percentage cumulative deviation of labour supply

	2006–2010	2010–2020	2021–2030	2031–2040	2041–2050
NSW	0	-0.67	-2.59	-4.65	-6.81
Vic	0	-0.53	-2.12	-3.84	-5.63
Qld	0	-1.91	-6.05	-9.65	-12.91
SA	0	-0.46	-1.91	-3.54	-5.36
WA	0	-1.96	-6.27	-10.07	-13.54
Tas	0	-2.00	-6.95	-12.16	-17.74
NT	0	-3.78	-12.03	-19.43	-26.10
ACT	0	-2.54	-8.37	-13.98	-19.37
AUS	0	-1.11	-3.87	-6.58	-9.25

Table 20: Average percentage cumulative deviation of real wages

	2006–2010	2010–2020	2021–2030	2031–2040	2041–2050
NSW	0	0.42	1.17	1.62	2.04
Vic	0	0.33	0.97	1.38	1.78
Qld	0	1.42	3.40	4.22	4.78
SA	0	0.31	0.93	1.39	1.94
WA	0	1.41	3.50	4.54	5.26
Tas	0	1.43	4.00	6.02	8.18
NT	0	3.04	7.03	8.49	9.32
ACT	0	1.45	3.77	5.14	6.17
AUS	0	0.77	1.99	2.62	3.12

Table 21: Average percentage deviation of real household consumption

	2006–2010	2010–2020	2021–2030	2031–2040	2041–2050
NSW	0	-0.53	-2.06	-3.80	-5.65
Vic	0	-0.50	-1.89	-3.44	-5.04
Qld	0	-0.96	-3.72	-6.75	-9.75
SA	0	-0.48	-1.84	-3.35	-4.98
WA	0	-0.97	-3.76	-6.83	-9.90
Tas	0	-1.02	-3.98	-7.43	-11.16
NT	0	-1.20	-5.76	-11.69	-17.71
ACT	0	-0.84	-3.60	-7.08	-10.83
AUS	0	-0.68	-2.66	-4.92	-7.28

Table 22: Percentage cumulative deviation of export volume

	2006–2010	2010–2020	2021–2030	2031–2040	2041–2050
NSW	0	0.35	-0.63	-2.63	-4.78
Vic	0	0.55	0.02	-1.50	-3.06
Qld	0	-0.53	-2.55	-5.11	-7.80
SA	0	0.57	0.42	-0.68	-2.01
WA	0	-0.61	-2.85	-5.65	-8.54
Tas	0	-0.83	-4.36	-9.15	-14.53
NT	0	-2.31	-8.74	-15.65	-21.98
ACT	0	-2.75	-10.17	-17.36	-23.94
AUS	0	-0.149	-1.865	-4.459	-7.213

Table 23: Percentage cumulative deviation of real GSP

	2006–2010	2010–2020	2021–2030	2031–2040	2041–2050
NSW	0	-0.46	-1.99	-3.82	-5.81
Vic	0	-0.36	-1.63	-3.13	-4.75
Qld	0	-1.20	-4.37	-7.61	-10.69
SA	0	-0.32	-1.48	-2.90	-4.49
WA	0	-1.23	-4.48	-7.81	-10.99
Tas	0	-1.36	-5.25	-9.76	-14.71
NT	0	-2.46	-9.32	-16.62	-23.39
ACT	0	-1.89	-6.81	-12.03	-17.21
AUS	0	-0.75	-2.99	-5.51	-8.12

Impacts on inbound tourism

In this scenario, Northern Territory, Tasmania and the Australian Capital Territory have the most severe impacts on their overseas tourism markets. To some extent, the impacts on inbound tourism are more pronounced than the impacts on total exports for each region, implying that inbound tourism is the first export sector to be hit when domestic costs increase. This is quite plausible as tourism exports are unlike other traditional exports in the sense that they do not require any sale contract. Thus any movement in domestic prices could result in changes in tourism demand seemingly instantly, while most traditional exports are based on sales contracts. And often, sales contracts could allow room for price adjustments, and purchasers and sellers are locked into the contract for a certain period of time. Thus it is possible to have a time lag of sales volume changes in response to price movement. Table 24 summarises the changes in inbound tourism by showing the average of percentage cumulative deviation of the policy simulation as compared to baseline.

Table 24: Average cumulative deviation of inbound tourism

	2006–2010	2010–2020	2021–2030	2031–2040	2041–2050
NSW	0	0.27	-1.31	-3.82	-6.23
Vic	0	0.43	-0.76	-2.92	-5.06
Qld	0	-1.57	-5.68	-9.19	-11.98
SA	0	0.47	-0.45	-2.24	-4.06
WA	0	-2.65	-8.72	-13.37	-17.01
Tas	0	-1.84	-7.65	-14.11	-21.12
NT	0	-4.03	-12.45	-19.24	-24.83
ACT	0	-2.77	-10.21	-17.49	-24.22

Impacts on intra-state tourism

The changes in intra-state tourism demand are closely in line with changes in household consumption in each region as they are affected by income level, as well the size of the population in a region.

Table 25: Percentage cumulative deviation of intra-state tourism demand

	2006–2010	2010–2020	2021–2030	2031–2040	2041–2050
NSW	0	-0.58	-2.06	-3.64	-5.23
Vic	0	-0.55	-1.92	-3.31	-4.65
Qld	0	-0.89	-3.55	-6.47	-9.21
SA	0	-0.54	-1.88	-3.26	-4.65
WA	0	-0.86	-3.56	-6.67	-9.71
Tas	0	-0.95	-3.76	-7.06	-10.56
NT	0	-1.11	-5.86	-11.78	-17.50
ACT	0	-0.56	-2.96	-6.20	-9.59

Impacts on inter-state tourism demand

As in the previous case, the inter-action between the income level of the origin region and the costs of tourism output in the destination region results in a convergence of final impacts across all States. The reductions in inter-state tourism are broadly the same by the end of the timeframe. Results in this scenario also confirm that when income changes are not strong enough, the price effect does help some regions to attract more tourists than others. This is the case for New South Wales and Victoria in the 2010–2020 period, when real wage increases in these two regions are not as high as in other regions, and income reductions are not significantly different between regions.

Table 26: Percentage cumulative deviation of inter-state tourism demand

	2006–2010	2010–2020	2021–2030	2031–2040	2041–2050
NSW	0	-0.55	-2.44	-4.78	-7.24
Vic	0	-0.57	-2.41	-4.68	-7.11
Qld	0	-0.65	-2.40	-4.34	-6.36
SA	0	-0.60	-2.54	-4.93	-7.47
WA	0	-0.64	-2.51	-4.66	-6.92
Tas	0	-0.63	-2.48	-4.65	-6.94
NT	0	-0.65	-2.48	-4.56	-6.73
ACT	0	-0.60	-2.36	-4.40	-6.56

Conclusions

In this report, we examine the impacts of changes in the regional population projections on the overall economy and the tourism sectors specifically. Projections on the population provide a range of estimates that the population growth might be in the future. As stated by ABS, these estimates are not intended to be forecasts or predictions into the future; they are merely illustrations of a range of outcomes if certain assumptions were to prevail over the projection timeframe. Our analysis in this report is built upon this approach. Results in the report should not be read as predictions or forecasts for the tourism sector in the future. Instead, this report compiles a range of the impacts on the tourism sector if some of the ABS' assumptions on the regional population were to prevail.

The population projections show that changes in the regional population are driven by three factors: (a) the natural increase rate (birth minus death), (b) net overseas migration, and (c) net inter-state migration. The net overseas migration contributes as much as the natural increase to the overall changes in the sizes of the regional populations, while the net inter-state migration has an important role in the relative ranking of changes of the population among regions. Results in this report show that the magnitude of the economic impacts depends on the changes in the sizes of the regional population. It should be emphasised that overseas migration plays an important role in the domestic labour market. It alleviates problems in the labour market associated with the population ageing phase that Australia has entered.

Given the way that State and Territory populations are projected to grow in the future, the inbound and intra-state tourism sectors in New South Wales, Victoria and South Australia seem to be the most resilient to change compared to other States. The adjustment of both intra-state and inbound tourism sectors in these States fluctuate within a small range (-5 to +10 percent) over the whole timeframe and seem to respond more gradually to changes (see Charts 15, 16, 18 and 19).

In contrast, the impacts on the inbound and intra-state tourism sectors in Queensland, Western Australia, Northern Territory, Tasmania and Australian Capital Territory occur more rapidly with fluctuations over a wider range. The most volatile markets are in those in Northern Territory while the impacts on Queensland are the least in this second group.

Comparing tourism exports with other traditional exports (Table 10 versus Table 12; Table 22 versus Table 24), tourism exports seem to be affected by changing competitiveness the most, as it is more responsive to price signals than exports of goods and services overall. Tourism exports appear to accelerate first, or be the exporting sector that is hit most quickly by negative impacts.

This report differentiates the drivers of intra-state and inter-state tourism markets. Intra-state tourism is assumed to be driven just like any other commodities in a region with demand mainly determined by the level of income and the number of people in the region. In this way, impacts on demand for intra-state tourism from changes in population differ between States, as each State is affected by the population projection differently. Three different groups of States or Territories are identified: the most resilient (New South Wales, Victoria and South Australia); the most volatile (Northern Territory); and the middle ground (Queensland, Western Australia, Tasmania, and Australian Capital Territory. The pattern of changes (impact) in intra-state tourism is very similar to the pattern of changes in aggregate household consumption.

It should be noted that only economic relationships are used to formulate equations in the model. However, in household consumption, taste change is another factor that affects household decisions on tourism consumption, but the taste change in tourism consumption is not captured in the model. It is interesting, therefore, to cross check the findings here using ABS and TRA data against one another as a guide to estimating changes to intra-state tourism demand using the aggregate household consumption.

Inter-state tourism demand is assumed to be driven by two factors that link the origin region and the destination together. Thus, on the one hand, higher incomes encourage visitors from a State or region to travel more to other States. On the other, the cost of tourism products in destination States will influence the choice of destination State by visitors from other States.

The results show that in the early stages of changes in population size—when income differential as well as increases in income level are less pronounced—cost factors play a much more significant role in determining impacts on tourism markets. For example, in the first scenario under the impact of larger projected populations, New South Wales and Victoria have more difficulty attracting inter-state tourists than other States like Queensland during the 2010–2020 period (Table 17). However, as income increases become more pronounced, this becomes a dominant factor which overrides the price effect. As a result, inter-state tourism markets across all States adjust in an increasingly uniform fashion as the simulation period progresses and income changes become more pronounced, to the extent that it is as if there were only one inter-state tourism market across Australia.

Further Research

A further consideration is a possibility that population ageing may be associated with changes in the ratio of working age population to total population, and the labour participation ratios that we have inherited as shocks in the baseline projections from CoPS. Given the complexity of these issues and the timeframe of this project, these issues were determined to be beyond the scope of the current project.

Also, the simulation results suggest that the adjustment of capital costs in New South Wales, Victoria and South Australia is so slow as to override the changes in real wages for these regions during the period 2010–2020 (Table 10). This could be a result of parameter settings for these regions that need further investigation. As the long-term adjustment of these regions converges to all other States, it does not appear to be a priority issue for rectification, but it is an issue that could be the subject of future examination.

Chart 5: Percentage cumulative deviation of labour supply

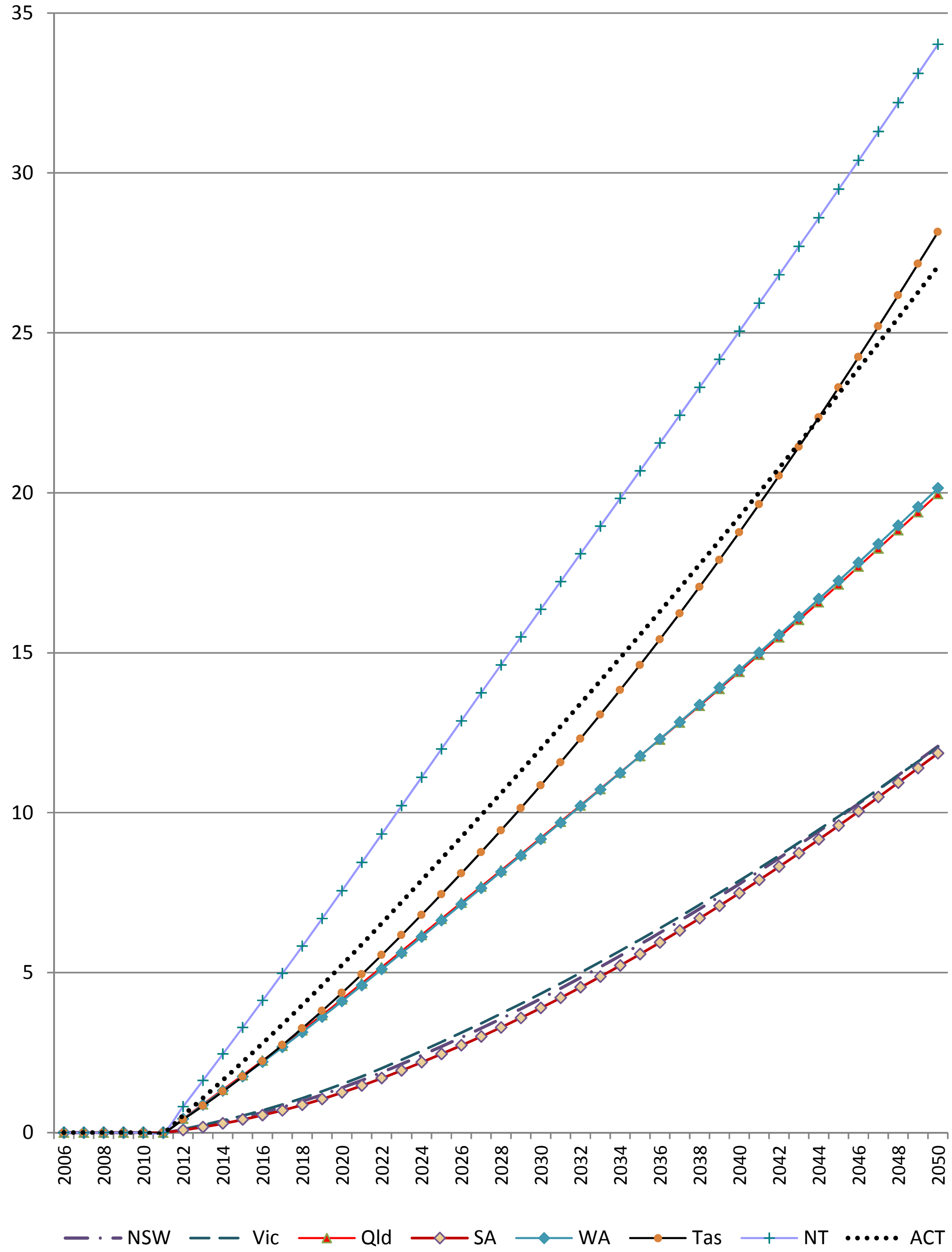


Chart 6: Percentage cumulative deviation of real wages (incurred to producers) – 2004-05 prices

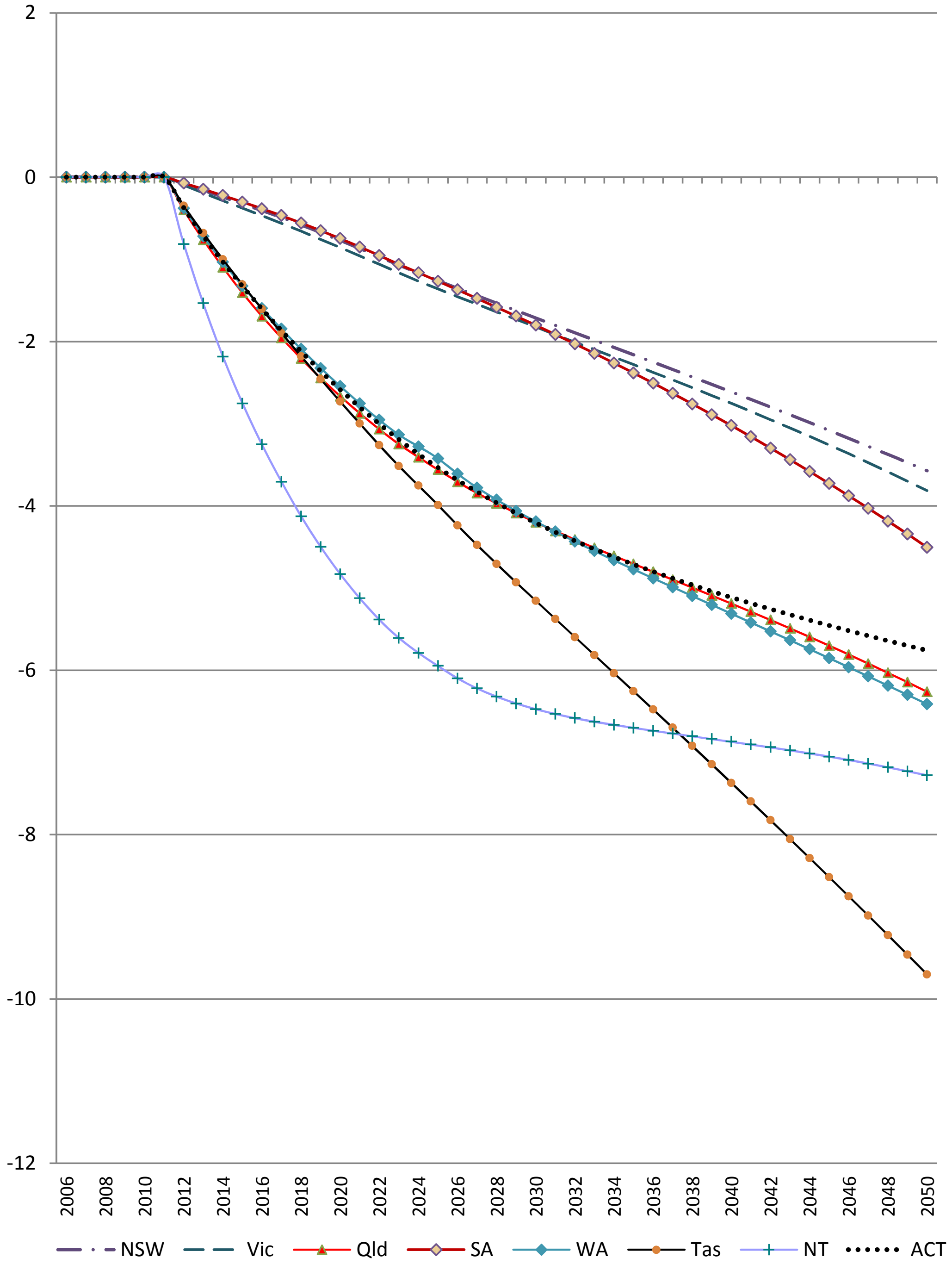


Chart 7: Percentage cumulative deviation of export volumes

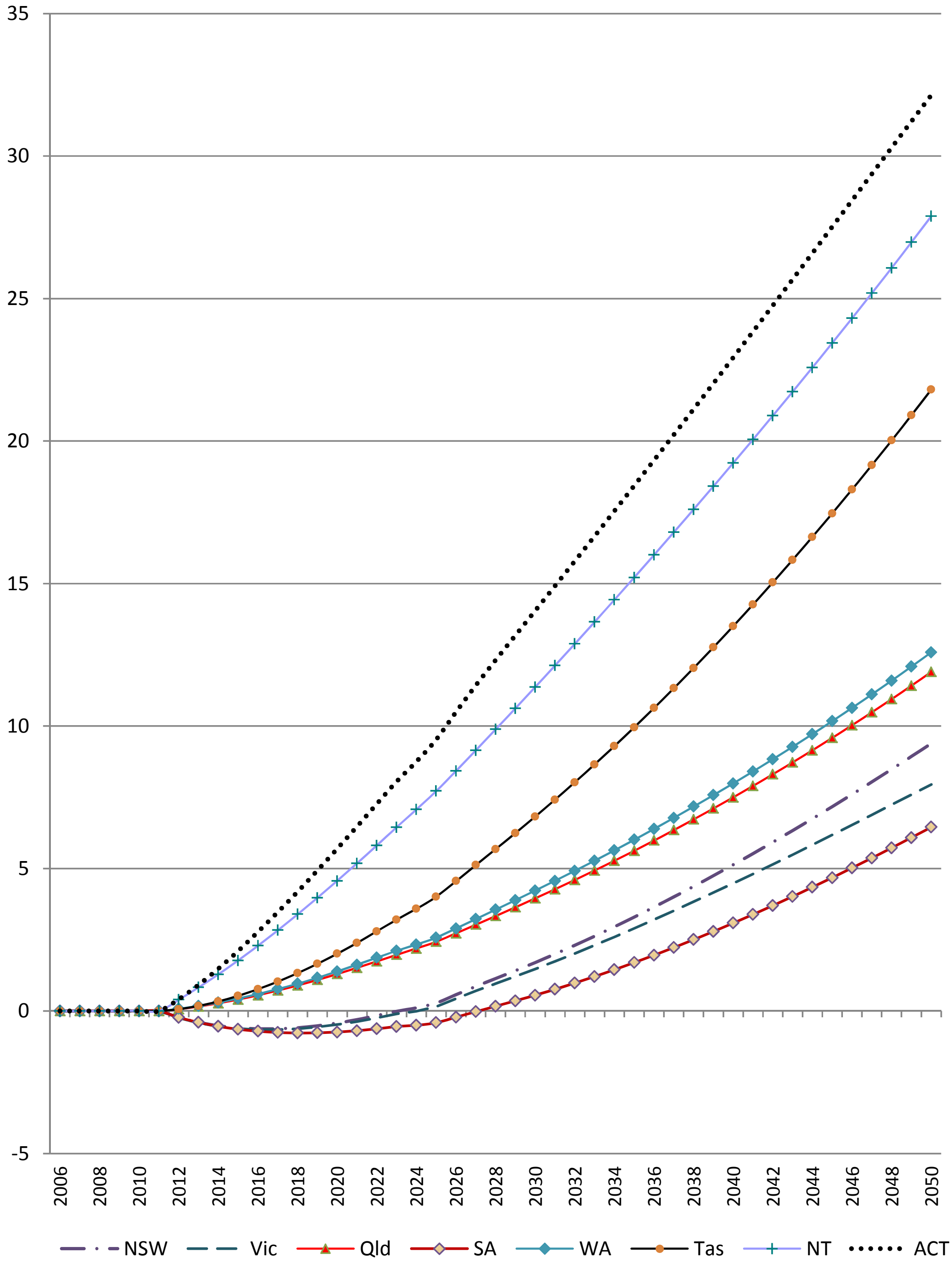


Chart 8: Percentage cumulative deviation of real household consumption

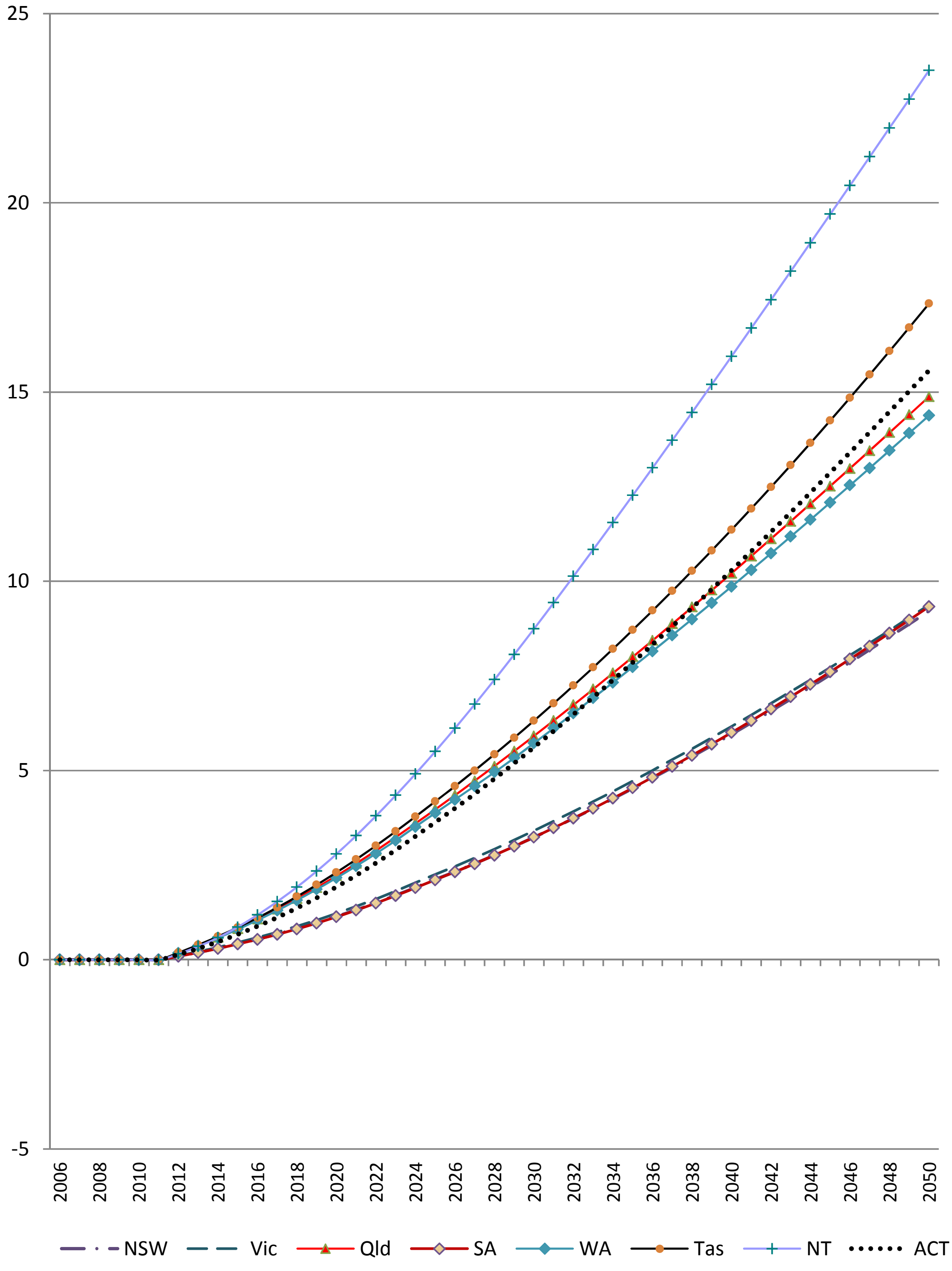


Chart 9: Percentage cumulative deviation of import volume

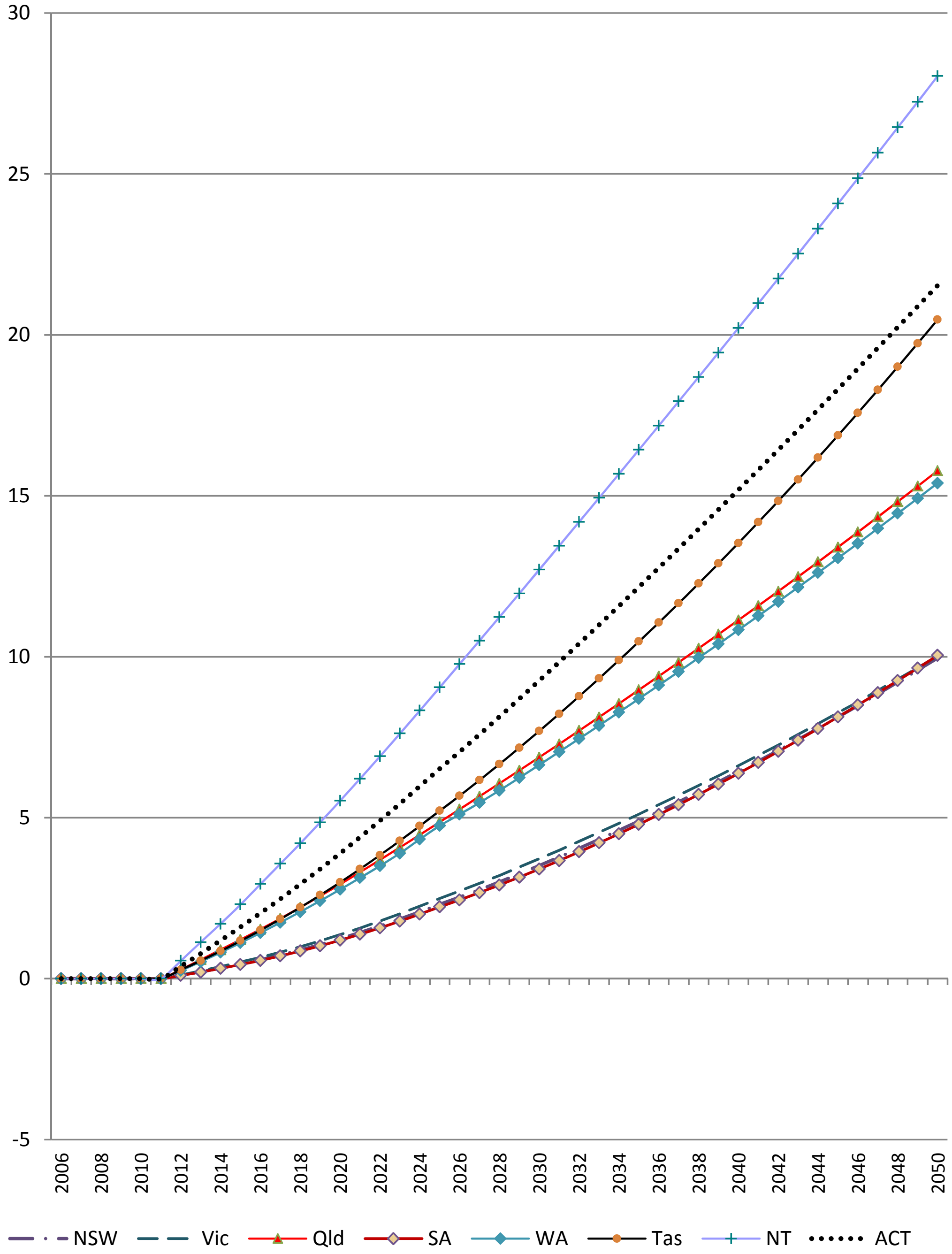


Chart 10: Percentage cumulative deviation of capital growth

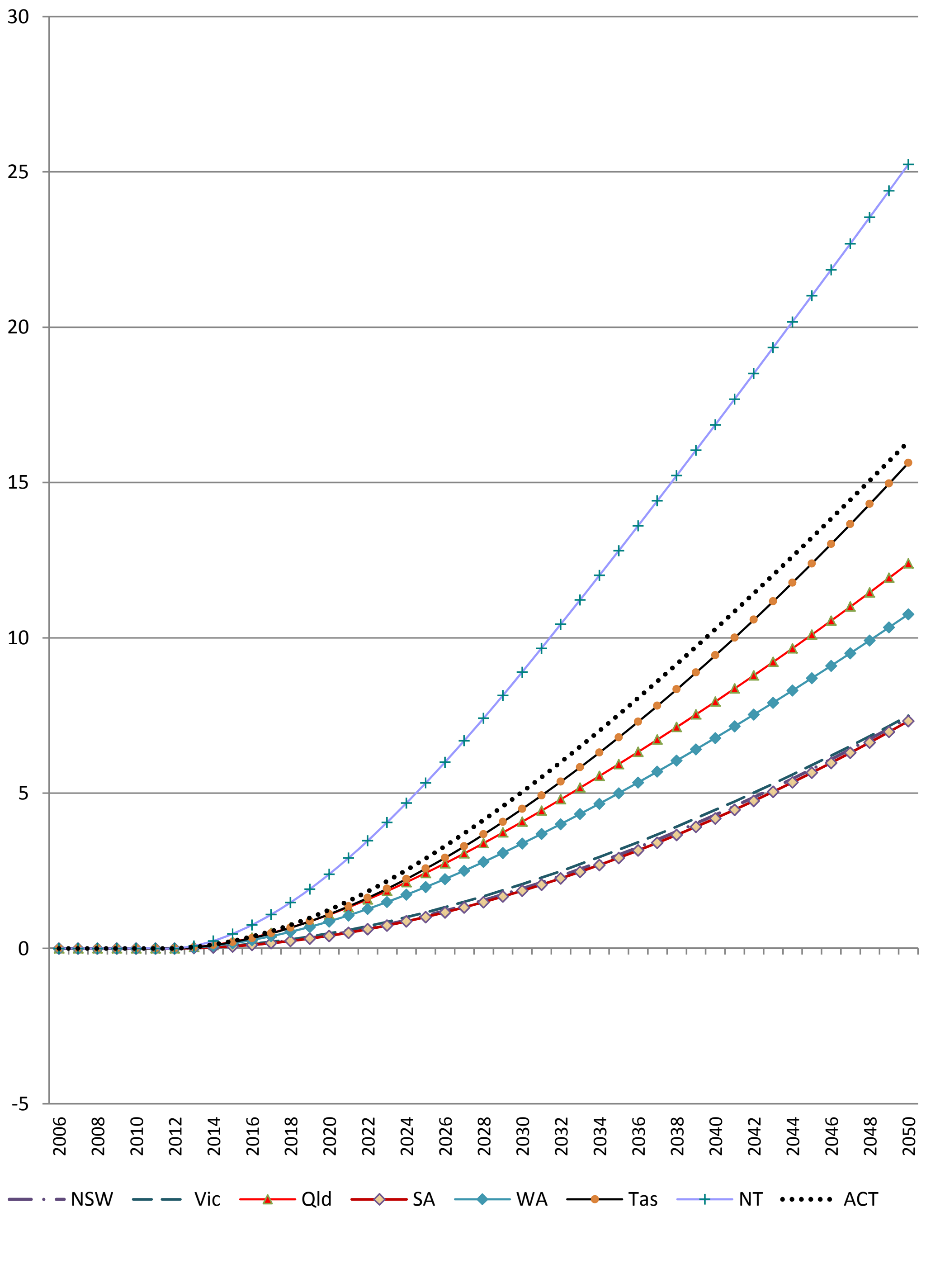


Chart 11: Percentage cumulative deviation of real investment growth

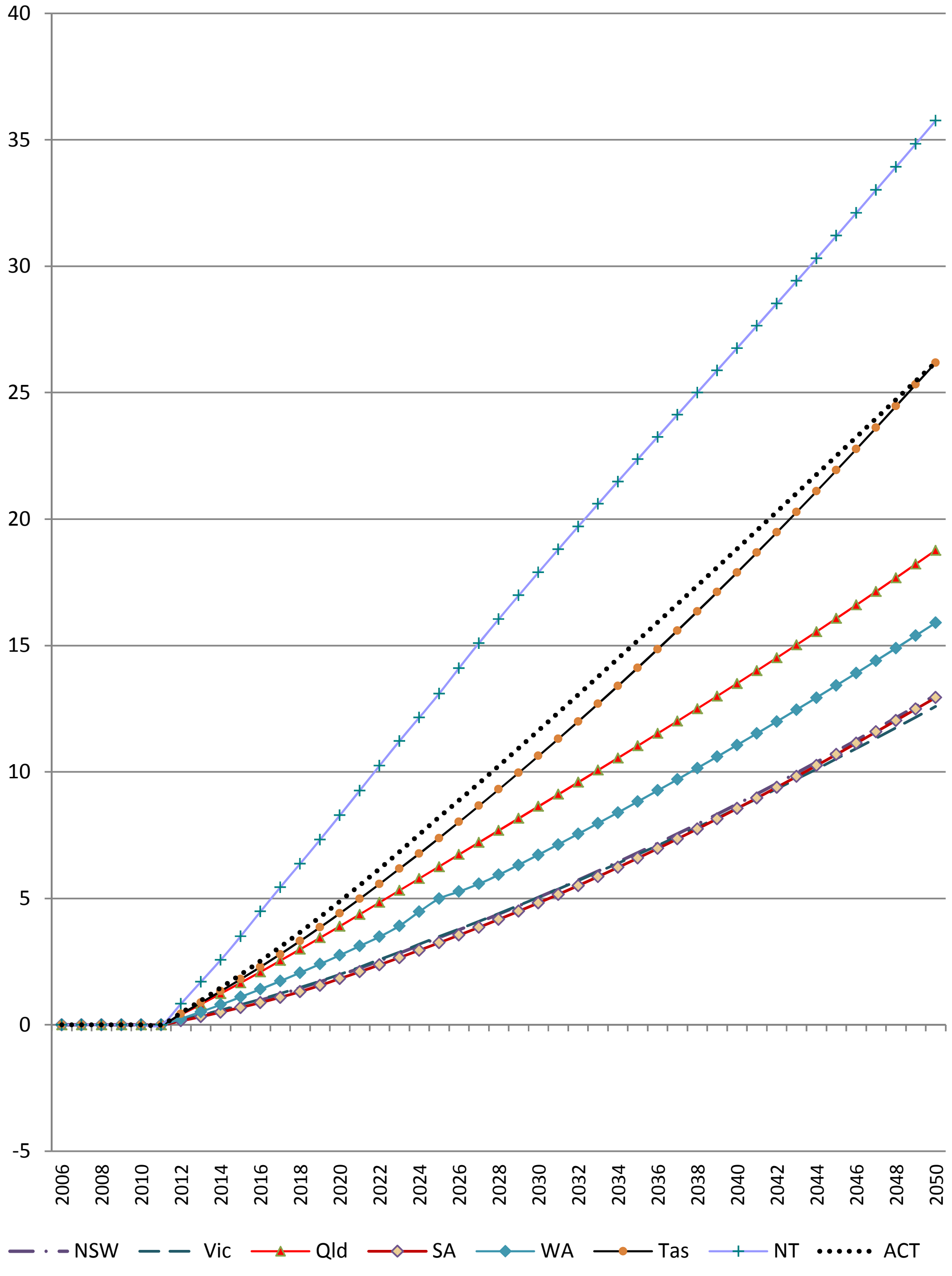


Chart 12: Percentage cumulative deviation of labour income – 2004-05 constant prices

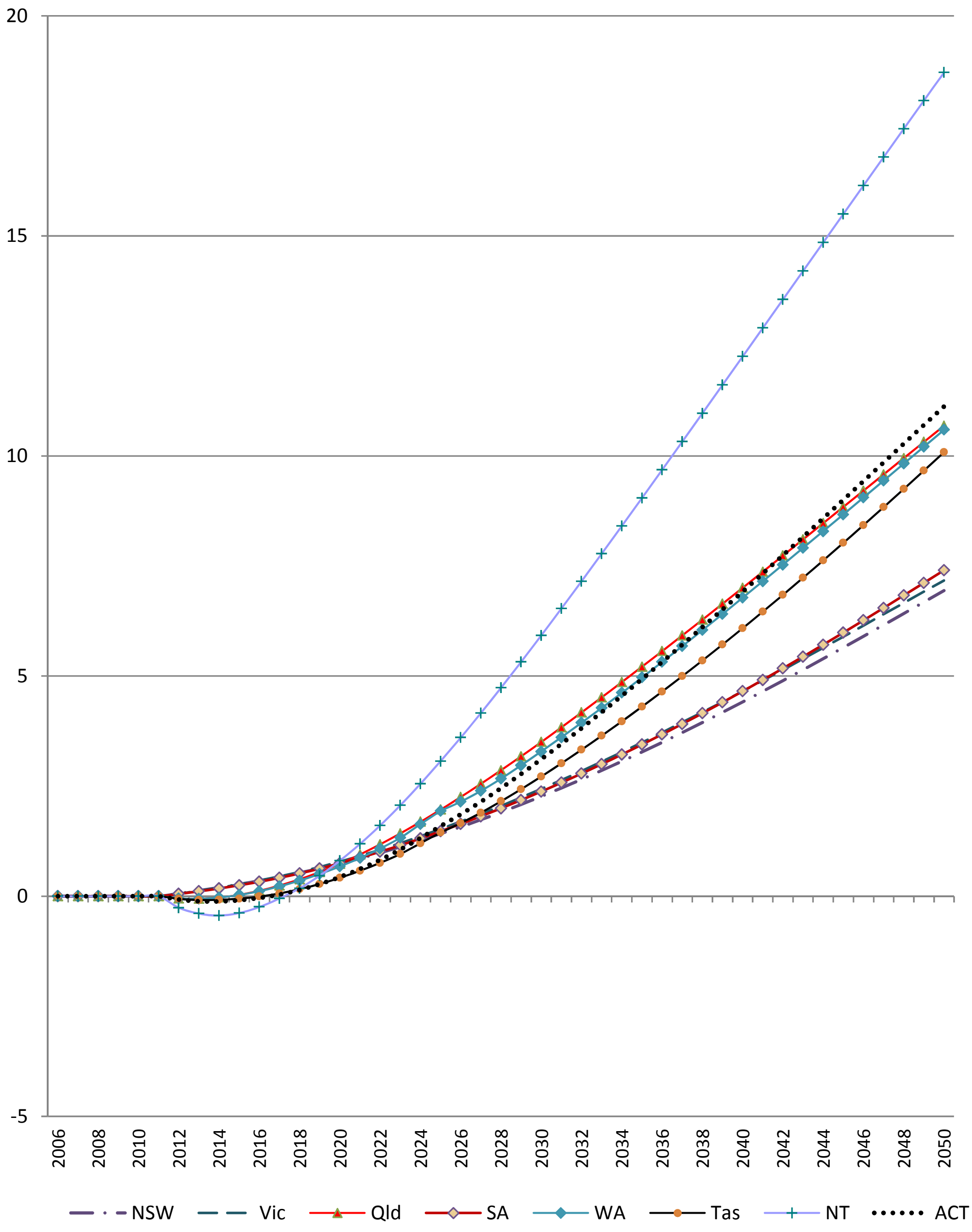


Chart 13: Percentage cumulative deviation of the terms of trade

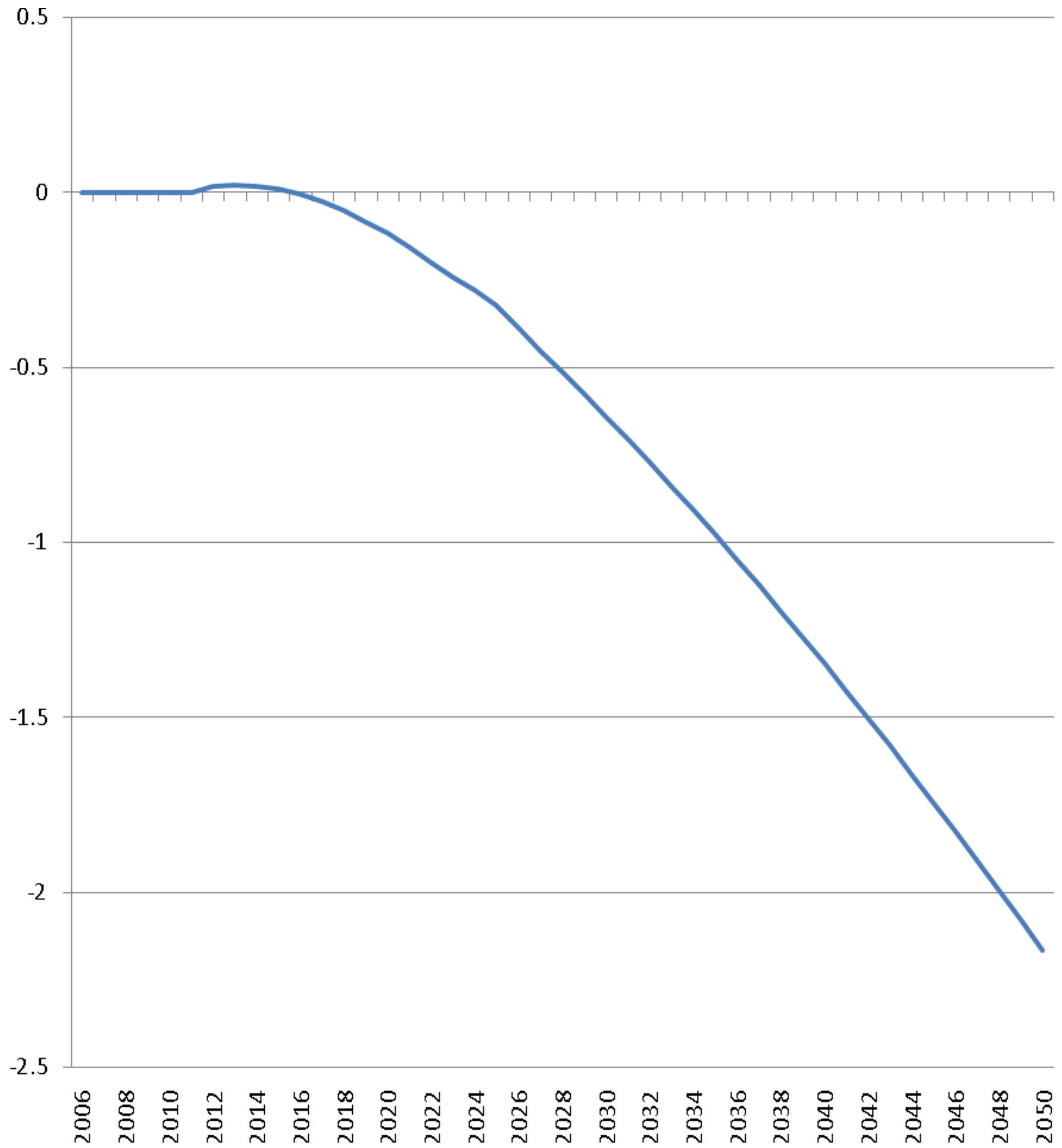


Chart 14: Percentage cumulative deviation of GSP – 2004-05 constant prices

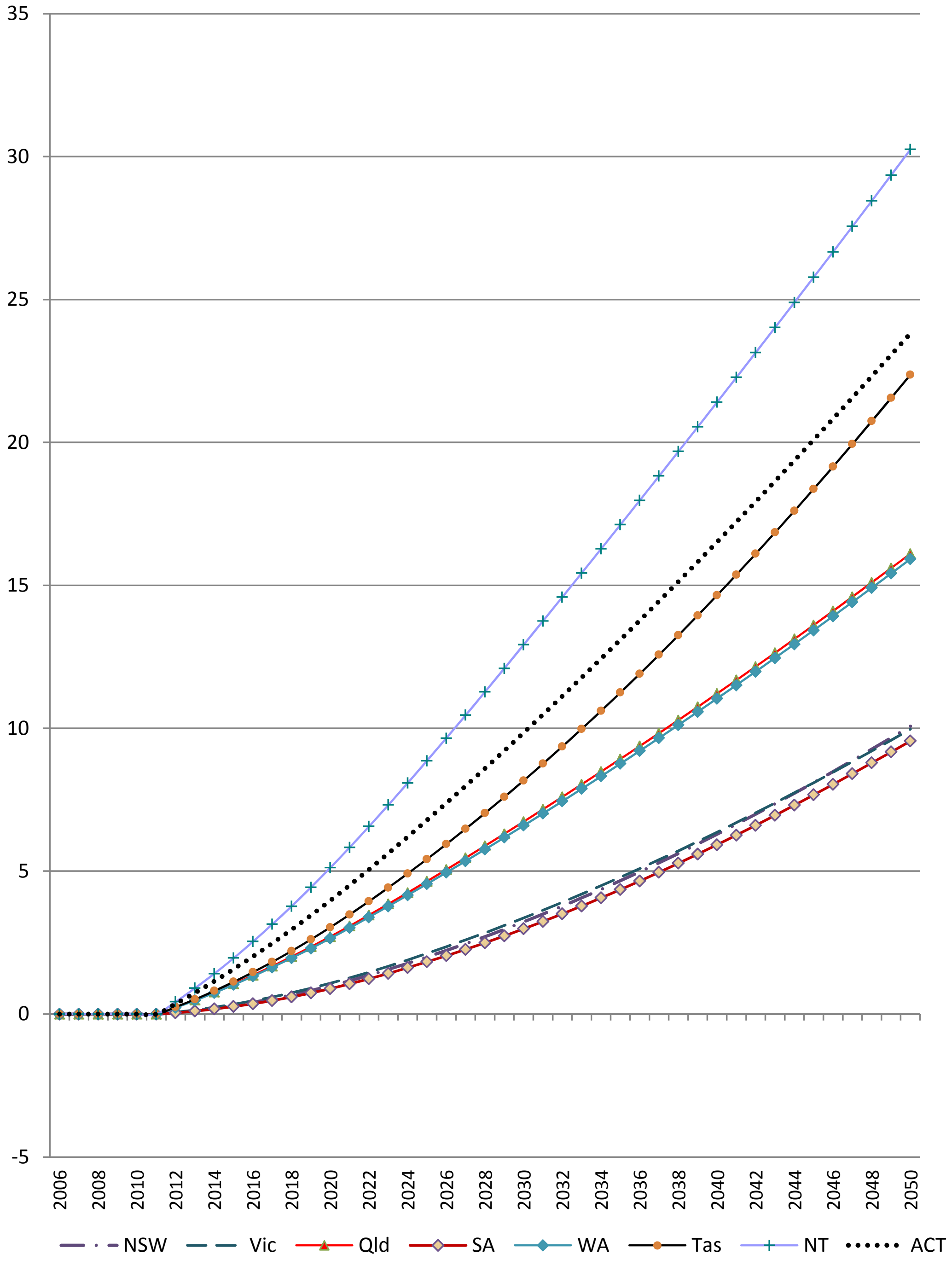


Chart 15: Impacts on inbound tourism induced by Series A

(percentage cumulative deviation)

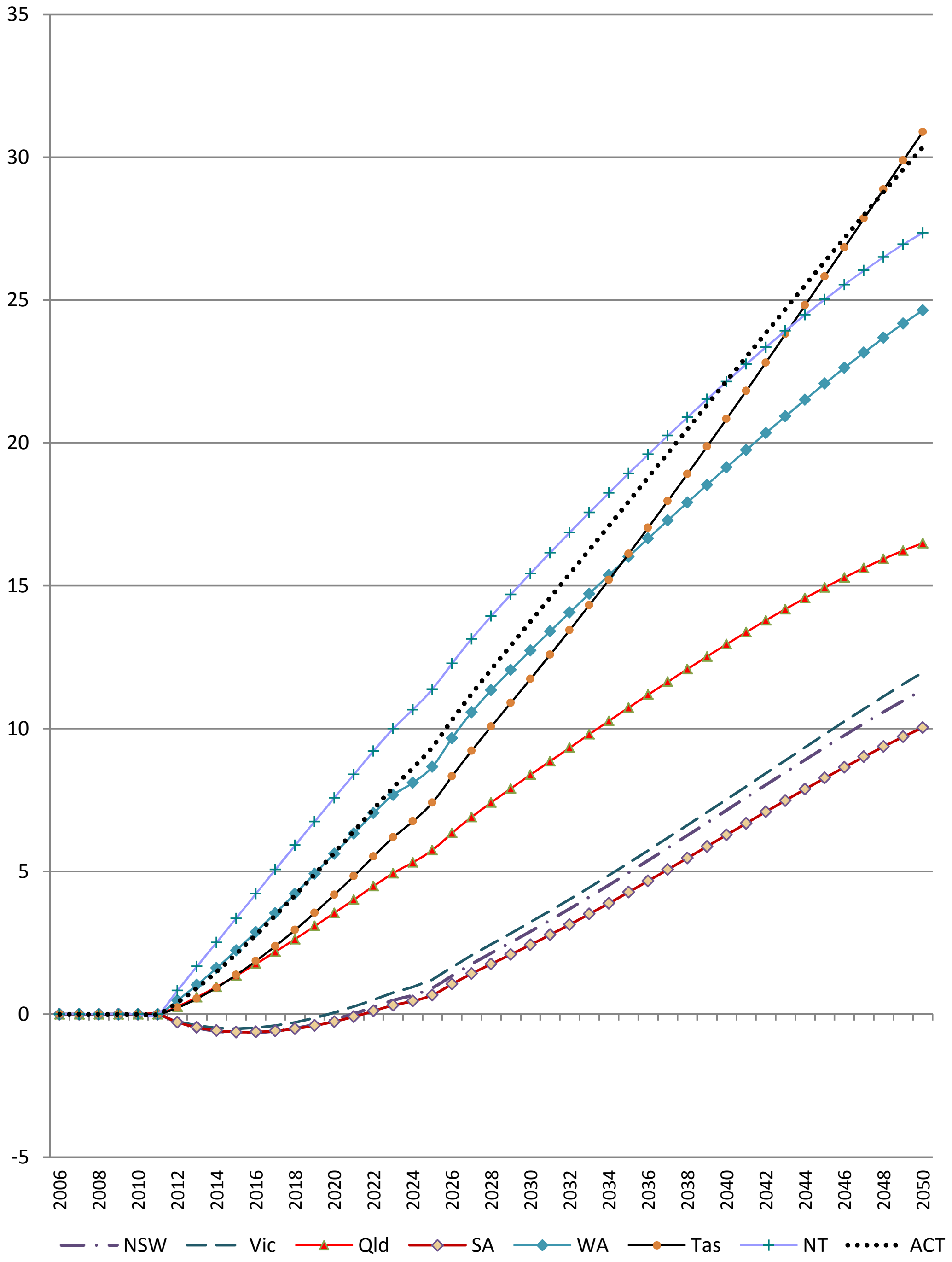


Chart 16: Impact on intra-tourism induced by Series A

(percentage cumulative deviation)

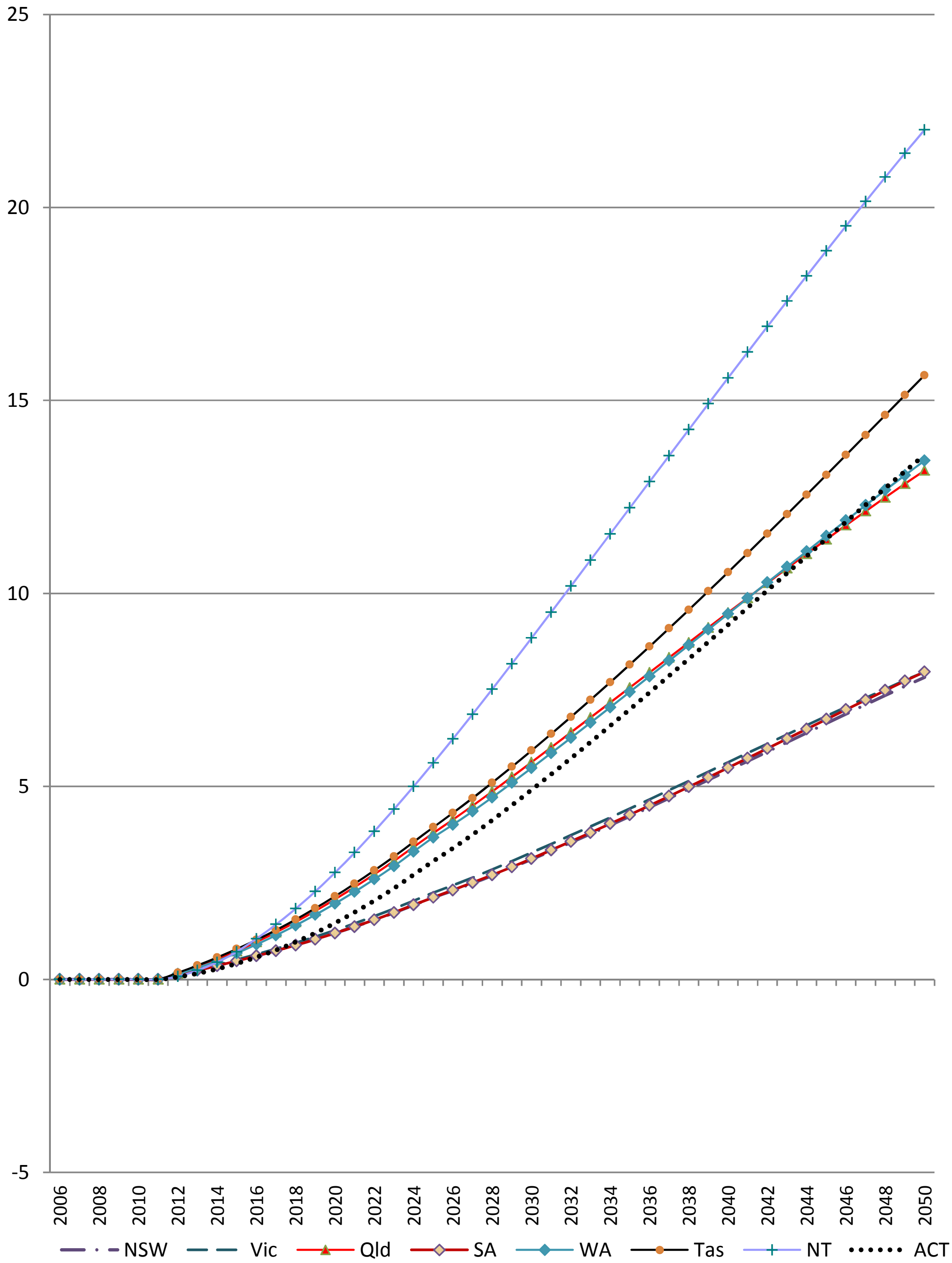


Chart 17: Impact on inter-state tourism induced by Series A

(percentage cumulative deviation)

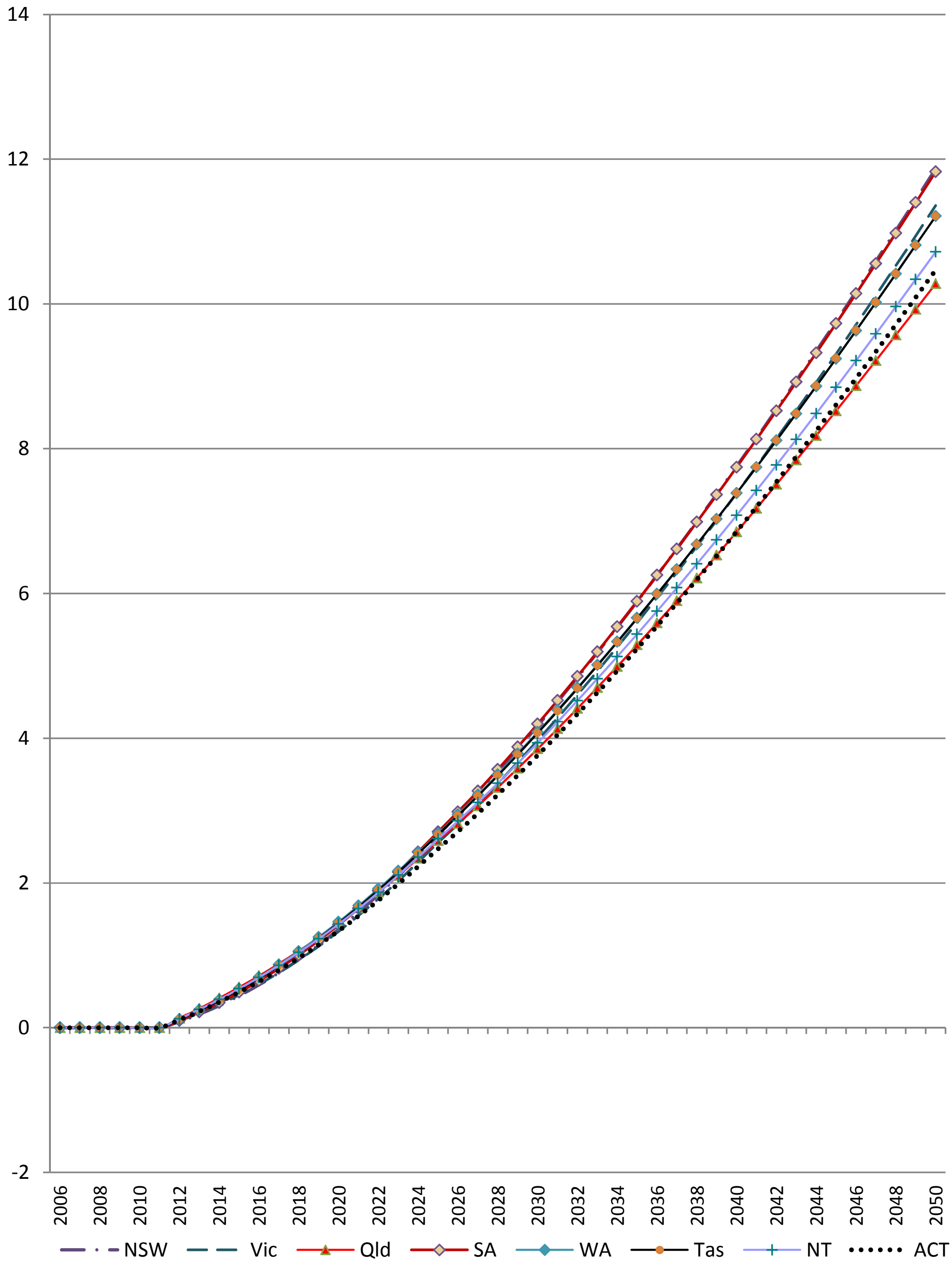


Chart 18: Impacts on inbound tourism induced by Series C

(percentage cumulative deviation)

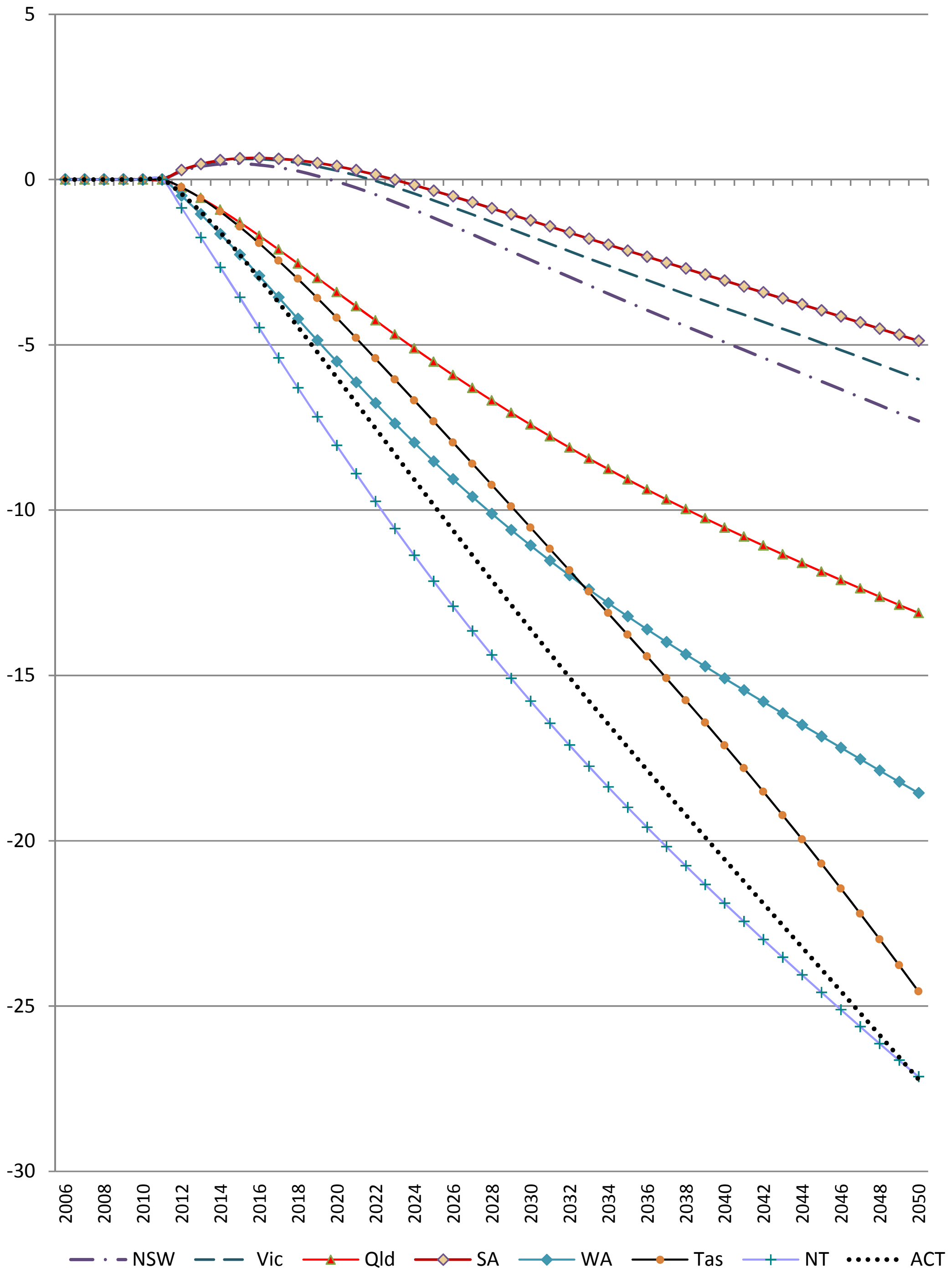


Chart 19: Impacts on intra-state tourism induced by Series C

(percentage cumulative deviation)

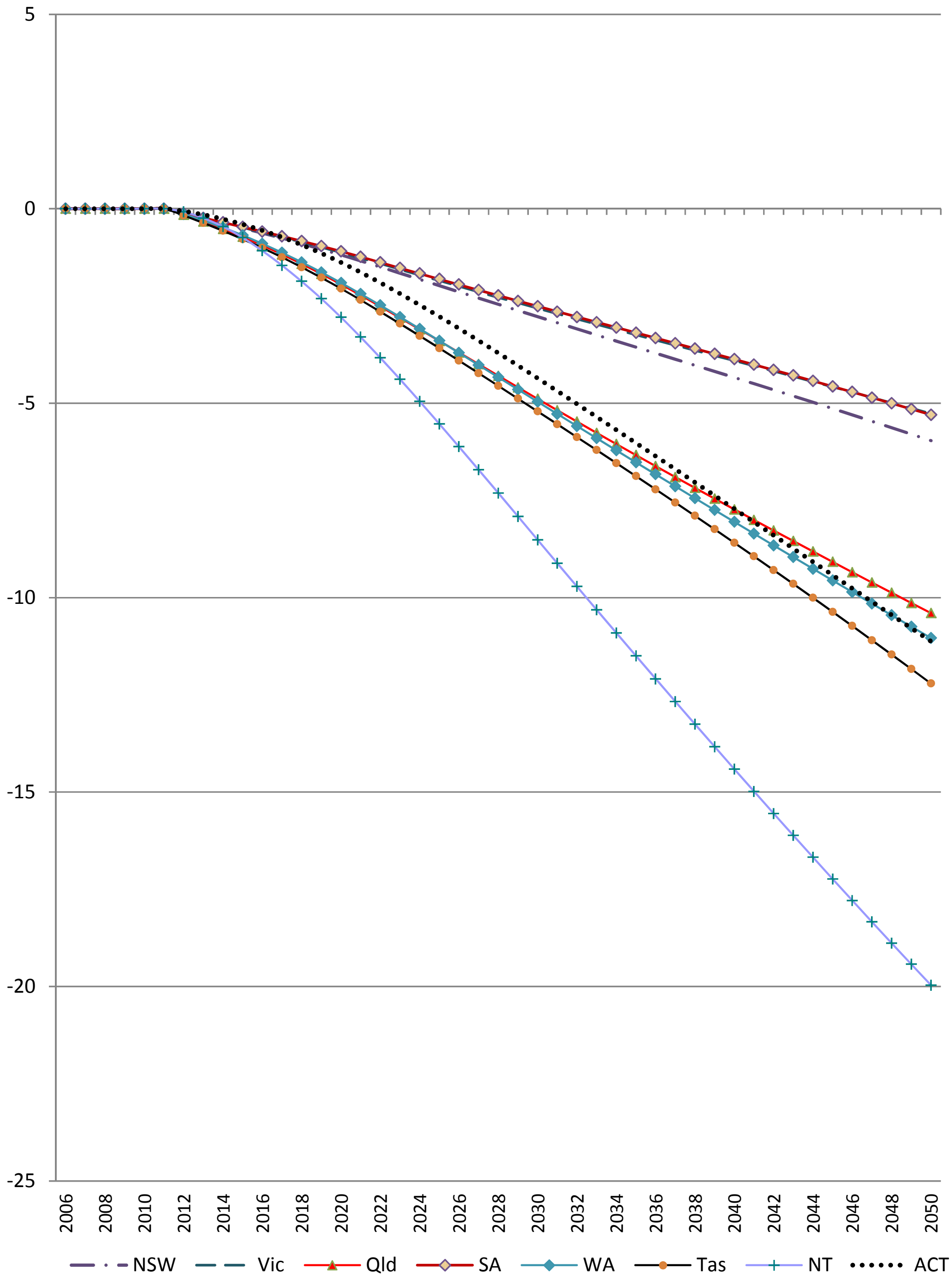
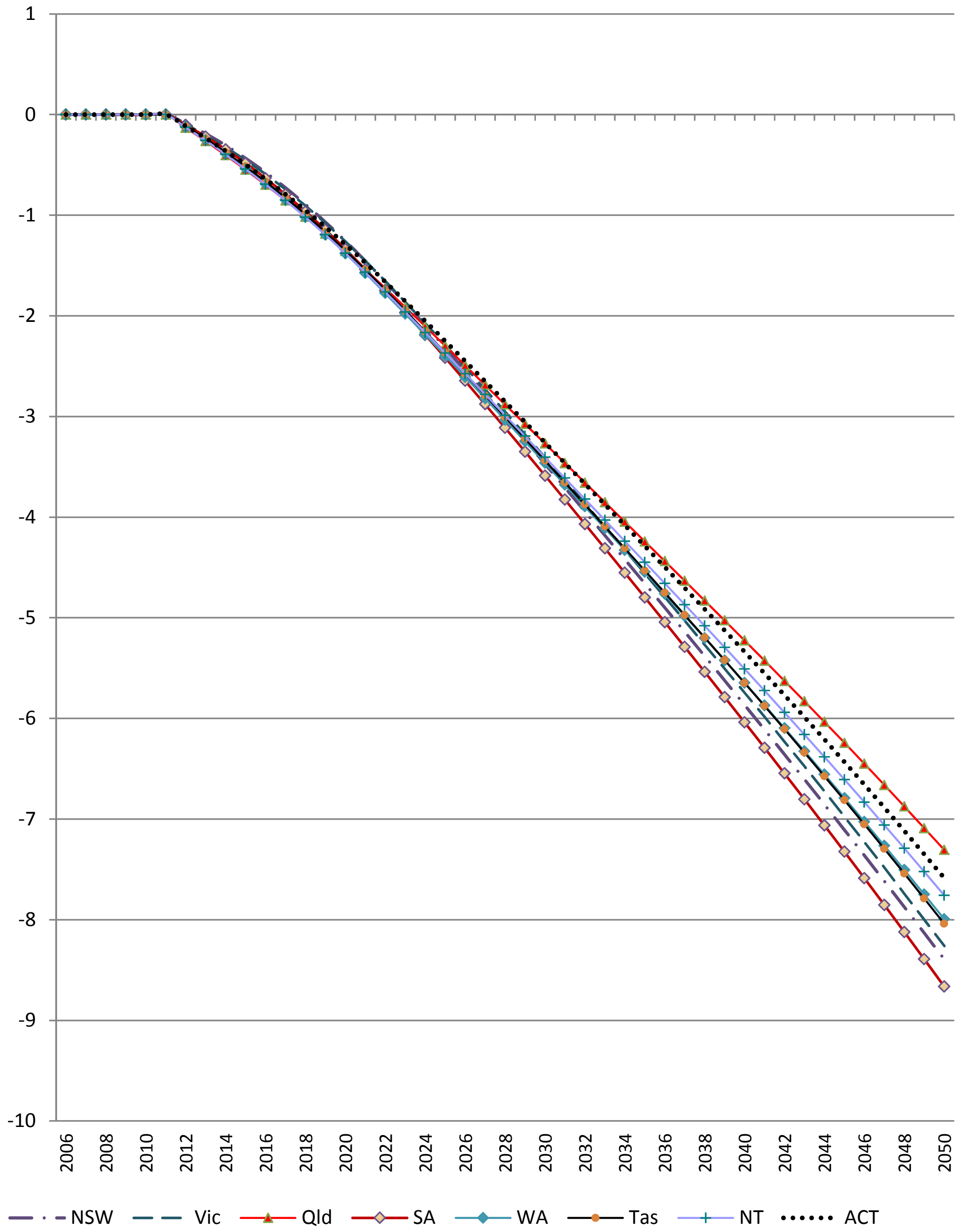


Chart 20: Impacts on inter-state tourism induced by Series C

(percentage cumulative deviation)



Appendix A: Modelling Approach

MMRF contains altogether eight States and Territories of Australia. Hereafter, they can be referred to as States, or just as regions for simplicity. Each State is treated as an economy with inter-state trade flows to link with other States in the country and international trade flows for overseas demands as well as sources of overseas imports. Figure 1 illustrates the conventional foundation database structure of a region in MMRF. This is often referred to as an Input-Output Table. Each column in the Input-Output table represents a user in an economy; users include all industries, household consumption (HH), investment by industries (INV), government consumption (GOV) and overseas export (EXP). Users purchase commodities from the rows for their consumption, for example the amounts C_{11}, C_{21} … C_{n1} represent the amounts of all *n* commodities that industry 1 purchases as intermediate inputs in the production process; the household sector purchases the amounts HH_1, HH_2 … HH_n of those *n* commodities for their final consumption; and the amounts of E_1, E_2 … E_n are exports to overseas market. Total sales of a locally produced commodity is the sum across all sales across a row, such as TS_2 for commodity 2. In addition to the usage of intermediate inputs, industries will also pay wages to employees (P1), capital rental (P2), net commodity taxes on intermediate inputs (P3), net production taxes (P4), and imported goods (P6). The total cost (TC) of production for an industry is the column total. The total cost has to equal total sales for every industry, for example $TC_2 = TS_2$.

Figure 1: MMRF input-output database

	Industry					Final demands				Total supply
	J1	J2	J3	…	Jn	HH	INV	GOV	EXP	
C1	C_{11}					HH_1			E_1	TS_1
C2	C_{21}	C_{22}	....		C_{2n}	HH_2			E_2	TS_2
	. . . .					. . . .			. . . .	. . . .
Cn	C_{n1}					HH_n			E_n	TS_n
	T1: Total intermediate use									
	Value added									
	P1: Compensation of employees (COE)					(not applicable)				**COE**
	P2: Gross operating surplus & mixed income					(not applicable)				**GOS**
	P3: Net taxes on products									**PTAX**
	P4: Net taxes on production					(not applicable)				**CTAX**
	P6: Imports									**M**
	T2: Australian production									
Total	**TC1**	**..**	**TC3**	**..............................**	**TCn**	**C**	**I**	**G**	**E**	

At the aggregate level, gross domestic product from the expenditure and income sides is calculated as follows.

Gross domestic product (expenditure side) =

+	Total household consumption	(C)
+	Total investment	(I)
+	Total government consumption	(G)
+	Total export	(E)
–	Total imports	(M)

Gross regional product (income side) =

+	Total wages	(COE)
+	Total gross operating surplus	(GOS)
+	Total net commodity taxes	(CTAX)
+	Total net production taxes	(PTAX)

The conventional CGE database in Figure 1 does not present tourism expenditure data explicitly. Domestic tourism expenditure is embedded in household final consumption and the overseas tourism expenditure is included in the export vector. In other words, final demand data in the CGE database include both tourism and non-tourism data for the same final demand category. As a result, tourism impact analysis using the conventional CGE database will not be able to capture the impact of changes in tourism consumption on non-tourism components (or vice versa) for the same commodity.

The tourism sector has been incorporated more explicitly into the CGE framework in Australia in recent years due to: the importance of tourism in an economy; the ability for impact analysis that a CGE model can offer; and the availability of Tourism Satellite Account (TSA) data for the Australian States and Territories. (Pham, Simmons and Spurr 2010; Dwyer Forsyth, Spurr and Ho, 2003; and, Madden and Thapa, 2000).Figure 2 is a continuation of Figure 1, in which a process to modify the original CGE database is carried out in order to incorporate the tourism sector into a CGE model (Pham *et al*., 2010). In a Tourism CGE database, most of the original elements remain unchanged, with the exception of the new industries, *Dtour* and *Etour,* which have been created for domestic tourism and overseas tourism respectively. The final household consumption by commodities is broken down into tourism and non-tourism parts, and the tourism part is moved to the intermediate quadrant to represent the domestic tourism supplier. Similarly, elements of *Etour* are extracted from the export vector. The tourism sectors *Dtour* and *Etour* do not require primary inputs. They act as a middle man to select all goods and services for tourism activity, and then sell all tourism services to the corresponding tourists. This follows closely the approach adopted in the construction of the Tourism Satellite Account (Pham, Dwyer and Spurr, 2009), where the tourism sector is not a commodity or industry per se, as tourists consume a wide range of commodities and services for their tourism activity. *Dtour* is not purchased by any users in the economy other than the household sector, and similarly *Etour* by the export sector. These purchases of tourism services are defined as domestic and inbound tourists' consumption respectively. To some extent, the treatment here reflects exactly how loosely defined the tourism sector is in relation to goods and services in reality.

Figure 2: Tourism CGE IO database

	Industry							Final demands				Total supply
	J1	J2	J3	…	Jn	Dtour	Etour	HH	INV	GOV	EXP	
C1	C_{11}					HH_{1T}	E_{1T}	HH_{1NT}			E_{1NT}	**TS_1**
C2	C_{21}	C_{22}	....		C_{2n}	HH_{2T}	E_{2T}	HH_{2NT}			E_{2NT}	**TS_2**
	.					.	.	.			.	**.**
	.					.	.	.			.	**.**
	.					.	.	.			.	**.**
	.					.	.	.			.	**.**
Cn	C_{n1}					HH_{nT}	E_{nT}	HH_{nNT}			E_{nNT}	**TS_n**
Dtour						0	0	Tot_Dtour			0	**Tot_Dtour**
ETour						0	0	0			Tot_ETour	**Tot_ETour**
T1: Total intermediate use												
Value added												
P1: Compensation of employees (COE)						0	0		(Not available)			**COE**
P2: Gross operating surplus & mixed income						0	0		(Not available)			**GOS**
P3: Net taxes on products												**PTAX**
P4: Net taxes on production						0	0		(Not available)			**CTAX**
P6: Imports												**M**
T2: Australian production												
Total	**TC1**	**..**	**TC3**	**.....................**	**TCn**	**Tot_Dtour**	**Tot_ETour**	**C**	**I**	**G**	**E**	

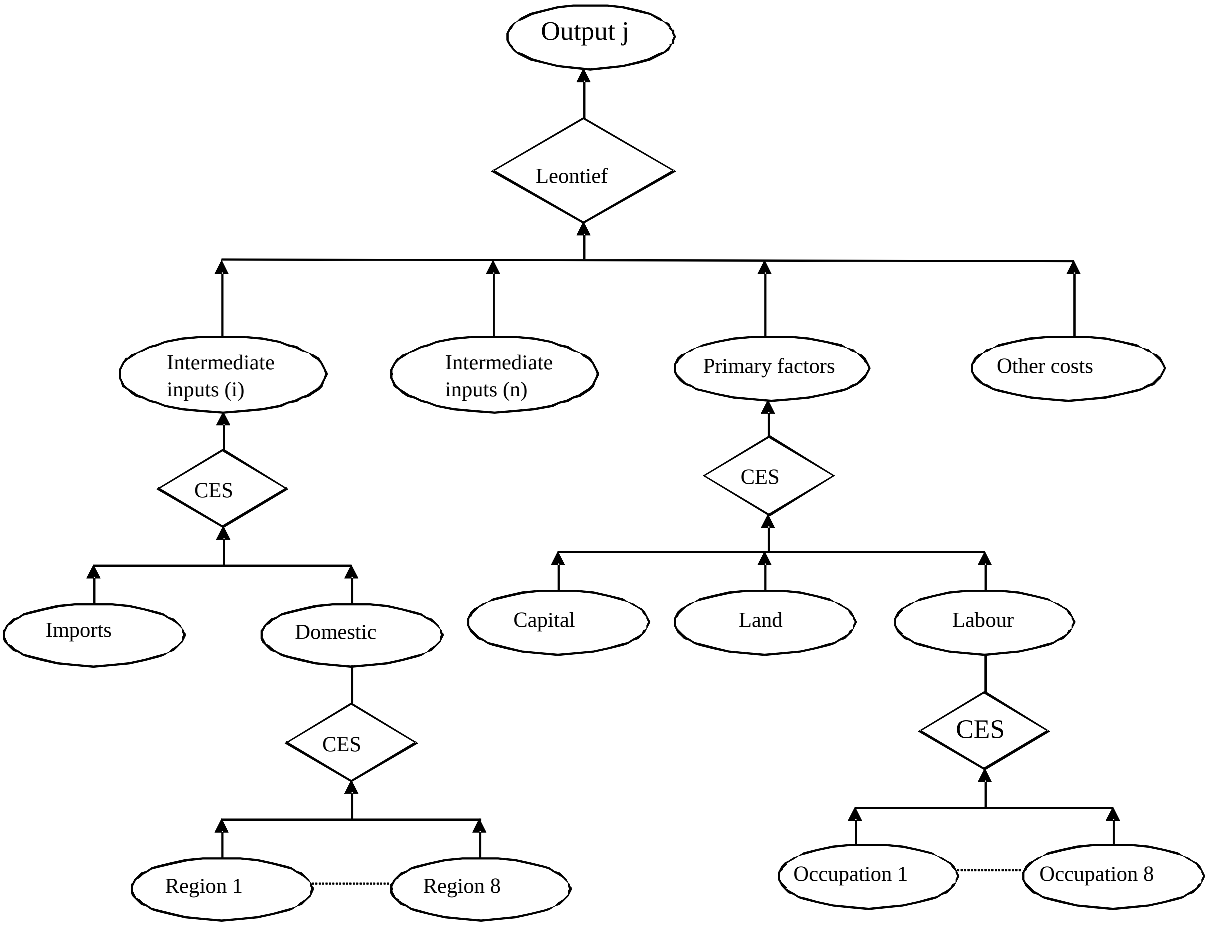
Input demands - Current production

Figure 3 illustrates the structure of a production nest for an industry in a regional economy. Diagrams in this report are borrowed from Peter, Horridge, Meagher, Naqvi and Parmenter, 1996 (here after PHMNP, 1996). At the top level, the producer combines intermediate inputs, primary inputs and all other costs in the constant shares relationship, which is often referred to as the Leontief technique in CGE modelling. It might be useful to see the application of this functional form in a situation where there are abundant intermediate inputs, but only a certain level of labour and machines available to the producer. The producer cannot increase its supply to the market as much as he/she would like using the unlimited supply of the intermediate inputs because there are only a certain number of hours the employees can operate the machines in a given timeframe. Thus the production level is driven by simultaneous availability of all inputs to a producer at a point in time in the constant shares relationship.

For each intermediate input, the producer can minimise the cost by choosing the right source. The input can be sourced from the domestic economy, or from overseas countries depending on which source is *relatively* cheaper. This is governed by the constant elasticity of substitution in the production nest between *imports* and *domestic* in Figure 3. In a similar approach, the producer then chooses the cheapest region among all regions in the domestic economy. This is represented at the bottom of the substitution level among '*region 1*' to '*region 8*' in Figure 3.

The primary input bundle is also a combination of labour, capital and land using the CES functional form in order to minimise the cost of this bundle.

Figure 3: Production nest

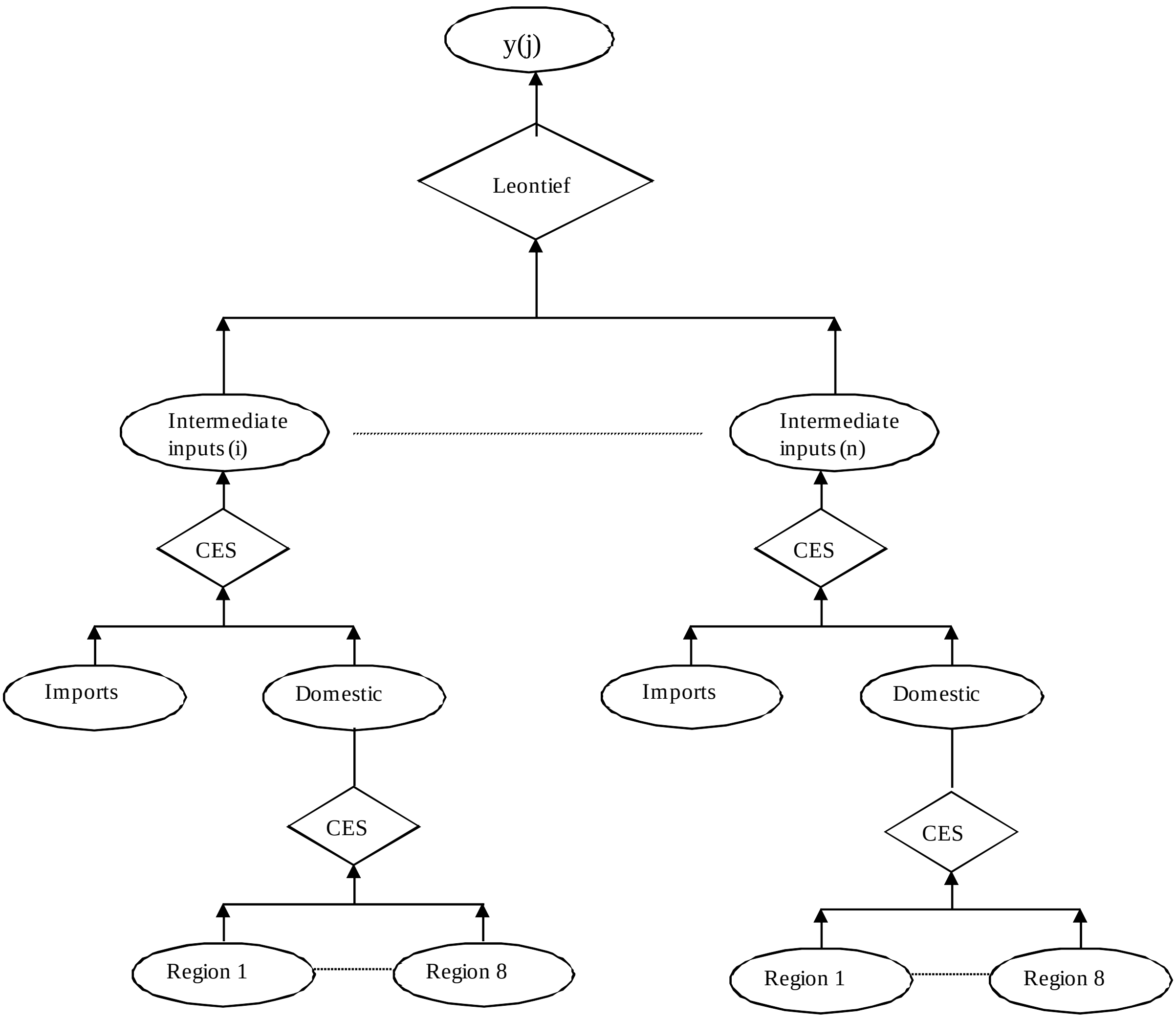


Source: PHMNP, 1996

Investment demands

Figure 4 illustrates how costs are minimised for the second user in the IO table – the investment. Investment activity is modelled in a similar approach with the above production process except that there are no value-added required in the investment nest. The producer will only have to choose the relatively cheaper sources among all sources from domestic regions and overseas countries.

Figure 4: Investment structure

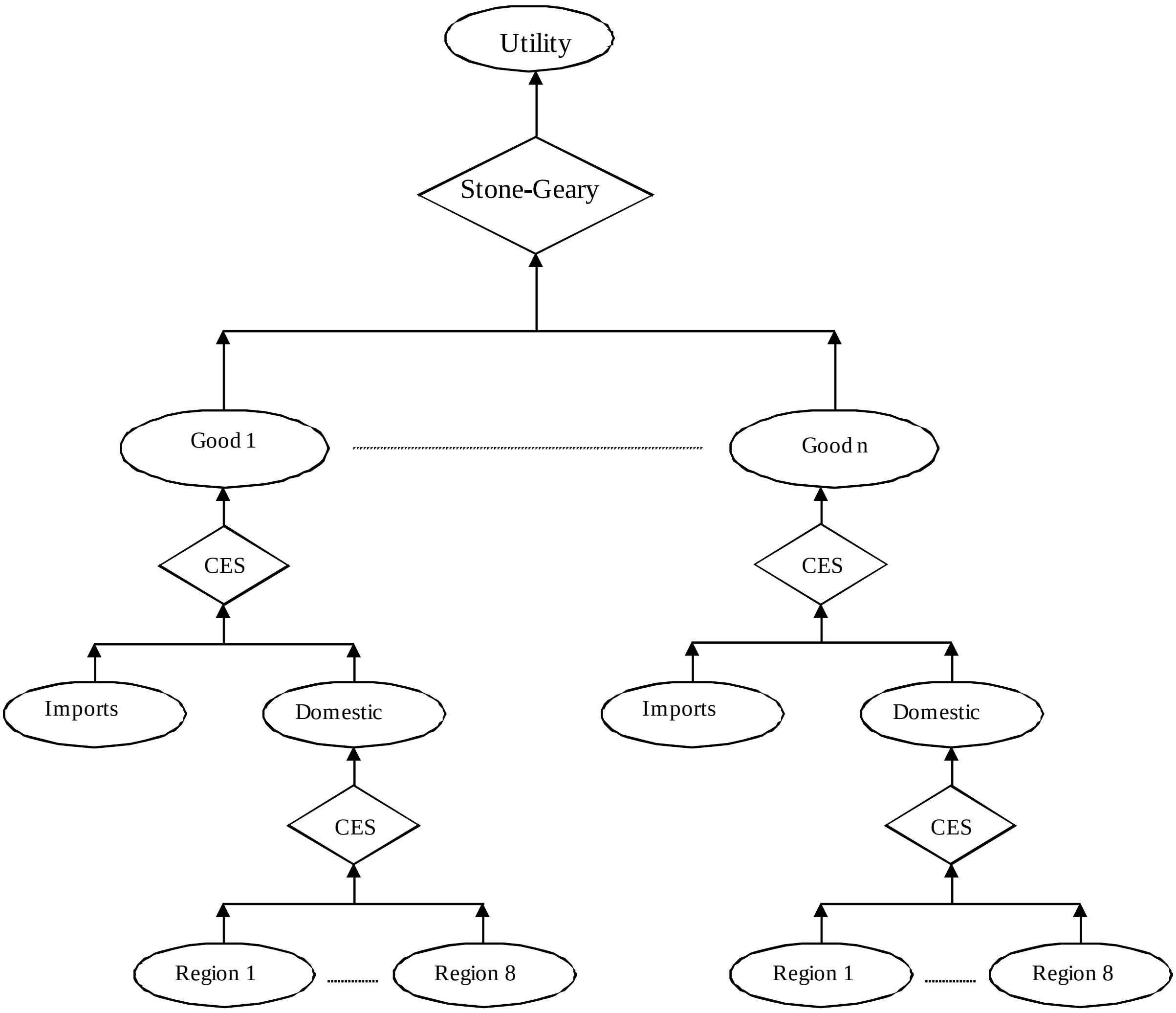


Source: PHMNP, 1996

Household demands

MMRF has eight representative household sectors, one for each State. Total household expenditure in a region is driven by the regional household disposable income (a Keynesian approach) and the changes of the number of households in the region. In Figure 5, the nesting in the household demands is nearly the same as the nesting in the investment structure, except that MMRF adopts the Stone-Geary utility function at the top level instead of a Leontief function for investment and current production[6].

Figure 5: Household consumption nest



Source: PHMNP, 1996

Government demands

[6] For more information about the functional forms, please see both PHMNP (1996) and Adams (2008).

There are two government demand groups in MMRF: one by the Federal Government and one by the State government. The modelling of government demands is straight forward. The total of Federal government demands is driven by either aggregate national household consumption or by the GDP growth. The total of government demands is driven by either the regional aggregate household consumption or GSP growth. In this exercise, GDP and GSP growth rates are adopted as the drivers of the corresponding government expenditure.

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