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A REGIONAL FRAMEWORK FOR ANALYSING THE WESTERN AUSTRALIAN ECONOMY*

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ABSTRACT

Western Australia is a diverse state with unique regions. Studies on the economy that adopt a 'one size fits all' approach' are likely to be hindered by a lack of the richness and variability inherent in the intra-state regions. This paper proposes a modelling framework for the Western Australian macroeconomy by utilising existing and constructed data on its ten regions. As an export-oriented state, WA is affected by external factors such as the exchange rate, commodity prices and developments in emerging economies. However, with different composition of domestic- versus external-facing industrial sectors, each region is expected to respond differently to such shocks. Initial projections suggest WA's growth is likely to decrease from its present 5.1 per cent to between 5-7 per cent through 2013-2014. When hit with an adverse shock to commodity prices initiated by, for example, a structural change in the Chinese economy, the mining-intensive region of Pilbara suffers by a factor of 3 percentage points in the near term over less exposed regions such as Great Southern and Peel.

Keywords: Western Australian economy, Gross Regional Product, Regional Analysis, Industrial Composition, Forecasting and simulation

JEL classification: E01, R11, E17

1. Introduction

The very source of Western Australia's economic prosperity also makes it the most vulnerable to adverse external shocks. Natural resources dominate WA's export such that, in 2012-13, iron ore and concentrates, gold, crude petroleum and natural gas comprised almost 80 per cent of goods outflow. Shocks to the exchange rate and domestic developments in WA's principal export destination, China, have proven to be damaging to the economy. This was witnessed in 2012 when the spot price of iron ore fell from highs of US$150 to US$87 per tonne, which triggered delays to mining expansion plans, development of overseas assets, port capacity increase, a significant layoff of mine-site contractors, a lesser though no less significant layoff in the professional labour force in Perth, and induced negative sentiment elsewhere in the state. One could also argue that the downgrade in the state's credit rating to AA+ by Standard & Poor's in September 2013 was a consequence of windfalls from the

* The views and findings in this paper are those of the authors and do not necessarily reflect those of Bankwest.

resource sector leading to increased expectations which, in turn, placed increased tensions in managing the fiscal balance.

Though various indicators point to an improving economy and uptick in business confidence, the fallout from the aforementioned shocks is so drastic that aiming to insulate the state, or at the very least, better understanding the cause-and-effects remain pertinent on the agenda of policymakers and analysts.[1] With this onset of a structural change, the following questions which have all been previously raised would benefit from re-examination from a fresh perspective:

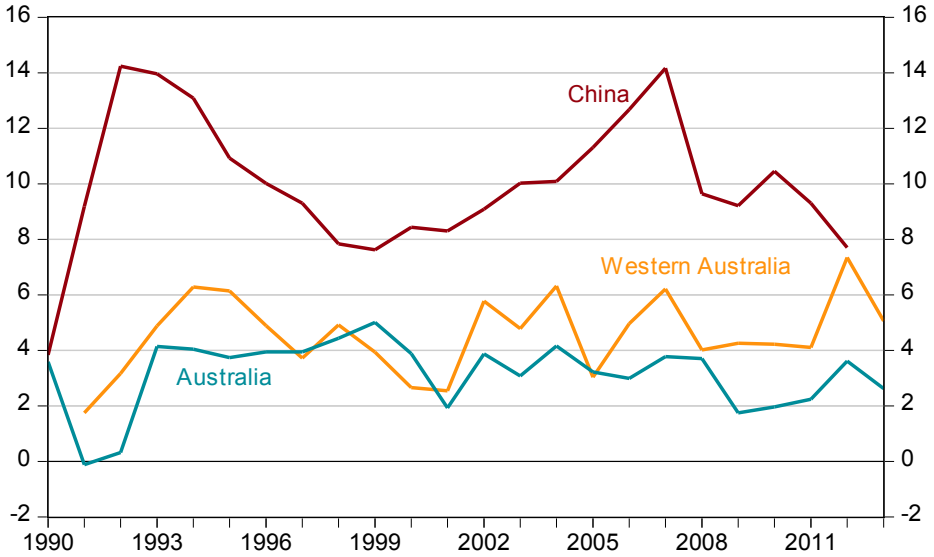
- How can the state cope with resource companies' move from an investment to production phase?
- What are the implications of China's transition from a fixed asset investment driven to a consumption driven economy?
- To what extent can WA diversify to areas such as education export, agribusiness, tourism, and back to manufacturing?

This paper aims to present a coherent modelling framework of the Western Australian macro-economy that seeks to address these questions, as well as provide a foundation for forecasting and policy analysis. It complements research by the Bankwest Curtin Economics Centre (BCEC) on workforce and migration within the state of Western Australia and the sharing of windfalls from the mining boom by focussing on the broader economy and industrial composition. The rest of the paper is organised as follows. Section 2 compares the performance of the Western Australian economy with Australia and examines its industrial composition over time. In Section 3, a regional approach to analysing the economy is proposed. The method for imputing gross regional product from gross state product is discussed in Section 4. Section 5 specifies the econometric model and Sections 6 and 7 present some baseline and scenario simulations from the model. Section 8 concludes with some thoughts on future directions where this project can ideally be fruitfully taken.

[1] See, for example, the media reporting in October 2013 relating to Deloitte (2014).

2. The Western Australian Economy

Figure 1: Year-on-Year Percentage Change in Gross Domestic/State Product



Source: ABS Cat No 5220.0 (2012-13). IMF World Economic Outlook Database (October 2013).
Note: All series are constant price. Australia data are expressed in financial year (1 July – 30 June).

Figure 1 shows the growth experienced by WA since 1990 and, for comparison, Australia and its primary trading partner - China. The West Australian economy is worth $243 billion. The 5.1% increase in 2012-13 from 2011-12 comes on the back of strong export, and follows the previous year's 7.3% which was the strongest since the data series began in 1990-91. Annual Gross State Product (GSP) growth rates have also been the highest in recent years when compared to other states and territories. On a per capita basis, 2012-13 GSP was $98,069 per person, the highest among any state/territory. In real terms, per capita GSP has been the highest in Australia since 1995-96.

WA growth has exceeded that of Australia since mid-2005. From Figure 1, it can also be observed that it is a testament to the exceptional strength and persistence of China's growth from the start of the last decade that its current rate of 7.8% is regarded as a slowdown and a cause for concern. Indeed, the future of China's economic transformation and continued rural-urban migration is pivotal to the prospects of the WA economy, especially in the latter's present economic structure.

On the topic of economic structure Table 1 depicts the changing industrial composition of the Western Australian economy.

Table 1: Composition of the Western Australian Economy

Industry	1990-1991		2000-2001		2012-2013	
	IGVA ($m)	Share of GSP (%)	IGVA ($m)	Share of GSP (%)	IGVA ($m)	Share of GSP (%)
Agriculture, forestry and fishing	3,885	3.7	4,039	3.5	2,441	1.3
Mining	24,318	17.6	46,463	21.6	86,814	29.2
Manufacturing	4,846	8.9	6,463	7.8	11,916	5.0
Electricity, gas, water and waste services	2,458	3.0	3,331	1.9	5,149	2.1
Construction	8,832	7.4	11,270	7.1	30,334	12.9
Wholesale trade	1,733	3.8	3,390	3.0	7,360	2.5
Retail trade	2,738	4.2	4,656	4.1	8,149	3.5
Accommodation and food services	1,045	1.6	1,868	1.8	3,113	1.3
Transport, postal and warehousing	4,429	5.6	6,946	4.1	11,221	4.8
Information media and telecommunications	797	2.6	1,827	2.6	2,860	1.2
Financial and insurance services	3,225	3.8	4,681	4.8	7,354	3.1
Rental, hiring and real estate services	2,071	3.1	2,447	2.6	4,273	1.7
Professional, scientific and technical services	2,817	3.7	5,212	4.8	12,769	5.4
Administrative and support services	1,465	1.6	3,213	2.1	5,874	3.1
Public administration and safety	3,141	4.1	4,615	4.1	6,998	2.8
Education and training	4,016	3.7	5,209	3.5	6,829	2.9
Health care and social assistance	3,824	5.5	5,802	5.7	10,195	4.5
Arts and recreation services	429	0.4	546	0.7	1,109	0.4
Other services	1,189	1.6	1,584	1.5	3,333	1.4
Ownership of dwellings	7,462	6.3	10,795	5.8	15,232	6.7
Taxes less subsidies on production	4,882	7.9	6,612	6.8	8,401	4.0
Statistical Discrepancy	3,580	-0.2	2,769	0.0	1,275	0.0
Gross state product	92,436	100	140,895	100	252,999	100

Source: ABS Cat No 5220.0 (2012-13). Values are chain volume measure. Shares are current prices.

Alongside the increase in the share of mining, presently at 29%, there is also an increase in the share of construction and a decrease in manufacturing. Reflecting the strong growth in house prices the ownership of dwellings component has also shown persistent strength. To an extent, the fortune of WA is not completely at the hands of China and emerging economies. As shown in Table 1, industries such as Construction, housing and imputed rent in the form of Ownership of Dwellings, Professional, scientific and technical services, as well as other sectors which are individually small but which add up to a sizeable amount, are largely domestically focussed. It is these sectors that are the target of concerted efforts to diversify the WA economy to insulate the state from external shocks. Duncan and Koshy (2013) examines the state‘s comparative performance with other states and territories before and since the onset of the mining boom in greater depth and discusses the longer term outlook.

3. A Regional Approach

Western Australia is a diverse state with unique regions. Studies on the economy that ignore regional developments are likely to be hindered by a lack of the richness and variability inherent in the intra-state regions. This section proposes a regional approach to analysing the Western Australian economy. Regardless of how intra-state regions are defined, there are significant differences in endowment of resources, climate and connectivity to the capital city of Perth. In addition, different regions have different exposure to export (domestic and international) markets and belong to distinct electoral boundaries which set different priorities for future development.

The first step in the analysis is to arrive at a classification of the regions within Western Australia. Table 2 illustrates that this is not necessarily straightforward, since government departments dissect WA along different geographic boundaries, each set of course catering for a different audience or to facilitate a different purpose.

Table 2: Examples of Alternative Classification of Regions within Western Australia

Regional Development Commissions Act 1993	Bureau of Meteorology	Department of Agriculture and Food	Natural Resource Management WA	Main Roads Western Australia	Tourism Western Australia
Gascoyne	Kimberley	Northern Agricultural	Avon	Kimberley	Perth
Goldfields – Esperance	Pilbara	Rangelands	Swan	Pilbara	Coral Coast
Great Southern	Gascoyne	Southern Agricultural	South West	Gascoyne	Golden Outback
Kimberley	Goldfields	Central Agricultural	South Coast	Mid-West	North West
Mid West	Eucla	South West Agricultural	Northern Agricultural	Goldfields –	South West
Peel	Northern Interior		Rangelands	Esperance	
Pilbara	Southern Interior			Wheatbelt North	
South West	Central West			Wheatbelt South	
Wheatbelt	Lower West			Metropolitan	
	South West			Great Southern	
	South East Coastal			South-West	
	Great Southern				
	Central Wheat Belt				

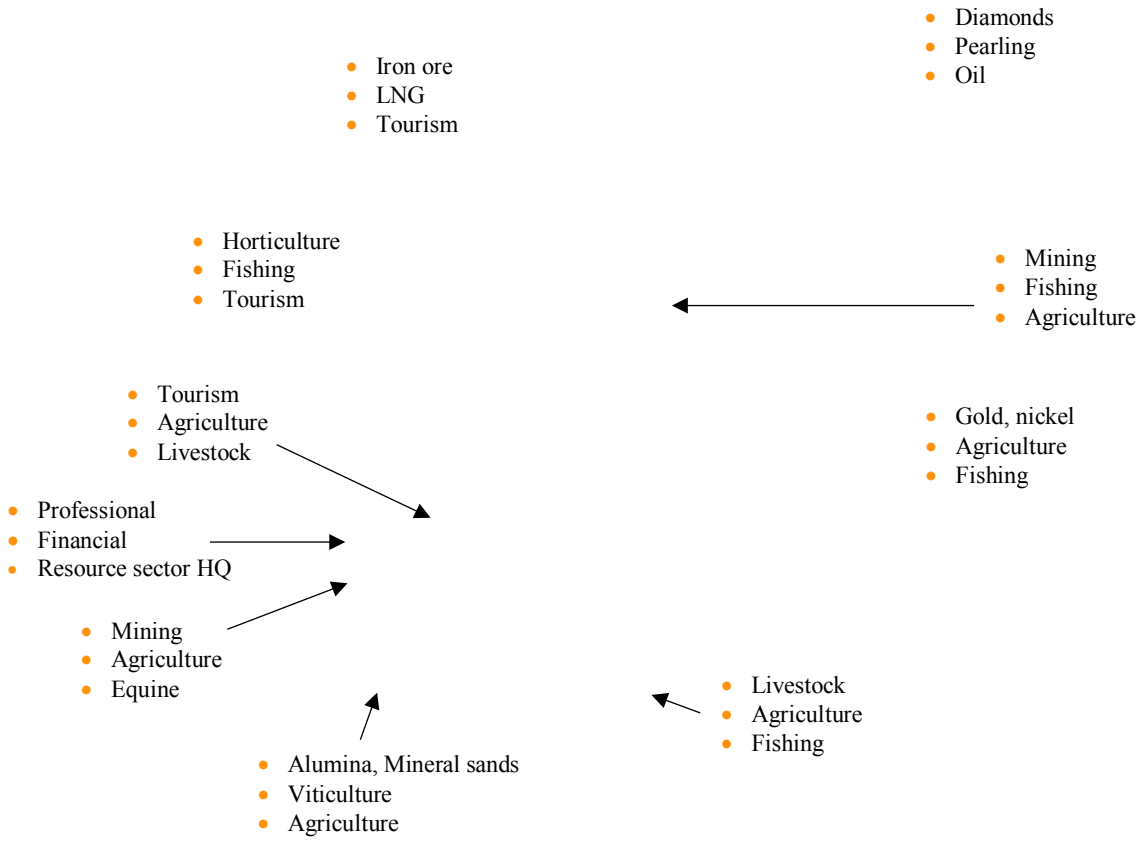
Source: Government departments.

Most of the data used in the empirical part of this project is obtained from the Australian Bureau of Statistics. The ABS has largely moved away from broad regional grouping such as those in Table 2 to the Australian Statistical Geography Standard (ASGS) Statistical Areas.[2] As such the source of data is not a guiding factor in deciding on regional grouping since low-

[2] Statistical areas are classified into SA2 [e.g, Pemberton], SA3 [e.g. Manjimup], and SA4 [e.g. Bunbury]. In this example, these sub-areas belong to the South West region of Western Australia. The smallest locality unit SA1, built from mesh blocks, is similar to the non-ABS concept of Local Government Area (LGA). For example, 50103102001 is a SA1 block within Pemberton SA2, and has a 100% correspondence with the LGA Manjimup (Shire).

level statistical area data can easily be aggregated to construct broader groupings. Importantly for this project, there are development commissions/agencies for each of the nine regions corresponding to the Regional Development Commissions Act. Since the individual development commissions provides additional data as well as future plans with which to cross-check findings from BCEC studies, the Regional Development Commission definition (with the addition of the City of Perth) is chosen for this project. Appendices A and B show the ten regions and their constituent sub-areas and contain further details on the regional groupings.

Figure 2: West Australian Regions and Principal Industries



Note: Principal industry identification from regional development commissions.

Figure 2 shows the ten regions and their predominant industries. A similar map can also be made showing rainfall dispersion and temperature differences through the state. Yet another map can show the spread of population and skilled workers in WA (see, for example,

Cassells *et al.* 2013). These further illustrate the benefit for modelling the West Australian economy at the regional level.

Representing the state into regions also allows a closer examination of the trends apparent in Table 1. There, the contribution to the WA economy from Mining and Construction has clearly increased, whilst Manufacturing has taken a backward step. In 2007, there were 2,493 registered Australian businesses in WA in the Mining sector. By 2012, this has increased to 2,977. In looking at the regions, the Pilbara had 38 registered mining businesses in 2007 and this actually fell/consolidated to 34 in 2011. Though somewhat counterintuitive given that the Pilbara is a world powerhouse in mining, it is important to note that though operations are done in the Pilbara region the head offices are often registered in Perth, which has more access to non-operations functions such as financial and legal services, technology support and the international airport. Indeed, whilst there were only 1,995 businesses in the metropolitan area back in 2007 this grew to 2,500 by 2012.

In 2006, 63,964 people were employed in the Manufacturing sector in Perth and 7,175 in the South West. By 2011, the Manufacturing labour force in Perth was 63,839 and 7,476 in the South West, representing only modest change which, along with competitive world prices and the rise of Mining and Construction, contributed to the sector's overall decline in WA. The analysis can be further extended to locality. In 2006, the City of Canning had the most employees in Manufacturing (9,688) and this fell to 9,469 in 2006. In the South West, there were 1,715 employees in the City of Bunbury and 1,224 in the Shire of Harvey. By 2011, these have decreased to 1,526 and 1,211, respectively.

4. Measuring Gross Regional Product

Many national statistics departments compile data for and calculate measures of gross product at the state or provincial level, usually using a top down approach by allocating national estimates to the state level using state indicators. While underlying surveys are conducted at times at the postal code level of granularity there are difficulties in arriving at measures of gross product at the *regional/intra-state* level. Indeed, the ABS does not calculate gross product at the regional level.

However, in WA, the Department of Regional Development estimates Gross Regional Product (GRP) using the state accounts measure of WA Gross State Product.[3] At present, the data are not published on a regular basis as the methodology is currently under review. For these reasons, a methodology for constructing an experimental series of GRP is developed and presented in this section.

The starting point is the state account's GSP for WA, which is expressed on a financial year basis from 1990-91. Analogous to the measures of GDP for Australia it is also available in current price and chain-volume estimates. Within the state accounts, industrial gross value added (current price and chain volume measure) and total factor income (current price) are available by industrial sectors.

$$GSP_t = aff_t + min_t + man_t + egw_t + cst_t + wht_t + ret_t + afs_t + tpw_t + imt_t + fis_t + rhr_t + pst_t + ass_t + pas_t + edt_t + has_t + ars_t + ots_t + OWD_t + (T - S)_t + StatDiscp_t \quad (1)$$

Equation 1 shows the production approach of the national accounting identity where gross state product is decomposed into industry gross value added for each ANZSIC 2006 industry division.[4] Assume that each industrial sector, including ownership of dwellings, net taxes, and statistical discrepancy, can be disaggregated by region, where $aff_t = \sum_{i=1}^{10} aff_t^i$, $min_t = \sum_{i=1}^{10} min_t^i$, …, $StatDiscp_t = \sum_{i=1}^{10} StatDiscp_t^i$ where i denotes region (1=Gascoyne, …, 10=Wheatbelt).

The allocation of state-level industrial gross value added into the ten regions is done through the use of shares, where $sect_t^i = \alpha_{sect,t}^i \times sect_t$, where *sect* denotes industrial sector and α is a share, or weight, where $\sum_{i=1}^{10} \alpha_{sect,t}^i = 1$.

In splitting national level industry gross value added to the states the ABS uses components of compensation of employees, gross operating surplus and mixed income and taxes less subsidies on production to obtain the shares. To further split the state level industry gross

[3] There are no official statistics on Australia's state and territory GRP. Apart from the Western Australian Department of Regional Development and Queensland Treasury and Trade, numerous private consultancies have estimated gross regional products for intra-state regions of Australia. Of these, Queensland Treasury and Trade has the most comprehensively documented methodology and appears to be the most rigorous (see Queensland Treasury and Trade 2013).

[4] Unduplicated value of goods and services produced by sub-level industries. Refer to Appendix C for variable definitions.

value added to the regions, time series data on a regional basis with a sectoral focus are required to construct the shares. Unfortunately, there is only a limited amount of published data available at this level of detail. For all sectors excluding ownership of dwellings, data on *persons employed by industry*[5], *count of Australian businesses by industry*[6], and count of business by industry are used.[7] In addition to these, Agriculture, Forestry and Fishing uses the Value of agricultural commodities produced, Mining uses the Value of minerals and petroleum[8], and Construction uses the value of total building approvals. Equation 2 illustrates the mechanism:

$$\alpha^{i}_{sect,t} = mean\left[\frac{employ^{i}_{sect,t}}{employ^{WA}_{sect,t}}, \frac{ctbus^{i}_{sect,t}}{ctbus^{WA}_{sect,t}}, \frac{agrival^{i}_{aff,t}}{agrival^{WA}_{aff,t}}, \frac{minval^{i}_{min,t}}{minval^{WA}_{min,t}}, \frac{bapprov^{i}_{cst,t}}{bapprov^{WA}_{cst,t}}\right] \quad (2)$$

where *i* denotes region, *sect* denotes all sectors and *agrival* (value of agricultural commodities produced), *minval* (value of minerals and petroleum) and *bapprov* (value of building approval) are additional data available on a regional level of disaggregation that are used for the Agriculture, forestry and fishing (*aff*), Mining (*min*) and Construction (*cst*) sectors. For ownership of dwellings, the shares are generated by equally weighting median house price for the most populous towns within each region and population shares. For taxes less subsidies on production, the shares are generated by equally weighting total wage and salary income and population shares. Finally, WA's statistical discrepancy is distributed evenly into the 10 regions. The final shares for each industrial sector for the year 2012-2013 (i.e., $\alpha^{i}_{sect,2013}$) are shown in Table 3.

[5] Census 2006 and Census 2011 number of persons employed by industry (place of work) by LGA. Only 2006 and 2011 data are available. 2007-2010 data are linearly interpolated.
[6] Census 2011 and ABS Cat No 8165.0 by SA2, SA3 and SA4.
[7] For example, $\alpha^{4}_{man,2010}$ is the number of persons employed in the manufacturing sector in the Kimberley in 2010 divided by total WA manufacturing workforce in 2010.
[8] The WA total value of minerals used in calculating the regional shares excludes the value of offshore petroleum. Offshore petroleum in 2012-13 was worth $24.4 billion and mostly belong to the commonwealth.

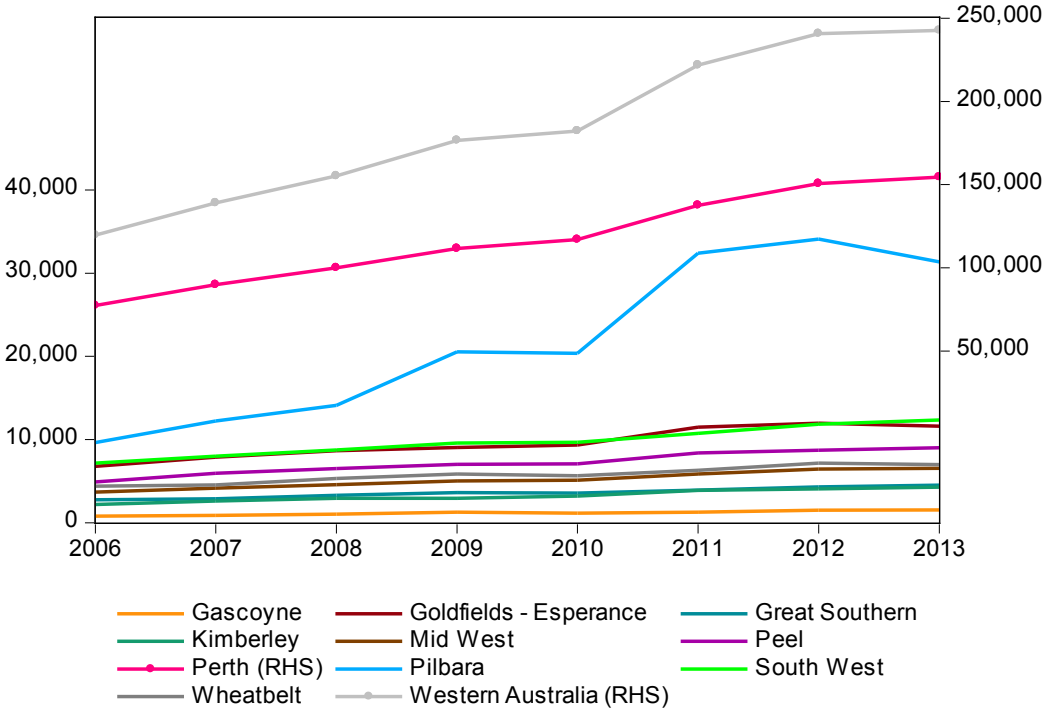
Table 3: Shares to Disaggregate WA Industry Gross Value Added to its Regions

Year 2012-13	gas	goe	grs	kim	miw	pee	per	pil	sow	whb
Agriculture, forestry and fishing	1.31	4.82	15.30	1.85	10.99	3.75	16.55	0.68	16.77	27.99
Mining	0.24	10.76	0.17	1.39	3.34	3.76	41.49	34.80	1.70	2.35
Manufacturing	0.26	2.13	2.32	0.63	1.61	4.05	76.95	1.39	8.24	2.41
Electricity, gas, water and waste services	0.75	2.91	2.62	0.97	2.43	2.82	73.12	2.76	8.26	3.36
Construction	0.47	1.96	2.04	2.04	2.33	4.16	68.78	8.63	7.27	2.33
Wholesale trade	0.24	1.69	1.83	0.58	1.51	2.17	83.59	1.12	4.38	2.90
Retail trade	0.47	2.13	2.95	1.35	2.34	4.13	74.84	1.09	7.58	3.12
Accommodation and food services	0.76	2.76	2.80	2.01	2.62	3.83	71.02	2.80	8.39	3.00
Transport, postal and warehousing	0.63	2.94	2.02	1.53	2.60	2.95	75.91	3.40	4.50	3.53
Information media and telecom.	0.36	1.08	1.56	1.90	0.99	1.85	85.65	0.59	4.82	1.20
Financial and insurance services	0.13	1.24	1.35	0.47	1.47	1.91	87.15	0.55	4.02	1.69
Rental, hiring and real estate services	0.32	2.13	2.21	1.14	1.94	3.12	78.46	2.51	6.26	1.91
Professional, scientific and tech. services	0.14	1.12	1.30	0.56	0.97	1.90	87.94	1.20	3.86	1.02
Administrative and support services	0.39	1.95	1.61	1.80	1.79	3.16	78.50	3.45	5.62	1.72
Public administration and safety	0.57	2.50	1.97	1.42	1.75	3.64	80.41	1.72	4.14	1.88
Education and training	0.36	1.92	2.59	1.53	1.92	3.40	78.18	1.54	6.32	2.25
Health care and social assistance	0.19	1.53	2.10	1.30	1.91	2.88	81.23	1.05	5.93	1.89
Arts and recreation services	0.36	1.39	1.50	1.23	1.29	4.37	82.68	0.72	4.94	1.53
Other services	0.31	3.44	2.29	1.93	2.52	3.66	73.72	2.18	6.59	3.37
Ownership of dwellings	4.58	4.54	4.84	7.29	5.25	6.88	42.62	10.60	7.86	5.53
Taxes less subsidies on production	0.36	2.41	1.94	1.29	2.09	4.64	75.29	3.01	6.45	2.53
Statistical discrepancy	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

Note: Shares expressed in percentages where each row sums to 100.

Note that the GRP estimates constructed in this section are current price, as opposed to chain volume, estimates. There are two limiting factors that prevent the construction of chain volume GRP data. First, it is not appropriate to disaggregate state-level chain volume measure GSP into the regions. Second, there are no regional price indices for the ANZSIC 2006 sectors which can be used to construct chain volume GRP estimates. The estimated GRP data are plotted in Figure 3.

Figure 3: Gross State Product and Estimated Gross Regional Products



Source: ABS Cat No 5220.0 (2012-13) and BCEC analysis. Values expressed in millions of dollars, current price.

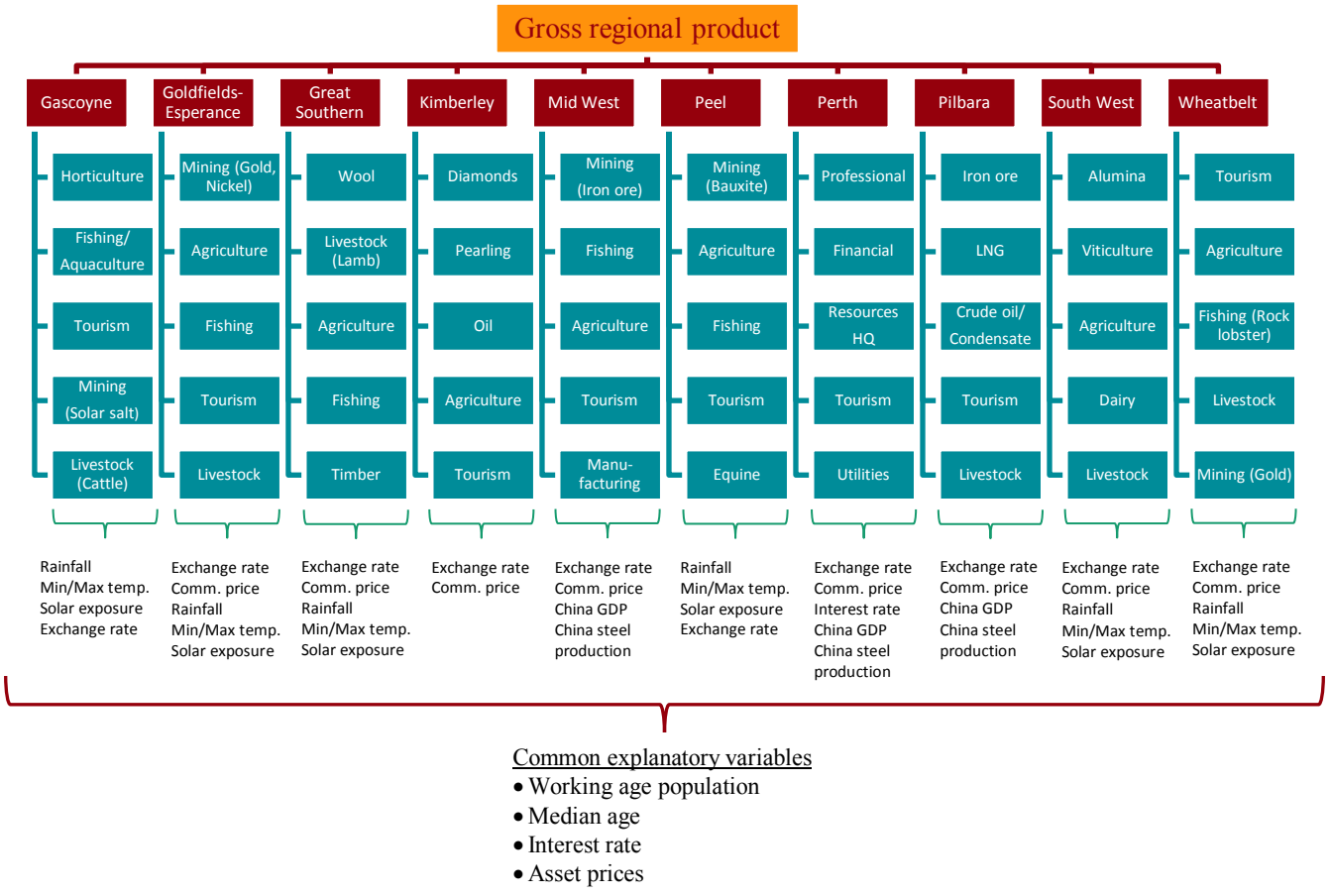
Appendix D shows the industrial composition of each region using area charts. Several points are worth noting. Perth has the highest GRP and, along with the South West, is also the most diversified. Regions such the Pilbara, Goldfields – Esperance and Mid West are heavily mining driven. The economies of Great Southern and Wheatbelt in contrast have a significant share of agriculture, forestry and fishing. This GRP dataset is continually refined with the use of more regional data and forms of the basis of the modelling work. Appendix D also shows the industrial composition of the WA economy as a whole as well as for Australia. When comparing WA with Australia it is evident that WA is dominated by mining.

5. Model

The purpose of this paper is to forecast WA economic growth by aggregating regional GRP projections. To this end, an econometric specification derived ideally from a theoretical framework is required. With that said, a balance needs to be struck between theoretical foundation and being pragmatic due to the challenge of the exercise (analysis by region and industry), most notably limited by the availability of regional-level time series data.

As an export-oriented state, WA is affected by external factors such as the exchange rate, commodity prices and developments in emerging economies in addition to domestic economic conditions. To facilitate policy and scenario analysis the model for GRP should, if possible, include a set of variables on demography, regional trade and climate in addition to macroeconomic drivers. Figure 4 expands the information in Figure 2 by specifying the principal industries followed by an articulation of their underlying drivers. With different mix of domestic- versus external-facing industrial sectors, each region is expected to respond differently to shocks. In the process of arriving at Figure 4, a range of region-specific as well as common explanatory variables becomes evident. GRP (per capita) being a function of demographic/social/economic/meteorological determinants as well as regional and possibly period fixed effects is well documented in the literature (see, for example, Kelly and Schmidt 2005).

Figure 4: Determining Common and Region Specific Drivers for WA Economy Growth



A compilation of a range of common and region-specific variables that forms the basis of the analysis is contained in Table 4 (see also Appendices C and E). Much of the regional level data are obtained from the Census, in which data are available at the Statistical Area level. Regional demographic and economic data are also obtained from the Census. Climate data are obtained from the Bureau of Meteorology. Financial and overseas data are obtained from the Reserve Bank of Australia and the International Monetary Fund. Appendix C contains a full description of the data and assumptions adopted in constructing missing values (e.g. constructing 2012 data not available from Census 2011).

Table 4: Specifying Groups of Explanatory Variables for WA Gross Regional Product

Demographic	Economic
• Population • Working age population (age 15-64) • Population density (population per square kilometre of land mass) • Median age • Number of wage and salary earners • Urban clusters (centres with 1,000 or more people)	• Total wage and salary income • Median house price • Cash rate • Exchange rate, Commodity prices • China: GDP, Crude steel production (unfinished steel usually produced through a blast furnace from sintered iron ore)
Meteorological	**Indicators**
• Average rainfall • Average minimum/maximum temperature • Average daily global solar exposure (total solar radiation on the earth's surface)	• Coastal influence • Other regional-specific restrictions/bottlenecks • Factors such as Community safety, Business confidence, Tertiary institution rankings

Having compiled the data a challenge arises where the dependent variable GRP (per capita), which uses Census sectoral employment to allocate state-level data into the regions, is only available from 2006 to 2012, that is, 12 observations per region.[9] Notwithstanding data construction work to update the dataset to 2012-13 (the latest data point in the state accounts) many of the explanatory variables often span 2007 to 2011. Moreover, an inclusion of a single lag in the model will result in the loss of 10 observations. This challenge lends itself to pooling the data together to form a panel. This panel approach has two advantages. First, with 10 regions and data from 2007 to 2012-13, the pooled dataset has 70 observations, which is a good start for modelling work, bearing in mind that any new data release will make available a further 10 observations. Second, in using fixed and random effects, the

[9] An obvious alternative would be to use higher frequency data, such as quarterly or monthly observed data. However, from the State Accounts, state/territory GSP is only released on a financial year (i.e. annual) basis. National accounts data on state final demand is available quarterly but components such as taxes less subsidies on production are only collected annually.

model will not restrict gross product in different regions to react in the same way to changes in the exogenous variables.

Guided by the flow chart in Figure 4 and the availability of variables in Table 4, three specifications for GRP are estimated and summarised in Table 5. The specifications are derived using a general-to-specific approach with the starting point being the growth rate of GRP or per capita GRP regressed on sets of drivers (Table 1) with a range of dynamic (lag) terms. Domestic and external drivers are included in all initial specifications. Specification 1 includes both domestic and external drivers. Specification 2 includes only domestic drivers. Specification 3 is expressed in the log-difference of GRP (instead of log-difference of per capita GRP).

In all three specifications, the dependent variable is expressed in (log) first difference, rendering these equations for the growth rates of GRP (per capita). This transformation is supported by results from panel unit root tests suggesting the level of GRP(/Pop) is I(1) while its first difference is I(0) or stationary.[10]

[10] For per capita GRP in log-level, the Im, Pesaran and Shin statistic is -0.139 [0.445]. In first-difference, the statistic is -2.266 [0.012]. For GRP in log-level, the Im, Pesaran and Shin statistic is -0.083 [0.467] while in first-difference it is -2.198 [0.014]. The auxiliary equations in log-levels include individual effects and linear trends, while the first difference equations include only individual effects. The optimal lag length is selected by BIC.

Table 5: Model Specifications

Variable	Specification 1 Dependent variable: Log-difference per capita GRP		Specification 2 Dependent variable: Log-difference per capita GRP		Specification 3 Dependent variable: Log-difference GRP	
	Value	t-stat [Prob.]	Value	t-stat [Prob.]	Value	t-stat [Prob.]
Constant	-1.799	-3.473 [0.001]	-0.853	-0.480 [0.634]	-6.826	-2.980 [0.005]
Domestic drivers						
GRP (lag 1)					-0.439	-4.258 [0.000]
GRP per capita (lag 1)	-0.184	-2.213 [0.039]	-0.215	-2.614 [0.013]		
Population aged 15-64 (lag 1)					0.887	3.347 [0.002]
Average wage (lag 1)			0.426	3.144 [0.003]		
Change in no. of wage earners					0.672	3.829 [0.001]
Change in median house price	0.150	1.826 [0.075]				
Change in level of cash rate	-0.038	-2.580 [0.013]				
Average maximum temperature			-1.276	-2.837 [0.007]		
Average minimum temperature					-0.481	-2.123 [0.041]
Change in ave. maximum temp.	-0.659	-1.799 [0.079]				
External drivers						
China per capita GDP (lag 1)	0.509	3.479 [0.001]				
China steel production (lag 1)					0.382	3.632 [0.001]
Change in China steel pro. (lag 1)	2.546	3.127 [0.003]				
Regional response to changes in commodity prices						
Gascoyne	0.174	2.573 [0.014]	0.177	2.49 [0.017]	0.153	2.634 [0.012]
Goldfields – Esperance	0.131	1.933 [0.060]	0.118	1.692 [0.099]	0.233	4.038 [0.000]
Great Southern	0.109	1.644 [0.107]	0.076	1.083 [0.286]	0.102	1.813 [0.078]
Kimberley	0.013	0.198 [0.844]	0.036	0.516 [0.609]	0.047	0.845 [0.404]
Mid West	0.084	1.243 [0.221]	0.121	1.729 [0.092]	0.144	2.584 [0.014]
Peel	0.111	1.628 [0.111]	0.166	2.349 [0.024]	0.265	4.397 [0.000]
Perth	0.120	1.752 [0.087]	0.116	1.66 [0.105]	0.192	3.286 [0.002]
Pilbara	0.461	5.775 [0.000]	0.491	6.008 [0.000]	0.490	6.760 [0.000]
South West	0.088	1.313 [0.196]	0.105	1.505 [0.141]	0.159	2.788 [0.009]
Wheatbelt	0.171	2.438 [0.019]	0.150	2.147 [0.038]	0.166	2.778 [0.009]
Regional fixed effects						
Gascoyne	0.054		0.331		1.176	
Goldfields – Esperance	0.084		-0.056		0.231	
Great Southern	-0.080		-0.343		-0.040	
Kimberley	-0.003		0.291		0.441	
Mid West	-0.008		0.121		0.155	
Peel	-0.091		-0.318		-0.331	
Perth	-0.061		-0.173		-1.596	
Pilbara	0.248		0.452		0.775	
South West	-0.089		-0.261		-0.642	
Wheatbelt	-0.053		-0.044		-0.168	
Summary statistics						
Adjusted R-squared	0.698		0.674		0.808	
Standard error of the residuals	0.047		0.050		0.040	
F-test of poolability	0.931	[0.508]	1.925	[0.079]	2.599	[0.021]
LM test AR(1) autocorrelation	3.937	[0.054]	0.197	[0.660]	0.131	[0.720]
Akaike information criterion	-3.006		-2.796		-3.322	
Bayesian information criterion	-2.171		-2.307		-2.450	

Note: All variables expressed in logs, unless otherwise specified. Model estimated from 2007 to 2013.

Specification 1 has a slightly higher $\bar{R}^2$ than Specification 2. In terms of model selection criteria AIC suggests that Specification 1 is preferred to Specification 2 while BIC suggests

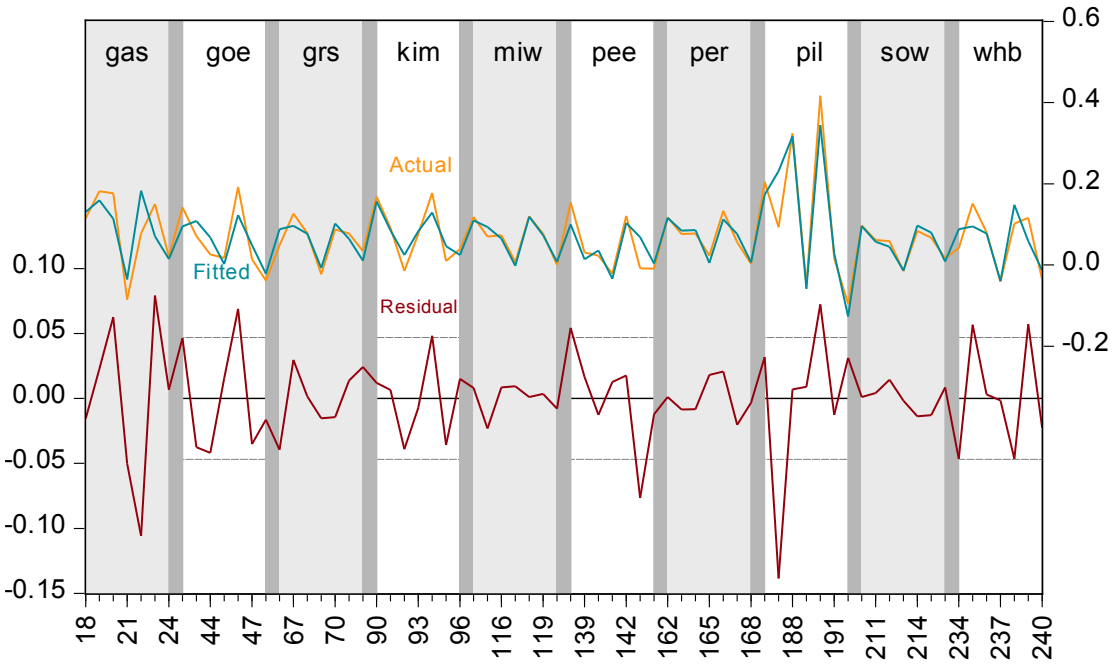
the reverse. Specification 3 fits the data better though it is not appropriate to compare this to Specifications 1 and 2 using the information criteria as the dependant variables are measured differently.

Specification 1 is selected for illustration since it contains domestic and external factors as well as a domestic policy instrument in the form of the cash rate and a measure of asset price in the form of house prices. In this specification (equation 3), the growth rate in per capita GRP is a function of Chinese per capita GDP in the long run, and in the short run affected by growth in Chinese crude steel production, growth in median house prices, growth in the cash rate, and growth in commodity prices. The model allows each region to have a different intercept in the form of regional fixed effects.

$$\Delta ln\left(\frac{GRP}{Pop}\right)_{i,t} = \alpha_i + \beta\left[ln\left(\frac{GRP}{Pop}\right)_{i,t-1} + \gamma\left(\frac{GDP}{Pop}\right)_{t-1}^{China}\right] + \delta_1\Delta ln(CSP)_{t-1} + \delta_2\Delta ln(HsePrice)_{i,t} + \delta_3\Delta(CashRate)_t + \delta_4\Delta ln(maxtemp)_{i,t} + \varepsilon_{i,t} \quad (3)$$

From these estimates, it can be observed that the long- and short-run components in this error-correction specification are statistically significant and have the correct sign, with the exception of several regions where changes in commodity prices have no significant impact. Indeed, these are regions, for example the Kimberley and South West, whose economies are more inward-looking and less exposed to the export market to be affected by commodity prices. It is also the reason that, as six of the ten cross-section specific commodity price effects are insignificant, the test for fixed effects poolability is not rejected, suggesting in this instance that there is no added value in estimating a pooled model. With an $\bar{R}^2$ of 0.70, as expected from the as yet limited set of explanators with which to use, the estimated specification for regional gross product is not optimal. Figure 5 depicts the fit region-by-region where it can be observed that the specification fits better for regions such as Perth and the Great Southern, and less well for the Pilbara and Gascoyne.

Figure 5: Estimated Model and Residuals by Region



Note: Dependent variable is the log-difference in per capita GRP. Dotted lines are +/- one standard error. The numbers on the horizontal axis represent the stacked data where 1 = 1990, …, 24 = 2013; 25 = 1990, …, 48 = 2013, …, and gaps are the result of unavailable values.

6. Uses of Model – Ex Ante Forecasts

With a potential degree of richness, the model can be used as a simple framework with which to analyse developments in the economy and the effects of external shocks, and to generate a path of the state's likely future trajectory.

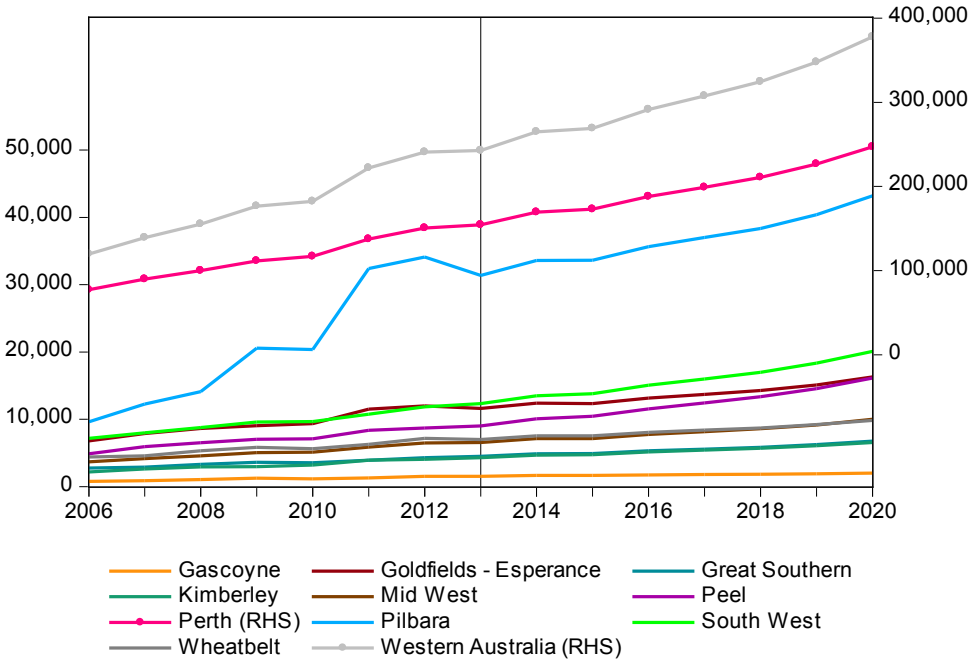
In this section, the model specification is used to forecast WA's Gross State Product through to 2020. The assumptions and procedure used in extrapolating forward the model's exogenous variables are shown in Table 6. There is scope to incorporate various rules for projecting the exogenous variables, as well as allowing users to enter preferred values.

Table 6: Steady State Values of the Exogenous Variables

Variable	Data edge	Extrapolation method
Population	2012	Extrapolated using the Department of Planning's Central Case projections (Department of Planning 2012).
Chinese GDP growth per capita	2012	Use IMF's World Economic Outlook projections (October 2013) until 2018 (end period of IMF forecast); thereafter smoothly converges to 6.5% growth per annum. Population projections also obtained from the IMF's World Economic Outlook.
Chinese steel production	2012	Projected based on assumption on finished steel intensity (see Section 7)
Median house price by region	2012	Projected using a combination of average 2010-12 and 2011-12 growth rates
Cash rate	2013	Converges from its current value to a constant neutral real cash rate of 3 per cent per annum (based on CPI inflation being 2.5 per cent).
Average maximum temperature	2012	Converges from its current value to the historical average from 2003 to 2012.
Index of commodity prices	2013	Scenario driven, assuming it converges smoothly from its 2012-13 value of 100 to 90 in the long run.

Having specified the model and characterised future trends of its fundamental drivers, Figure 6 shows forecasts of the WA economy by region.

Figure 6: Trajectories for Western Australian Gross State Product by Region



Note: Values expressed in millions of dollars, current price.

Section 4 discusses the drawback of the lack of regional price indices preventing the construction of a chain volume series of WA GRP. To obtain an indication of real changes in

GRP, however, one could apply an explicit deflator to the current price WA GSP forecast as obtained from the model. The growth rate of constant price GSP corresponding to the above is computed as follows. Chain volume measured GSP, unlike the superseded constant price measure, are valued using base prices which are updated annually, set to the previous year, e.g. the reference year for the latest 2012-13 state accounts is 2011-12. The 2013-14 implicit deflator will be 100 in 2012-13, where chain volume GRP will be identical to its current price value of $242,697 million. Assuming the deflator fluctuates within a range of 2-4% results in a 2013-14 growth of between 5.0 and 7.0 per cent.

7. Uses of Model – Scenario Analysis

There is now strong evidence of China's economy shifting from investment- to consumption-driven mode[11], leading to an earlier than expected peak in the production of crude steel and an ultimately lower level. As a result the price of iron ore fines falls and the commodity price profile shifts down.

The model, being augmented with external/overseas influences, can be used to quantitatively analyse a situation such as this. Table 7 sets up two scenarios with respect to the two external sector variables in the model.

Table 7: Scenario Specification

Exogenous variable	2012 T-2	2013 T-1	2014 T	2015 T+1	2016 T+2	2017 T+3	2018 T+4	2019 T+5	2020 T+6
Baseline									
Index of Commodity Prices	100.00	79.24	80.32	81.29	82.16	82.94	83.65	84.28	84.85
Crude steel production (Mt)	717	779	808	844	865	878	887	894	900
Scenario 1: Adverse shock to nominal commodity prices									
Index of Commodity Prices [Temporary shock]	100.00	79.24	72.29	81.29	82.16	82.94	83.65	84.28	84.85
Index of Commodity Prices [Sustained shock]	100.00	79.24	72.29	75.89	78.39	80.21	81.59	82.67	83.54
Scenario 2: China rebalancing scenario									
Crude steel production (Mt)	717	779	785	779	776	775	775	776	779
Index of Commodity Prices	100.00	79.24	76.30	75.29	74.37	73.55	72.81	72.15	71.55

Source: BCEC analysis. 2013 commodity prices are actuals.

[11] See, for example, Huang (2013).

The first scenario illustrates the responses of the regions to a negative shock in commodity prices, ceteris paribus. In this setup, a temporary shock where the 2014 value falls by 10% relative to baseline and a sustained shock where, following a fall of the same magnitude, the return to the baseline path is protracted, are both examined.

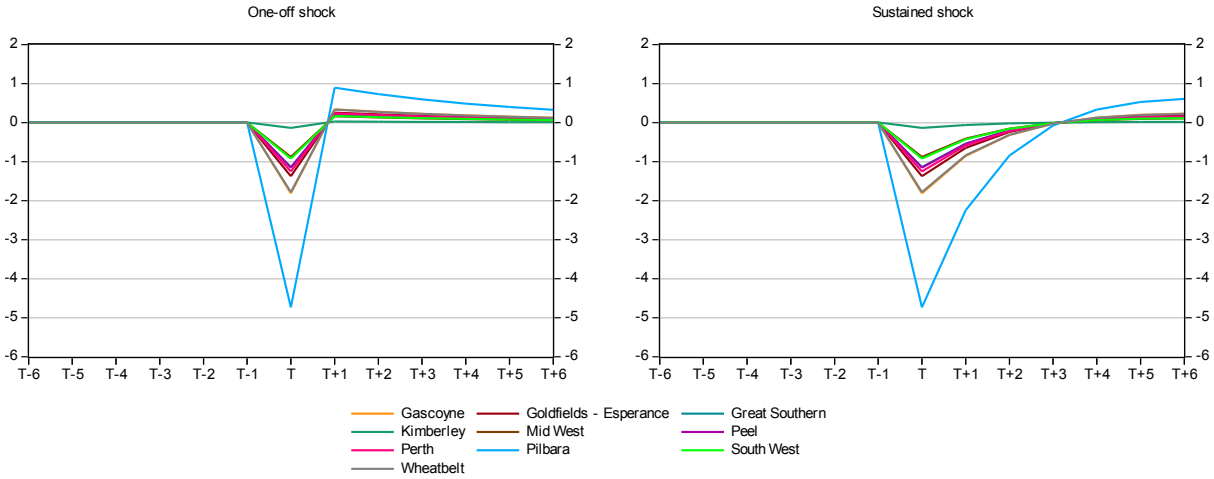
Table 7 also sets up the second scenario which varies the two external sector variables in the model. In the baseline assumption, China at its peak consumes just short of 600 kilograms of finished steel products per person, which translate to approximately 900 million tonnes of crude steel requirement.[12] Per capita finished steel consumption then converges to 550 kilograms per person in the long run. With the structural change in the Chinese economy, the maximum steel intensity is reduced by approximately 80 kilograms per person due to decreased investment in non-construction steel intensive sectors partly attributed to efforts to reduce pollution and a transition towards a service-based economy, and the peak in the curve is brought forward before settling at 500 kilograms per person in the long run. As a consequence of decreased demand, in 2014, the index of commodity prices (SDR terms) falls by 5% relative to its baseline value.[13] From 2015 onwards, it is assumed to converge to a new lower (by 25%) level, in this example of a sustained negative shock.

Figures 7 and 8 plot the percentage deviation of the scenario simulation relative to the baseline simulation (in the absence of the shock). The adverse shock is assumed to occur next year. In the first scenario, the coefficients of the model suggest that the Pilbara will be hardest hit by the commodity price drop, falling by 5 per cent relative to baseline. By contrast, the Kimberley, with the lowest (though insignificant) estimate, reacts slightly in the as predicted negative direction. The one-off shock sees a period of overshooting before the return to baseline. In the case of a sustained shock the system drifts permanently away from baseline.

[12] Crude steel production is projected forward as follows. Begin with a pre-determined scenario for the consumption of finished steel products per capita where, from its current (2012) 487 kilograms per person, it is assumed to follow the familiar logistic/Gompertz shape (intensity-of-use approach) until it converges to a saturation level, e.g. 550 kilograms per person. Using population projections, the level of finished steel consumption forecasts is then translated to the production of crude steel using assumptions on semi- and finished steel trade and a rolled-to-crude steel ratio of 0.95.

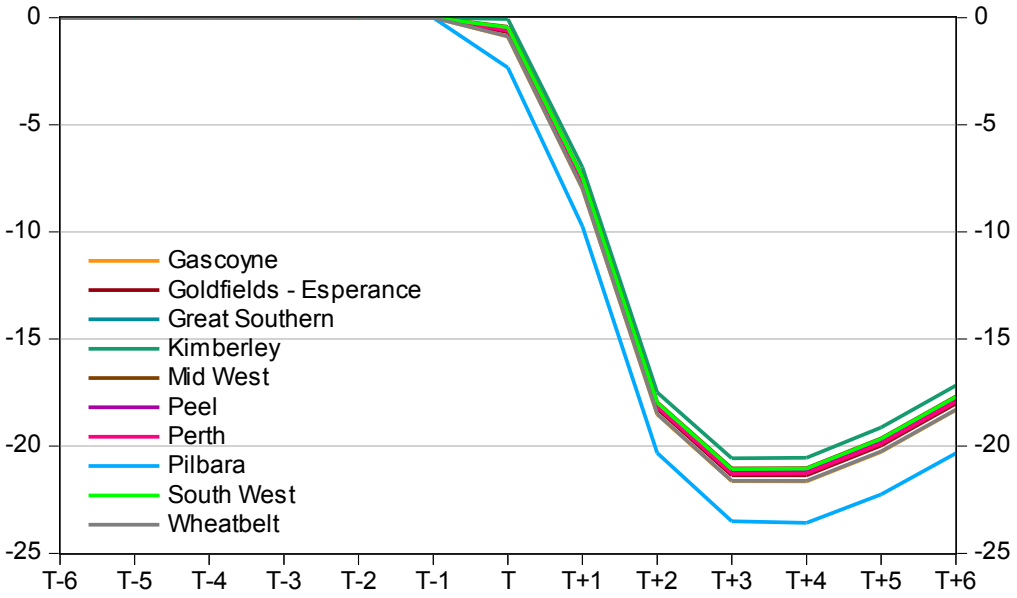
[13] In 2013, the index of commodity prices has its weights revised. Iron ore's weight has increased to 32.7% (Robinson and Wang 2013).

Figure 7: Time Path of GRP Response to an Adverse Commodity Price Shock, Relative to Baseline, Percentage Deviation



As for the second scenario, in the first period, the Pilbara, given its exposure to Chinese steel demand and exchange rate fluctuations, responds aggressively in the negative direction. Thereafter, the Pilbara continues to be the main region pulling WA GSP down. Great Southern and Peel, with little to no direct exposure to events in China, do fall relative to baseline given that their economies have a significant share of rural commodities and other resources which are affected by the sustained decrease in commodity prices. The city of Perth, with its diversified economy, reacts to the shock in the middle of the range of regions.

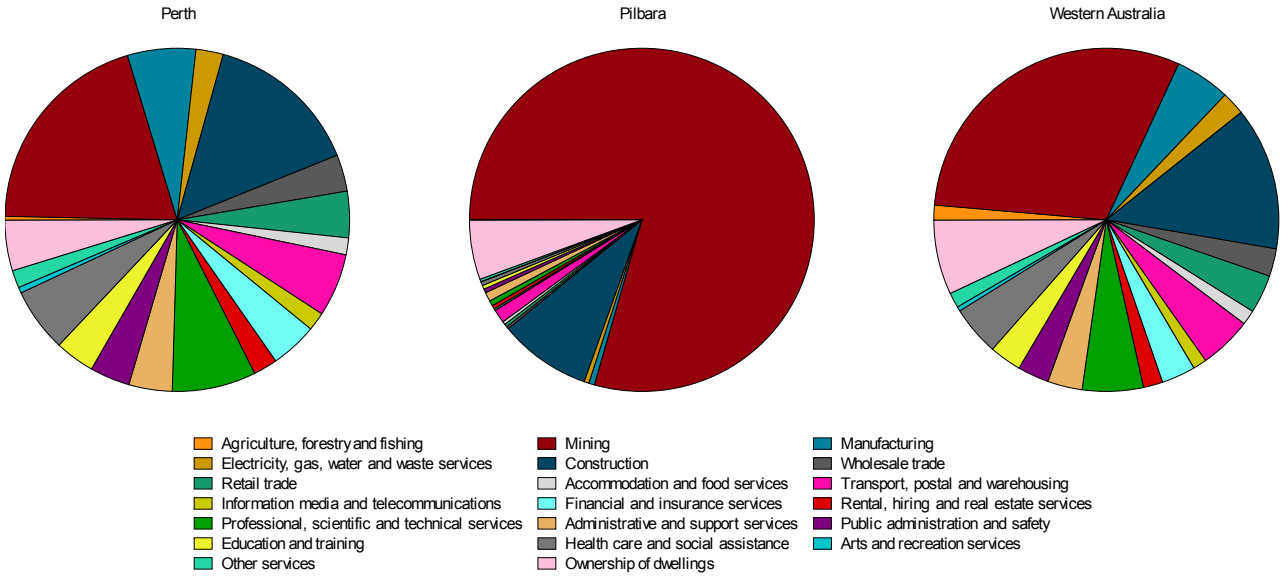
Figure 8: Time Path of GRP Response to a China Rebalancing Scenario, Relative to Baseline, Percentage Deviation



8. Uses of Model – Industrial Composition

Of interest to parties such as the state government and fund managers is the future makeup of the WA economy. Table 1 shows the composition of the WA economy in terms of industry gross value added. For WA as a whole, in 2012-13, Mining has a 29.2% share in the economy, followed by Construction with 12.9%, and Ownership of dwellings with 6.7%. The smallest component is Arts and Recreational Service with a 0.4% share. The procedure for constructing gross regional product in Section 4 is bottom-up where individual industry gross value added components are aggregated for each of regions. Appendix D depicts these as shares and illustrates how some sectors have emerged or decreased in influence through the years. Figure 9 shows the current composition.

Figure 9: Industrial Composition of Western Australia's Iron Ore Provinces, 2013



The framework presented in this paper is developed to project forward each region's total industry gross value added, or GRP. These individual projections are then aggregated to obtain a forecast of WA GSP. A valuable capability would be to forecast not only each region's gross product but also their industrial makeup, e.g. the share of Mining or Construction in the future. This, however, would involve modelling 20 sectors (or fewer as sectors can be aggregated into broader groups) for 10 regions, over the time period 2006-07 to 2012-13. At present this capability is under development.

Within this current modelling framework one could provide some analytics to thought experiments such as: 'What would happen if the mining sector were to fall by 10% in the next decade?'. Begin this analysis by projecting forward the 2012-13 estimated regional industrial composition shares for each sector till 2020. For example, the 2012-13 share of GRP for the Agriculture, Forestry and Fishing sector in the Gascoyne is 2.75%, and the 2012-13 share of Mining in Perth is 19.04%. Applying these to the baseline GRP forecasts derived in Section 6, the nominal value of the WA Mining sector in 2020 is estimated to be $115.3 billion, more than 1.5 times higher than the current value of $70.9 billion.

Table 8: Progressive Decline in the Mining Share of GRP in the Pilbara and Perth

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Baseline ($m, %)									
Mining IGVA – Perth	32,567	29,400	30,424	32,494	35,111	38,212	41,815	46,099	51,076
Share of Perth GRP	21.62	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04
Mining IGVA – Pilbara	27,606	24,661	24,865	26,025	27,362	29,174	31,178	33,655	36,559
Share of Pilbara GRP	80.95	78.63	78.63	78.63	78.63	78.63	78.63	78.63	78.63
GSP	240,811	242,697	249,874	265,717	285,957	310,181	338,063	371,560	410,524
Progressive reduction in mining share of GRP ($m, %)									
Mining IGVA – Perth	32,567	29,400	29,282	30,055	31,158	32,476	33,970	35,720	37,660
Share of Perth GRP	21.62	19.04	18.32	17.61	16.89	16.18	15.46	14.75	14.04
Mining IGVA – Pilbara	27,606	24,661	24,414	25,080	25,871	27,054	28,345	29,986	31,909
Share of Pilbara GRP	80.95	78.63	77.20	75.77	74.34	72.91	71.49	70.06	68.63
GSP	240,811	242,697	248,280	262,332	280,513	302,326	327,386	357,512	392,458
Impact of shock: Deviation from baseline ($m, %)									
Mining IGVA – Perth	0	0	-1,142	-2,439	-3,953	-5,736	-7,845	-10,379	-13,416
Mining IGVA – Pilbara	0	0	-452	-946	-1,491	-2,120	-2,832	-3,669	-4,650
GSP	0	0	-1,593	-3,384	-5,444	-7,856	-10,678	-14,048	-18,066
GSP, Percentage	0	0	-0.64	-1.27	-1.90	-2.53	-3.16	-3.78	-4.40

Source: BCEC analysis.

If the share of Mining in the Pilbara (operations) were to gradually decline from its 2012-13 share until it falls by a total of 10 percentage points by 2020, while in Perth (corporate) the share declines by a lesser 5 percentage points, the impact on WA Mining output will be drastic, with cumulative loss of nominal output in the range of $61 billion from 2014 to 2020 (Table 8). This analysis does not take into account the detrimental effect to employment and related downstream economic activity. Nor does it take into consideration any pre-emptive countermeasure to mitigate this from happening. Notwithstanding that, the broader consequences would be far reaching.

8. Conclusion

One of the aims of this project is to examine the capacity to forecast Western Australia's future economic trajectory. For the first stage of this study, we recognise the following in establishing a framework within which to build a model of regional economic growth:

- WA is a diverse state with separate and unique regions
- Each region has both fixed and variable endowment which explains its current economic composition and would dictate future evolution
- As an export-orientated state, WA will be affected by external factors such as the exchange rate, commodity prices and development in emerging economies

- However, with different composition of domestic- versus external-facing industrial sectors, each region is expected to respond differently to such shocks

A framework for analysing WA's future trajectory is developed and presented in this paper. The point of departure is the framework is centred around the ten regions of the state. Initial projections suggest WA's growth decreasing from its present 5.1 per cent to between 5-7 per cent in 2013-14. When hit with an adverse shock to commodity prices initiated by, for example, a persistent slowdown in China, the primary mining-intensive Pilbara region suffers by a factor of 3 percentage points in the near term over less exposed regions such as Great Southern and Peel.

A major part of this project has been the construction of a regional Western Australia database of economic, demographic and other indicators, from which other current and future research work in regional modelling and forecasting can derive.

We conclude by returning to where we started, i.e. by providing some directions for further investigation to these questions:

- How can the state cope with resource companies' move from an investment to production phase?
- What are the implications of China's transition from a fixed asset investment driven to a consumption driven economy?
- To what extent can WA diversify to areas such as education export, agribusiness, tourism, and back to manufacturing?

Two key implications of the shift in focus by the miners are the gap in investment it is expected to leave as a source of growth and the redistribution of skilled labour. The decline in resource-related investment, being a historically significant component, is likely to leave a dent in economic growth notwithstanding the increase in downstream activities and sectors such as transport and consumption arising from the rise in mining production. The second implication involves a shift in the workforce from 'Professional, Scientific and Technical Services' (operational) to 'Mining' (construction/on-the-pit) and 'Construction'. It is anticipated that that workforce demand will increase in mining provinces such as the Pilbara. The extent of the reduction in workforce demand in the capital Perth is less predictable, given

that strategies such as role redistribution, hiring freeze, extended leave and other adjustments to benefits have been used as alternatives to layoffs.

China's transition towards to consumption driven economy is inevitable and should not be a surprise, as it is not dissimilar to the development paths of countries before it. The relevant question here is: What opportunities would this present Western Australia and whether the state is in a position to capitalise on this? Indeed, with tens of thousands of people migrating from rural to urban centres and into higher income brackets, one can expect an exponential rise in the demand for consumer products, whitegoods and home appliances, and recreation goods and services often associated with high density city lifestyle. If domestic supply is not able to accommodate the rise in demand there will exist opportunities for Australian penetration into that market. It is difficult though to foresee Western Australia carving a section of that pie given its current endowment and comparative advantages unless there is a concerted drive to diversify the economy.

An examination of the characteristics of the ten regions reveals that many regions have the capacity to produce products or supply services over and above their present dominant economic activity. Hence, there is little restriction from an endowment point of view, especially given that certain factors of production such as skilled labour can have high mobility between regions. The key is to prepare the region to shift into another industry when economic conditions are rights, and to do so swiftly. This requires significant forward planning and initial investment. Manufacturing is likely to remain low in the state in the foreseeable future. Indeed, in states such as South Australia and Victoria the car industry has had recent setbacks. Export competitiveness and relatively high labour costs are barriers.

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Appendix A: Regions of Western Australia and Statistical Sub-areas

Region	SA4	SA3	SA2
Gascoyne	Western Australia - Outback	Gascoyne	Carnarvon, Exmouth
Goldfields – Esperance	Western Australia - Outback	Esperance Goldfields	Esperance, Esperance Region, Boulder, Kalgoorlie, Kalgoorlie – North, Kalgoorlie Airport, Kambalda - Coolgardie – Norseman, Leinster – Leonora, Trafalgar (WA)
Great Southern	Western Australia – Wheatbelt	Albany	Albany, Albany Region, Bayonet Head - Lower King, Denmark, Gnowangerup, Katanning, Kojonup, Little Grove – Elleker, McKail – Willyung, Plantagenet, Stirling Range National Park
Kimberley	Western Australia - Outback	Kimberley	Broome, Derby - West Kimberley, Halls Creek, Kununurra, Roebuck
Mid West	Western Australia - Outback	Mid West	Geraldton, Geraldton – East, Geraldton – North, Geraldton – South, Irwin, Meekatharra, Morawa, Northampton - Mullewa - Greenough
Peel	Mandurah *Serpentine – Jarrahdale SA3* *Waroona SA2* *Murray SA2*	Mandurah *Serpentine – Jarrahdale* *Waroona SA2* *Murray SA2*	Waroona, Dawesville – Bouvard, Falcon – Wannanup, Greenfields, Halls Head – Erskine, Mandurah, Mandurah – East, Mandurah – North, Mandurah – South, Pinjarra, Byford, Mundijong, Serpentine – Jarrahdale, Murray
Perth	Perth – Inner Perth – North East Perth – North West Perth – South East (less *Serpentine - Jarrahdale SA3*) Perth South West	Armadale Bayswater – Bassendean Belmont - Victoria Park Canning Cockburn Cottesloe – Claremont Fremantle Gosnells Joondalup Kalamunda Kwinana Melville Mundaring Perth City Rockingham South Perth Stirling Swan Wanneroo	City Beach, Claremont (WA), Cottesloe, Floreat, Mosman Park - Peppermint Grove, Nedlands - Dalkeith – Crawley, Swanbourne - Mount Claremont, Kings Park (WA), Mount Hawthorn – Leederville, Mount Lawley – Inglewood, North Perth, Perth City, Subiaco - Shenton Park, Wembley - West Leederville – Glendalough, Bassendean - Eden Hill – Ashfield, Bayswater - Embleton – Bedford, Maylands, Morley, Noranda, Chidlow, Glen Forrest – Darlington, Helena Valley – Koongamia, Malmalling – Reservoir, Mundaring, Swan View - Greenmount – Midvale, Avon Valley National Park, Ballajura, Beechboro, Bullsbrook, Ellenbrook, Gidgegannup, Hazelmere - South Guildford, Lockridge – Kiara, Malaga, Melaleuca – Lexia, Middle Swan - Herne Hill, Midland – Guildford, Stratton - Jane Brook, The Vines, Walyunga National Park, Craigie – Beldon, Currambine – Kinross, Duncraig, Greenwood – Warwick, Heathridge – Connolly, Hillarys, Iluka - Burns Beach, Joondalup – Edgewater, Kingsley, Mullaloo – Kallaroo, Ocean Reef, Padbury, Sorrento – Marmion, Woodvale, Balcatta – Hamersley, Balga – Mirrabooka, Dianella, Herdsman, Innaloo – Doubleview, Karrinyup - Gwelup – Carine, Nollamara – Westminster, Osborne Park Industrial, Scarborough, Stirling - Osborne Park, Trigg - North Beach - Watermans Bay, Tuart Hill – Joondanna, Wembley Downs - Churchlands – Woodlands, Yokine - Coolbinia – Menora, Alexander Heights – Koondoola, Butler - Merriwa – Ridgewood, Carramar, Clarkson, Girrawheen, Madeley - Darch – Landsdale,

			Marangaroo, Mindarie - Quinns Rocks – Jindalee, Neerabup National Park, Tapping - Ashby – Sinagra, Wanneroo, Yanchep, Armadale - Wungong – Brookdale, Ashendon – Lesley, Camillo - Champion Lakes, Forrestdale - Harrisdale - Piara Waters, Kelmscott, Mount Nasura - Mount Richon – Bedfordale, Roleystone, Seville Grove, Belmont - Ascot – Redcliffe, East Victoria Park – Carlisle, Kewdale Commercial, Perth Airport, Rivervale - Kewdale – Cloverdale, Victoria Park - Lathlain – Burswood, Bentley - Wilson - St James, Canning Vale – West, Canning Vale Commercial, Cannington - Queens Park, Parkwood - Ferndale – Lynwood, Riverton - Shelley – Rossmoyne, Welshpool, Willetton, Beckenham - Kenwick – Langford, Canning Vale – East, Gosnells, Huntingdale - Southern River, Maddington - Orange Grove – Martin, Thornlie, Forrestfield - Wattle Grove, High Wycombe, Kalamunda - Maida Vale - Gooseberry Hill, Lesmurdie - Bickley – Carmel, Como, Manning – Waterford, South Perth – Kensington, Banjup, Beeliar, Bibra Industrial, Bibra Lake, Coogee, Coolbellup, Hamilton Hill, Henderson, Jandakot, Jandakot Airport, North Coogee, South Lake - Cockburn Central, Spearwood, Success - Hammond Park, Wattleup, Yangebup, East Fremantle, Fremantle ,Fremantle – South, O'Connor (WA), Anketell – Wandi, Bertram - Wellard (West), Calista, Casuarina - Wellard (East), Hope Valley – Postans, Kwinana Industrial, Parmelia – Orelia, Applecross – Ardross, Bateman, Bicton – Palmyra, Booragoon, Bull Creek, Leeming, Melville, Murdoch – Kardinya, Willagee, Winthrop, Baldivis, Cooloongup, Port Kennedy, Rockingham, Rockingham Lakes, Safety Bay – Shoalwater, Singleton - Golden Bay - Secret Harbour, Waikiki, Warnbro
Pilbara	Western Australia - Outback	Pilbara	Ashburton (WA), East Pilbara, Karratha, Newman, Port Hedland, Roebourne, South Hedland
South West	Bunbury (less *Waroona SA2*)	Augusta – Margaret River – Busselton Bunbury (less *Waroona SA2*) Manjimup	Augusta, Busselton, Busselton Region, Margaret River, Australind – Leschenault, Bunbury, Capel, College Grove - Carey Park, Collie, Dardanup, Davenport, Eaton - Pelican Point, Gelorup - Dalyellup – Stratham, Harvey, Koombana, Bridgetown - Boyup Brook, Donnybrook – Balingup, Manjimup, Pemberton
Wheatbelt	Western Australia – Wheatbelt	Wheat Belt – North Wheat Belt – South (less *Murray SA2*)	Chittering, Cunderdin, Dowerin, Gingin – Dandaragan, Merredin, Moora, Mukinbudin, Northam, Toodyay, York – Beverley, Brookton, Kulin, Narrogin, Wagin

Ten regions of Western Australia (including Perth) are used in the analysis in this paper. The regions correspond to the classification in the Regional Development Commissions Act 1993.

The ABS uses Statistical Areas as the basic locality units for presenting data. LGA data are also sometimes provided. These are used to construct regional level data using the designations in the table above.

In the Australian Statistical Geography Standard:

- Byford SA2 is part of Serpentine – Jarrahdale SA3 within Perth – South East SA4
- Mundijong SA2 is part of Serpentine – Jarrahdale SA3 within Perth – South East SA4
- Murray SA2 is part of Wheatbelt – South SA3 within Western Australia – Wheat Belt SA4
- Serpentine – Jarrahdale SA2 is part of Serpentine – Jarrahdale SA3 within Perth – South East SA4
- Waroona SA2 is part of Bunbury SA3 within Bunbury SA4

In data construction work where sub-areas are aggregated to the ten WA regions this would suggest that:

- Byford SA2 is part of Perth
- Mundijong SA2 is part of Perth
- Murray SA2 is part of Wheatbelt
- Serpentine – Jarrahdale SA2 is part of Perth
- Waroona SA2 is part of South West

since in this respect it is undeniable that Perth – South East SA4 belongs to Perth, Western Australia – Wheat Belt SA4 belongs to the Wheatbelt, and Bunbury SA4 belongs to the South West.

This association or matching, however, is not consistent with the regional development commissions own classification (see Appendix B). Byford SA2 and Mundijong SA2 both have a 100% correspondence (in terms of mesh block population grid matches[14]) to Serpentine – Jarrahdale (S) and the Peel Development Commission has the shire of Serpentine – Jarrahdale LGA as part of Peel. Murray SA2 has a grid-based correspondence of 76.0% with Boddington (S) and 24.0% with Murray (S). Serpentine – Jarrahdale SA2 has a grid-based correspondence of 98.6% with Serpentine – Jarrahdale (S) and 1.4% with

[14] Source: ABS Cat No 1270.0.55.006 (July 2011).

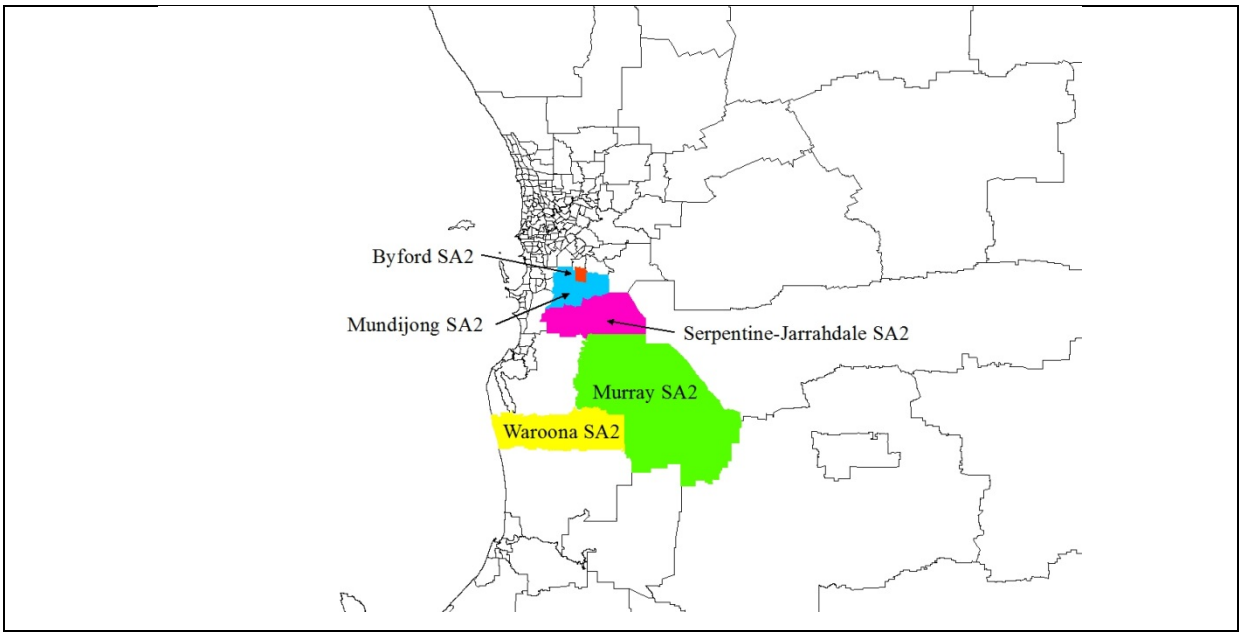
Murray (S).[15] Finally, Waroona SA2 has a 100% correspondence with Waroona (S). The Peel Development Commission also has the shires of Boddington, Murray and Waroona LGAs as part of Peel, while the South West Development Commission does not have the shire Waroona LGA as part of the South West.

Since the ten WA regions are classified according to the Regional Development Commission Act and information from the regional development commissions are used to guide/compare the analysis from this project:

- Byford SA2 is assigned to be part of Peel instead of Perth
- Mundijong SA2 is assigned to be part of Peel instead of Perth
- Murray SA2 is assigned to be part of Peel instead of Wheatbelt
- Serpentine – Jarrahdale SA2 is assigned to be part of Peel instead of Perth
- Waroona SA2 is assigned to be part of Peel instead of the South West

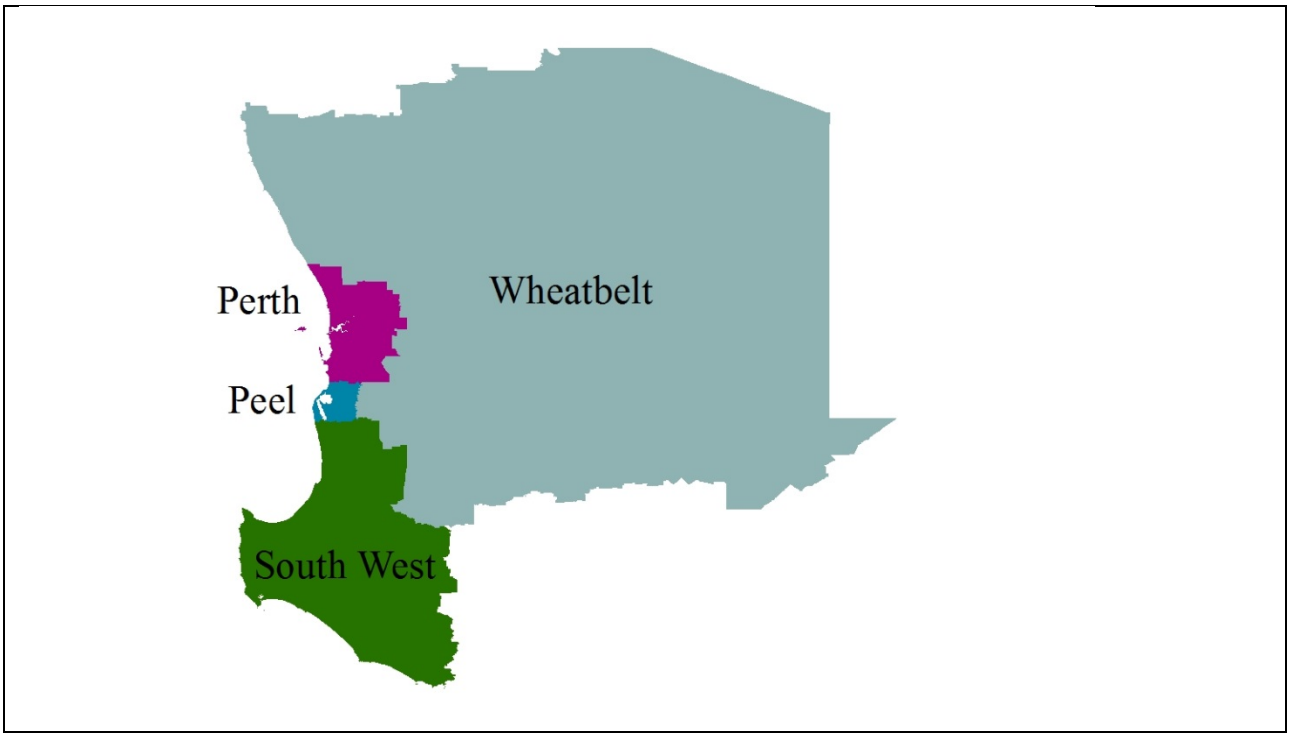
As illustrated in the maps below this suggests that care should be taken when comparing the analysis from this project with other regional WA work with respect to the regions of Peel, Perth, Wheatbelt and South West.

Partial SA2 Map of Perth, Peel, South West and Wheatbelt Indicating Boundary SA2s



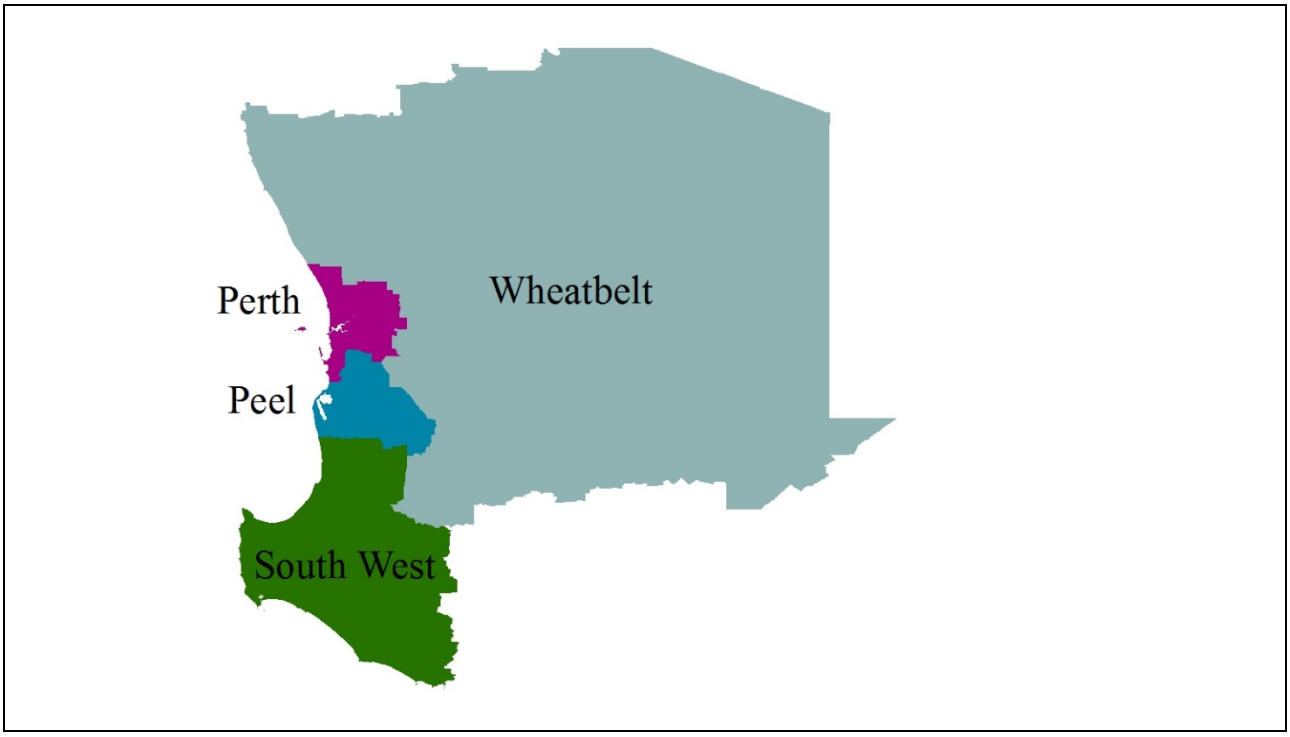
[15] The Shire of Serpentine-Jarrahdale has been the subject of a contentious boundary reshaping proposal. The State Government is proposing that the shire be part of the City of Armadale (which would suggest it is part of wider Perth), while the Shire itself and the Peel Development Commission are arguing for its place within the region of Peel. This issue is currently under community consultation.

Boundaries as implied by the ASGS SA4 and SA3 designations



Note: See, e.g., www.ausstats.abs.gov.au/ausstats/nrpmaps.nsf/NEW+GmapPages/national+regional+profile

Boundaries as indicated by the Peel, Wheatbelt and South West Development Commissions



Appendix B: Regions of Western Australia and Local Government Areas

Region	Local Government Areas
Gascoyne	Carnarvon (S), Exmouth (S), Shark Bay (S), Upper Gascoyne (S) Source: Gascoyne Development Commission URL: *www.gdc.wa.gov.au*
Goldfields - Esperance	Coolgardie (S), Dundas (S), Esperance (S), Kalgoorlie/Boulder (C), Laverton (S), Leonora (S), Menzies (S), Ngaanyatjarraku (S), Ravensthorpe (S) Source: Goldfields Esperance Development Commission URL: *www.gedc.wa.gov.au/Our-region/All-LGAs.aspx*
Great Southern	Albany (C), Broomehill-Tambellup (S), Cranbrook (S), Denmark (S), Gnowangerup (S), Jerramungup (S), Katanning (S), Kent (S), Kojonup (S), Plantagenet (S), Woodanilling (S) Source: Great Southern Development Commission URL: *www.gsdc.wa.gov.au/region/localgovt*
Kimberley	Broome (S), Derby-West Kimberley (S), Halls Creek (S), Wyndham-East Kimberley (S) Source: Kimberley Development Commission URL: *kdc.wa.gov.au/the-kimberly/location-and-area/local-shires/*
Mid West	Carnamah (S), Chapman Valley (S), Coorow (S), Cue (S), Greater Geraldton (C), Irwin (S), Meekatharra (S), Mingenew (S), Morawa (S), Mount Magnet (S), Murchison (S), Northampton (S), Perenjori (S), Sandstone (S), Three Springs (S), Wiluna (S), Yalgoo (S) Source: Mid West Development Commission URL: *www.mwdc.wa.gov.au/Population.aspx*
Peel	Boddington (S), Mandurah (C), Murray (S), Serpentine-Jarrahdale (S), Waroona (S) Source: Peel Development Commission URL: *peel.wa.gov.au/our-region/peel-statistics/*
Perth	Armadale (C), Bassendean (T), Bayswater (C), Belmont (C), Cambridge (T), Canning (C), Claremont (T), Cockburn (C), Cottesloe (T), East Fremantle (T), Fremantle (C), Gosnells (C), Joondalup (C), Kalamunda (S), Kwinana (T), Melville (C), Mosman Park (T), Mundaring (S), Nedlands (C), Peppermint Grove (S), Perth (C), Rockingham (C), South Perth (C), Stirling (C), Subiaco (C), Swan (C), Victoria Park (T), Vincent (C), Wanneroo (C)
Pilbara	Ashburton (S), East Pilbara (S), Port Hedland (T), Roebourne (S) Source: Pilbara Development Commission URL: *www.pdc.wa.gov.au/regional-information/*
South West	Augusta-Margaret River (S), Boyup Brook (S), Bridgetown-Greenbushes (S), Bunbury (C), Busselton (C), Capel (S), Collie (S), Dardanup (S), Donnybrook-Balingup (S), Harvey (S), Manjimup (S), Nannup (S) Source: South West Development Commission URL: *www.swdc.wa.gov.au/our-region.aspx*
Wheatbelt	Beverley (S), Brookton (S), Bruce Rock (S), Chittering (S), Corrigin (S), Cuballing (S), Cunderdin (S), Dalwallinu (S), Dandaragan (S), Dowerin (S), Dumbleyung (S), Gingin (S), Goomalling (S), Kellerberrin (S), Kondinin (S), Koorda (S), Kulin (S),

	Lake Grace (S), Merredin (S), Moora (S), Mount Marshall (S), Mukinbudin (S), Narembeen (S), Narrogin (S), Narrogin (T), Northam (S), Nungarin (S), Pingelly (S), Quairading (S), Tammin (S), Toodyay (S), Trayning (S), Victoria Plains (S), Wagin (S), Wandering (S), West Arthur (S), Westonia (S), Wickepin (S), Williams (S), Wongan-Ballidu (S), Wyalkatchem (S), Yilgarn (S), York (S) Source: Wheatbelt Development Commission URL: *wheatbelt.wa.gov.au/sites/default/files/report/Wheatbelt%20Infrastructure%20Plan%202011-12.pdf* (page 8)

Note: S, C, T denotes Shire, City and Town, respectively.

Appendix C: Glossary, Data and Sources

Glossary

aff	Agriculture, forestry and fishing
min	Mining
man	Manufacturing
egw	Electricity, gas, water and waste services
cst	Construction
wht	Wholesale trade
ret	Retail trade
afs	Accommodation and food services
tpw	Transport, postal and warehousing
imt	Information media and telecommunications
fis	Financial and insurance services
rhr	Rental, hiring and real estate services
pst	Professional, scientific and technical services
ass	Administrative and support services
pas	Public administration and safety
edt	Education and training
has	Health care and social assistance
ars	Arts and recreation services
ots	Other services
OWD	Ownership of dwellings
T – S	Taxes less subsidies on production
StatDiscp	Statistical discrepancy

Data and sources

GDP and related

Series	Australia Gross Domestic Product and industry components
Description	Chain volume measures and current prices, financial year, $m
Source	ABS Cat No 5220.0, Australian National Accounts: State Accounts, 2012-13, Table 10

Series	Western Australia Gross State Product and industry components
Description	Chain volume measures and current prices, financial year, $m
Source	ABS Cat No 5220.0, Australian National Accounts: State Accounts, 2012-13, Table 6

Series	Chinese Gross Domestic Product
Description	Constant price, calendar year, billion Yuan
Source	CEIC via IMF World Economic Outlook Database (October 2013 release)

Employment and number of businesses by industry

Series	Industry of employment
Description	Place of work, by LGA, INDP06P for 2006, INDP – 1 digit level for 2011, number
Source	Census 2006 and Census 2011

Series	Counts of Australian businesses, including entries and exits
Description	Number of businesses by industry division, at June, by SA3 and SA2, number
Source	ABS Cat No 8165.0, Counts of Australian Businesses, including Entries and Exits

Value of agricultural commodities produced

Series	Agriculture – total value
Description	By statistical division and NRM classification, financial year, $m
Source	ABS Cat No 7503.0, Value of Agricultural Commodities Produced, Australia

Value of minerals and petroleum

Series	Value of minerals and petroleum
Description	By regions (and LGA), financial year, dollars
Source	Statistics Digest, Department of Mines and Petroleum, Western Australia

House price and building approvals

Series	Building approvals
Description	Residential and non-residential, by SLA, calendar year, $'000
Source	ABS Cat No 8731.0, Building Approvals, Australia

Series	Median house price
Description	Median suburban price for top three most populous LGA in each region, $'000
Source	RP data via realestate.com.au

Wage and salary income

Series	Estimates of personal income - total wage and salary
Description	By LGA, calendar year, $m
Source	Census 2006 and 2011, via ABS.Stat Beta

Demographics and related

Series	Estimated resident population
Description	By LGA, calendar year, number
Source	ABS Cat No 3235.0, Population by Age and Sex, Regions of Australia

Series	Land area
Description	For constructing population density, square kilometre
Source	ABS Cat No 3218.0, Regional Population Growth, Australia

Series	Population age 15 to 64 years
Description	Selected measure of working age population, by LGA, number
Source	ABS 3235.0, Population by Age and Sex, Regions of Australia

Series	Number of wage and salary earners
Description	Estimates of personal income – wage and salary earners, by SA2, SA3, SA4, number
Source	Census 2006 and 2011

Series	Median age
Description	Usual residents, at 30 June, by LGA
Source	Census 2006 and 2011

Meteorological variables

Series	Total rainfall
Description	Total monthly rainfall, average of 1-6 weather stations in each region, mm
Source	Climate Data Online, Bureau of Meteorology

Series	Maximum and minimum temperatures
Description	Mean temperatures, average of 1-6 weather stations in each region, degrees Celsius
Source	Climate Data Online, Bureau of Meteorology

Series	Daily global solar exposure
Description	Average values across weather stations in each region, megajoules per square metre
Source	Climate Data Online, Bureau of Meteorology

Financial variables

Series	Consumer price index, Australia
Description	Quarterly data aggregated into financial year, index
Source	ABS Cat No 6401.0, Consumer Price Index, Australia, Tables 1 and 2

Series	Index of commodity prices
Description	Non-rural bulk commodity and all items, financial year by period average, index
Source	Table G5, Reserve Bank of Australia statistics

Series	Interest rates
Description	Cash rate, small business credit outstanding, housing mortgage standard, per cent
Source	Tables F1 and F5, Reserve Bank of Australia statistics

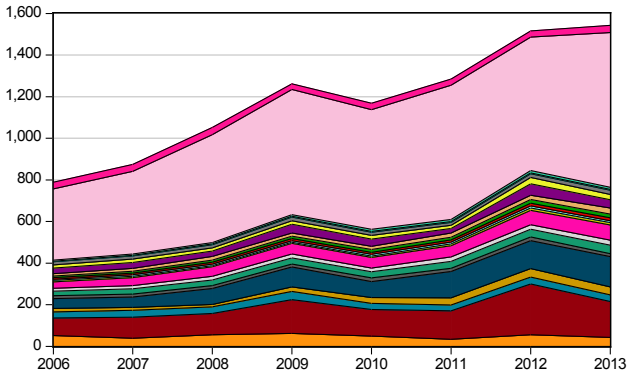
Series	Exchange rates
Description	USD and TWI, financial year aggregated from period average and end of period
Source	ABS Cat No 5302.0, Balance of Payments and International Investment, Table 83

Chinese steel production

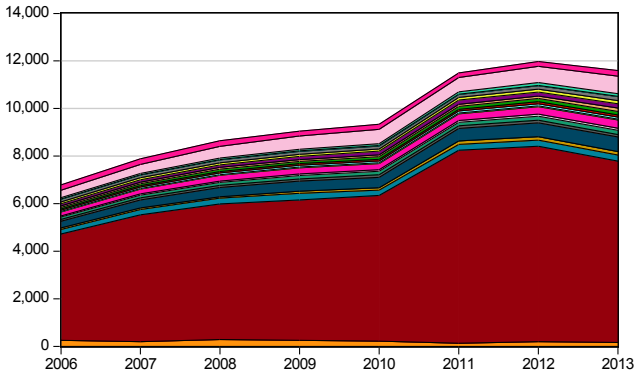
Series	Crude steel production, China
Description	Production of crude steel via integrated and electric arc processes, million tonnes
Source	World Steel Association

Appendix D: Estimated Gross Regional Product and components ($m, current price)

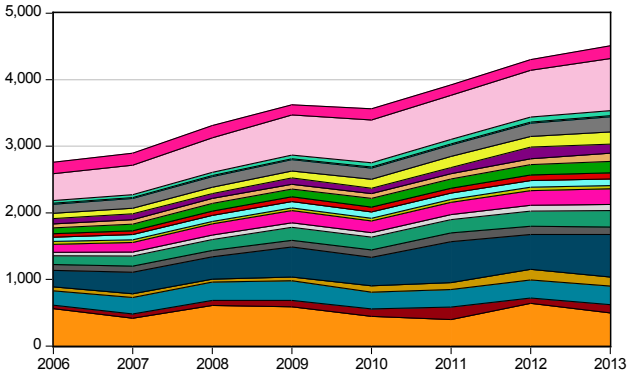
Gross Regional Product and components: Gascoyne



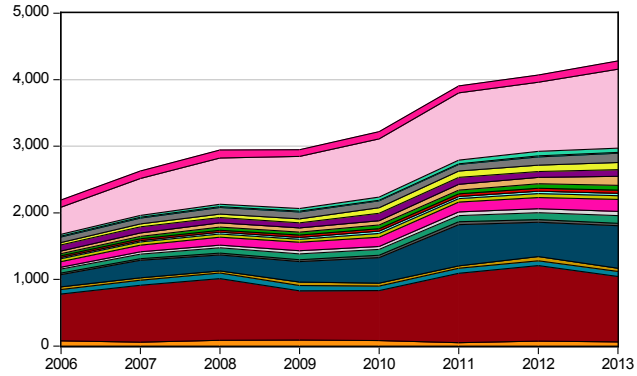
Gross Regional Product and components: Goldfields - Esperance



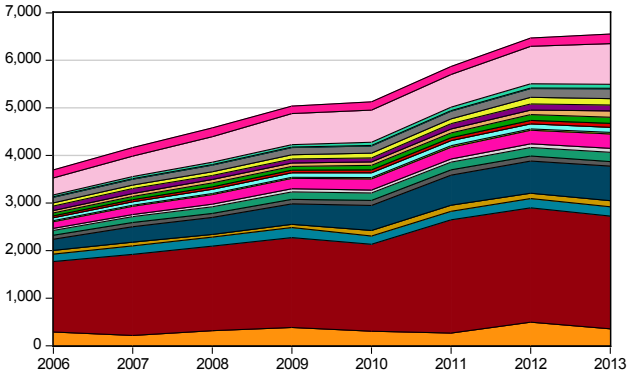
Gross Regional Product and components: Great Southern



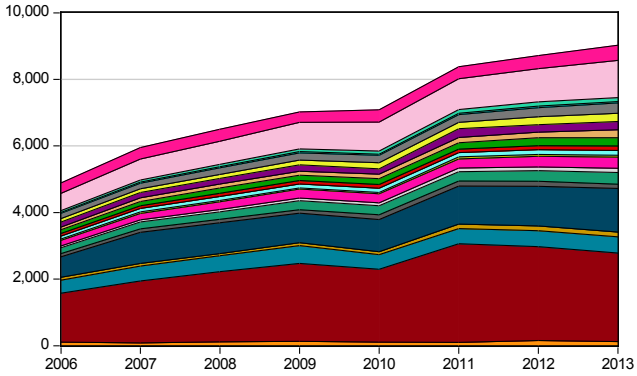
Gross Regional Product and components: Kimberley

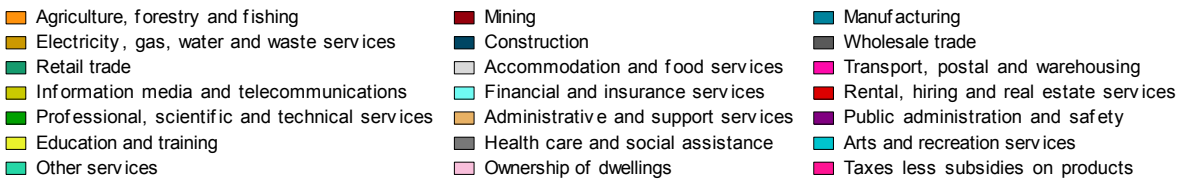


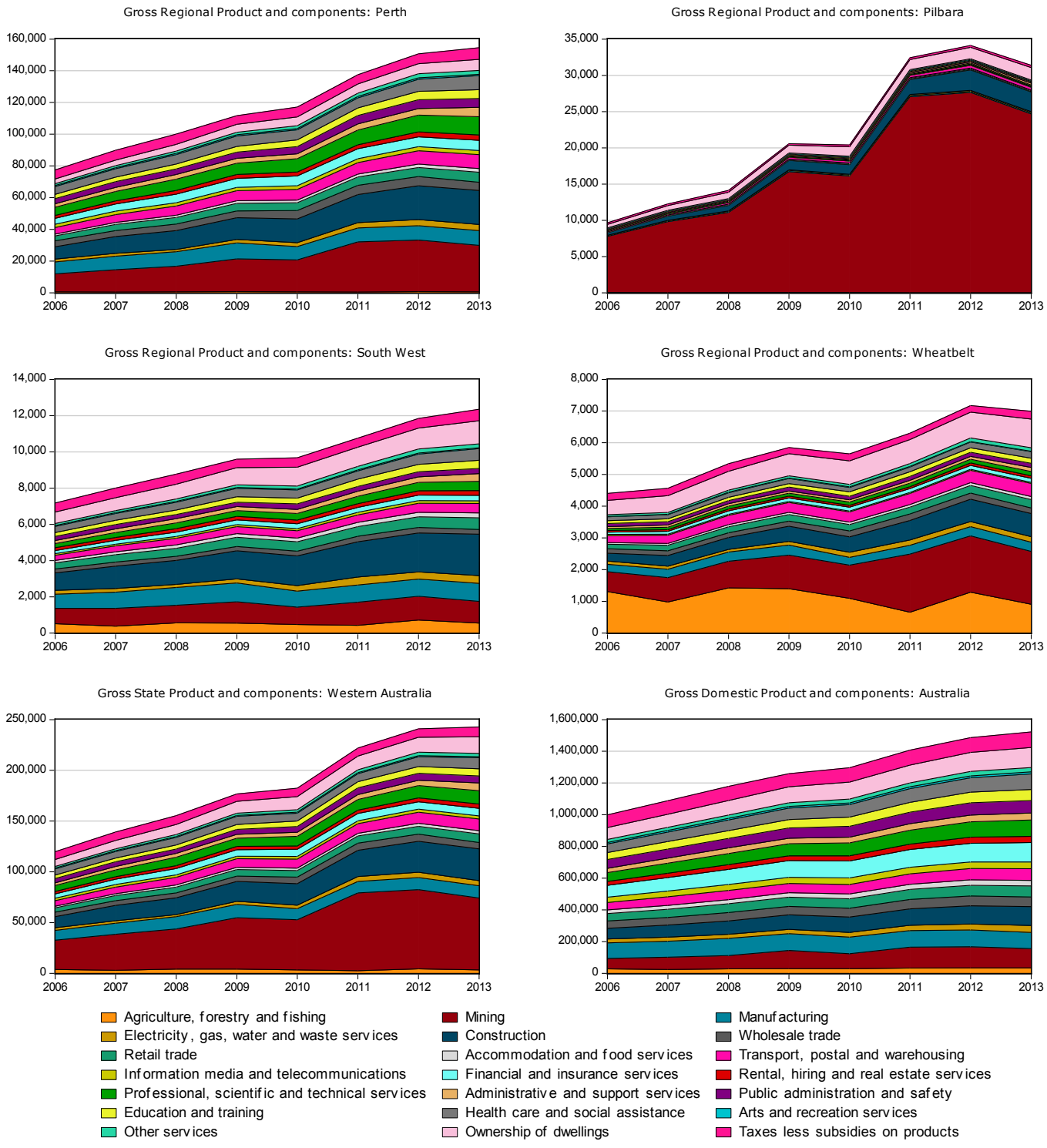
Gross Regional Product and components: Mid West



Gross Regional Product and components: Peel







Note: Perth's GRP has a significant mining component. The headquarters of Rio Tinto Iron Ore, BHP Billiton Iron Ore, FMG Group are all based in the CBD. In addition, in 2012-13, Perth produced $39.7 million worth of minerals, predominantly in the form of construction materials, silica sand and limesand-limestone in the local areas of Kalamunda, Swan, Wanneroo, Cockburn, Kwinana and Rockingham.

Appendix E: Selected General Characteristics of the Regions of Western Australia

Gascoyne

Most populous LGA	Carnarvon (S)
Population	9,826
Population density	0.07 per km^2
Working age population	6,515
No. of wage/salary earners	4,186
Median age	38.4 years
Average wage/salary income	$44,673
Median house price	$365,000
Total rainfall	214.3 mm
Mean temperature range	18.4 – 31.8°C

Top three industries of employment:

- Accommodation and Food Services (11.3%)
- Public Administration and Safety (11.2%)
- Agriculture, Forestry and Fishing (10.3%)

Estimated 2013 industrial composition (top three):

- Ownership of dwellings $744.10m (49.3%)
- Mining $173.19m (11.5%)
- Construction $145.57m (9.7%)

GRP $1,546.12m ($157,673 per capita, 3rd highest)

Goldfields – Esperance

Most populous LGA	Kalgoorlie/Boulder (C)
Population	61,005
Population density	0.08 per km^2
Working age population	42,831
No. of wage/salary earners	26,377
Median age	36.8 years
Average wage/salary income	$55,200
Median house price	$296,417
Total rainfall	343.2 mm
Mean temperature range	12.2 – 24.4°C

Top three industries of employment:

- Mining (27.1%)
- Retail Trade (7.6%)
- Manufacturing (7.1%)

Estimated 2013 industrial composition (top three):

- Mining $7,628.17m (67.1%)
- Ownership of dwellings $737.75m (6.5%)
- Construction $612.56m (5.4%)

GRP $11,606.06m ($189,027 per capita, 2nd highest)

Great Southern

Most populous LGA	Albany (C)
Population	58,058
Population density	1.49 per km^2
Working age population	36,288
No. of wage/salary earners	22,589
Median age	40.6 years
Average wage/salary income	$39,267
Median house price	$312,917
Total rainfall	913.5 mm
Mean temperature range	12.8 – 19.8°C

Top three industries of employment:

- Agriculture, Forestry and Fishing (16.1%)
- Retail Trade (12.5%)
- Health Care and Social Assistance (11.7%)

Estimated 2013 industrial composition (top three):

- Ownership of dwellings $786.44m (18.2%)
- Construction $638.69m (14.8%)
- Agriculture, forestry and fishing $497.61m (11.5%)

GRP $4,512.61m ($76,726 per capita, 8th highest)

Kimberley

Most populous LGA	Broome (S)
Population	37,957
Population density	0.09 per km^2
Working age population	27,047
No. of wage/salary earners	12,685
Median age	30.2 years
Average wage/salary income	$47,300
Median house price	$552,500
Total rainfall	583.7 mm
Mean temperature range	21.2 – 32.9°C

Top three industries of employment:

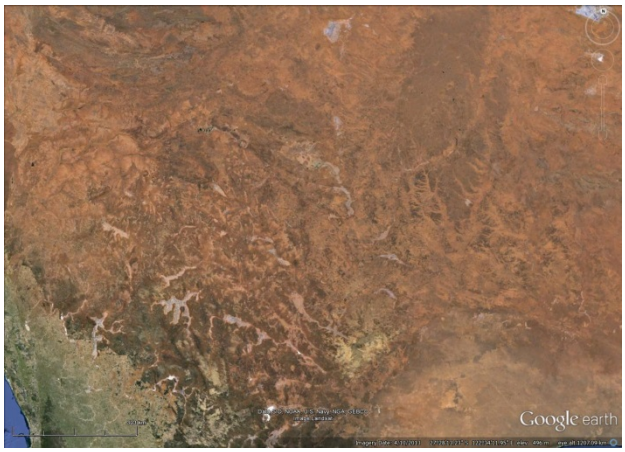
- Health Care and Social Assistance (12.4%)
- Education and Training (11.4%)
- Mining (10.1%)

Estimated 2013 industrial composition (top three):

- Ownership of dwellings $1,184.24m (28.5%)
- Mining $983.36m (23.6%)
- Construction $639.25m (15.4%)

GRP $4,287.25m ($111,605 per capita, 5th highest)

Mid West



Most populous LGA	Greater Geraldton (C)
Population	56,437
Population density	0.12 per km^2
Working age population	37,339
No. of wage/salary earners	22,009
Median age	38.8 years
Average wage/salary income	$46,981
Median house price	$370,000
Total rainfall	311.4 mm
Mean temperature range	13.9 – 29.3°C

Top three industries of employment:

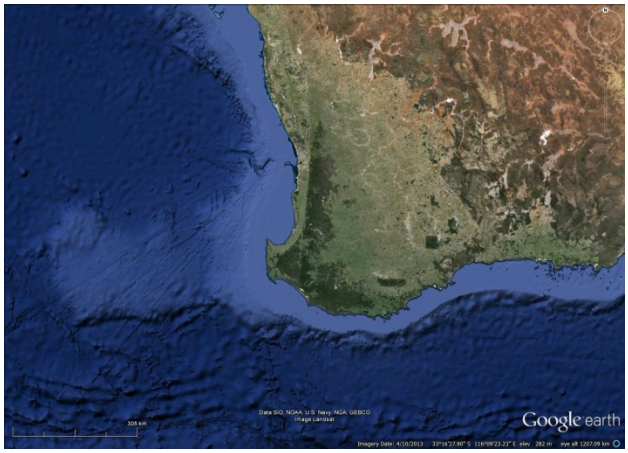
- Mining (11.9%)
- Retail Trade (10.2%)
- Health Care and Social Assistance (9.5%)

Estimated 2013 industrial composition (top three):

- Mining $2,370.34m (37.3%)
- Ownership of dwellings $852.98m (13.4%)
- Construction $729.17m (11.5%)

GRP $6,559.82m ($114,674 per capita, 4th highest)

Peel



Most populous LGA	Mandurah (C)
Population	118,116
Population density	21.40 per km^2
Working age population	73,624
No. of wage/salary earners	44,298
Median age	41.7 years
Average wage/salary income	$52,418
Median house price	$383,667
Total rainfall	924.6 mm
Mean temperature range	12.4 – 23.8°C

Top three industries of employment:

- Retail Trade (13.5%)
- Manufacturing (13.0%)
- Health Care and Social Assistance (10.7%)

Estimated 2013 industrial composition (top three):

- Mining $2,661.82m (31.0%)
- Construction $1,303.33m (15.2%)
- Ownership of dwellings $1,117.17m (13.0%)

GRP $9,031.89m ($73,151 per capita, 10th highest)

Perth

Most populous LGA	Stirling (C)
Population	1,788,740
Population density	399.43 per km^2
Working age population	1,236,316
No. of wage/salary earners	796,575
Median age	36.5 years
Average wage/salary income	$53,952
Median house price	$512,000
Total rainfall	641.4 mm
Mean temperature range	12.3 – 25.4°C

Top three industries of employment:

- Health Care and Social Assistance (11.7%)
- Retail Trade (11.0%)
- Professional, Scientific and Technical (9.2%)

Estimated 2013 industrial composition (top three):

- Mining $29,399.79m (20.0%)
- Construction $21,529.14m (14.6%)
- Professional, scientific tech. $11,565.87m (7.9%)

GRP $154,450.29m ($84,477 per capita, 7th highest)

Pilbara

Most populous LGA	Roebourne (S)
Population	63,950
Population density	0.13 per km^2
Working age population	50,888
No. of wage/salary earners	24,332
Median age	32.5 years
Average wage/salary income	$75,497
Median house price	$832,500
Total rainfall	344.4 mm
Mean temperature range	21.2 – 35.7°C

Top three industries of employment:

- Mining (40.6%)
- Construction (18.4%)
- Accommodation and Food Services (5.5%)

Estimated 2013 industrial composition (top three):

- Mining $24,660.93m (79.4%)
- Construction $2700.69m (8.7%)
- Ownership of dwellings $1,722.85m (5.5%)

GRP $31,364.04m ($484,687 per capita, highest)

South West

Most populous LGA	Bunbury (C)
Population	164,413
Population density	6.86 per km^2
Working age population	106,870
No. of wage/salary earners	70,309
Median age	39.7 years
Average wage/salary income	$48,002
Median house price	$391,000
Total rainfall	788.2 mm
Mean temperature range	9.9 – 23.7°C

Top three industries of employment:

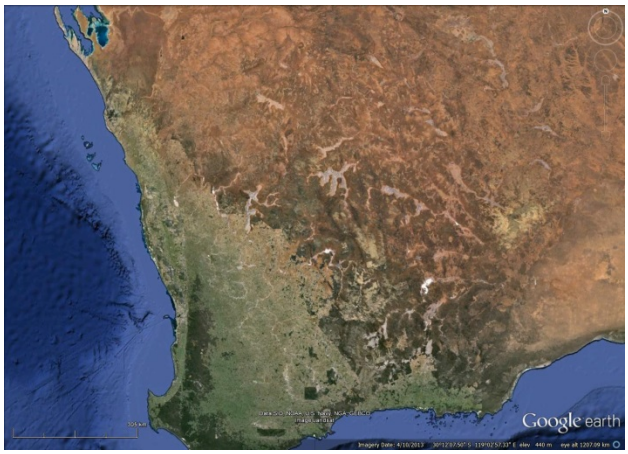
- Manufacturing (12.3%)
- Retail Trade (12.2%)
- Construction (11.2%)

Estimated 2013 industrial composition (top three):

- Construction $2,276.62m (19.4%)
- Ownership of dwellings $1,276.78m (10.9%)
- Mining $1,202.87m (10.3%)

GRP $12,347.59m ($73,251 per capita, 9th highest)

Wheatbelt



Most populous LGA	Northam (S)
Population	74,204
Population density	0.47 per km^2
Working age population	46,830
No. of wage/salary earners	27,785
Median age	41.8 years
Average wage/salary income	$42,217
Median house price	$349,167
Total rainfall	306.5 mm
Mean temperature range	10.0 – 25.7°C

Top three industries of employment:

- Agriculture, Forestry and Fishing (27.8%)
- Education and Training (9.0%)
- Retail Trade (8.4%)

Estimated 2013 industrial composition (top three):

- Mining $1,663.81m (24.7%)
- Agriculture, forestry and fishing $910.22m (13.5%)
- Ownership of dwellings $899.20m (13.3%)

GRP $6,991.34m ($93,240 per capita, 6th highest)

Source: Maps from Google Maps. Statistics from Census of Population and Housing 2011. Median house prices are the average of the top three most populous local government areas and are from realestate.com.au. Weather data obtained from averages of 1-6 weather stations from Bureau of Meteorology. Data are the latest available, ranging from 2010 (e.g. number of wage and salary earners) to 2012 (e.g. population).

The Bankwest Curtin Economics Centre is an independent economic and social research organisation located within the Curtin Business School at Curtin University. The Centre was established in 2012 through the generous support from Bankwest (a division of the Commonwealth Bank of Australia), with a core mission to undertake high quality, objective research on the key economic and social issues of relevance to Western Australia.

The Centre's research and engagement activities are designed to infl uence economic and social policy debates in state and Federal Parliament, regional and national media, and the wider Australian community. Through high quality, evidence-based research and analysis, our research outcomes inform policy makers and commentators of the economic challenges to achieving sustainable and equitable growth and prosperity both in Western Australia and nationally.

The Centre capitalises on Curtin University's reputation for excellence in economic modelling, forecasting, public policy research, trade and industrial economics and spatial sciences. Centre researchers have specifi c expertise in economic forecasting, quantitative modelling, microdata analysis and economic and social policy evaluation.

A suite of tailored and national economic models and methods are maintained within the Centre to facilitate advanced economic policy analysis: these include macroeconomic and time series models, micro(simulation) models, computable general equilibrium (CGE) models, spatial modelling methods, economic index analysis, and behavioural modelling methods.

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