The Role of Exports in Regional Economies
A System Dynamics model of the Western Australian economy

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Abstract

The U.S. cluster mapping project has highlighted the importance of export industries to the performance of regional economies. Understanding these traded clusters and their linkages with the local clusters that mainly serve local demand is an important element in developing intervention strategies that seek to improve economic performance at the regional scale. The economy of Western Australia is an example of a regional economy that is very dependent on the export of resource commodities, and has benefitted strongly from the massive expansion in the China economy since the early 2000s, representing the state's Black Swan moment. A simple system dynamics model of the traded and local elements of the economy derived from input-output analysis has been developed to gain insights into possible trajectories for the state's economy and income per capita. The results exemplify the situation of many non-renewable resource based export dominated economies that face long term challenges in replacing the value of those exports.

Introduction

There is increasing interest in the policy treatment of regional economies in general and of clusters in particular. This can be attributed in no small way to the influence of Michael Porter's *The Economic Performance of Regions* (Porter, 2003), itself a child of his earlier book *The Competitive Advantage of Nations* (Porter, 1990). Porter and his team at the Harvard Business School, in conjunction with MIT Sloan, the Temple Fox School of Business and the U.S. Economic Development Administration manage the U.S. Cluster Mapping Portal[1] which *'provides a broader data infrastructure that covers cluster presence and performance, as well as several types of data about regional economic performance, business environment quality, and regional characteristics'*.

Clusters are concentrations of related industries in a particular location or region consisting of firms and their supply chains, complemented by other actors that influence the productivity of the cluster including research, educational and training organisations and government agencies.

[1] http://www.clustermapping.us/

The US cluster mapping project has developed an algorithm to group U.S. industry codes into clusters groupings that reflect *'inter-industry linkages based on input-output measures, labor occupations, and the co-location patterns of employment and establishments'*. An important element of the method of grouping is the disaggregation of clusters into *traded* and *local* categories (Porter, 2003). Traded clusters are groups of firms that provide goods and services predominantly for export from the region of interest, while local clusters provide goods and services predominantly to local consumers including traded clusters. While the performance of both is important for regional economies, it is traded clusters that make the greatest contribution to income per capita. According to the U.S. Cluster Project:

> While local clusters account for most of the employment and employment growth in regional economies, traded clusters register higher wages, and much higher levels of innovation. Local clusters provide necessary services for the traded clusters in a region, and both are needed to support a healthy and prosperous regional economy.

While there is little doubt about the ability of cluster mapping in a regional economy to provide clarity about the nature and magnitude of economic activity, there is more controversy about how that information can be used to foster expansion or productivity gains. In their article in the Oxford Review of Economic Policy (Nathan & Overman, 2013), the authors argue that using this knowledge to development economic policy is not only fraught with difficulty, but that such policies have been shown not to work. They favour 'horizontal policies' that focus on locations rather than clusters and emphasise the benefits of agglomeration. Although Marshall (1890)is first credited with the identification of agglomeration economies, many others have contributed to the debate about their cause. Duranton and Puga (2004)review the literature and refine the reasons for economies (i.e. increased productivities) that arise from agglomerations of activity due to *sharing* (including indivisible goods and facilities); *matching* (of buyers, sellers and labour in the supply chain); and *learning* (knowledge spillovers due to the proximity of firms).

Agglomeration theory has attracted the interest of system dynamics practitioners (Buendía, 2005), (Fratesi, 2002), (Lin, Tung, & Huang, 2006), (Dangelico, Garavelli, & Petruzzelli, 2010), all of whom have modelled aspects of agglomeration and its role in regional economies.

Clusters and their agglomeration benefits are subjects of interest in the Australian state of Western Australia, where policy makers are turning their mind to economic diversification in a period where the state has reached the end of a massive recent expansion of capacity in the mining sector, and commodity prices have fallen dramatically. The state is heavily reliant on bulk commodity exports and the supply chains associated with these industries plays a critical role in the state's economy. A recent cluster analysis of the state's economy by local economics firm Pracsys[2] provides the opportunity to examine the role of traded and local clusters as an initial step in understanding the dynamics of the regional economy.

Western Australia – a profile

Western Australia is Australia's largest state, covering 2.5 million square kilometres or 33% of Australia, some six times the size of California. The population is

[2] http://pracsys.com.au/

approximately 2.5 million (about ten percent of Australia), of which some three-quarters live in the capital city of Perth and a further ten percent in the adjacent Peel and south west regions. Much of the state's east and north is very sparsely populated, although home to most of the state's mineral and energy resources. The population has been growing strongly (averaging 3% per annum) over the last 15 years, driven significantly by migration from interstate and overseas.

The state's Gross State Product in 2012-13 was A$253bn, representing about 17% of Australia's Gross Domestic Product (GSP), which translates to around A$100,000 per capita (approximately US$70,000 at present exchange rates). This is some 50% higher than Australian GDP per capita and 30% higher than equivalent U.S. GDP per capita.

The largest contributing industry is the mining sector (including and oil and gas), representing almost a third of GSP (Figure 1).

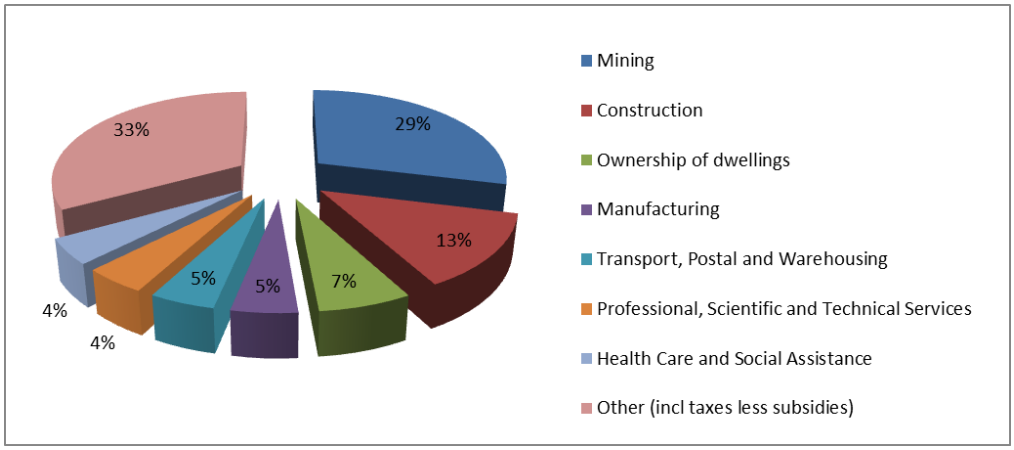

Figure 1 Contributions to Western Australian GSP (2013-14)

Source: (BankWest Curtin Economics Centre, 2015)

The economy has grown significantly over the last fifteen years (Figure 2), predicated largely on growth in the commodity export sector. Average annual growth of around 8% per annum has occurred over this period. Population growth over the same period has been around 3% pa, indicating how rapidly income per capita has increased.

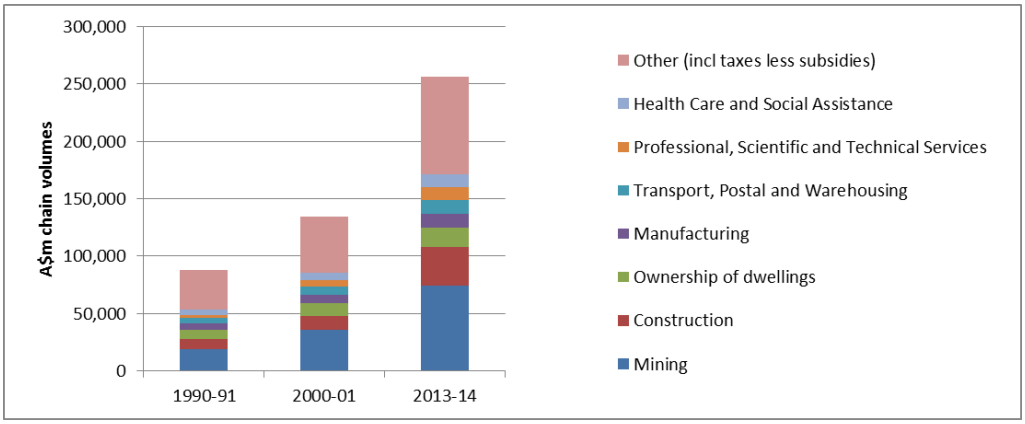

Figure 2 Western Australian GSP

Source: (BankWest Curtin Economics Centre, 2015)

The increase in GSP over this period correlates strongly with exports which have grown from 30 to 50% of GSP (Figure 3).

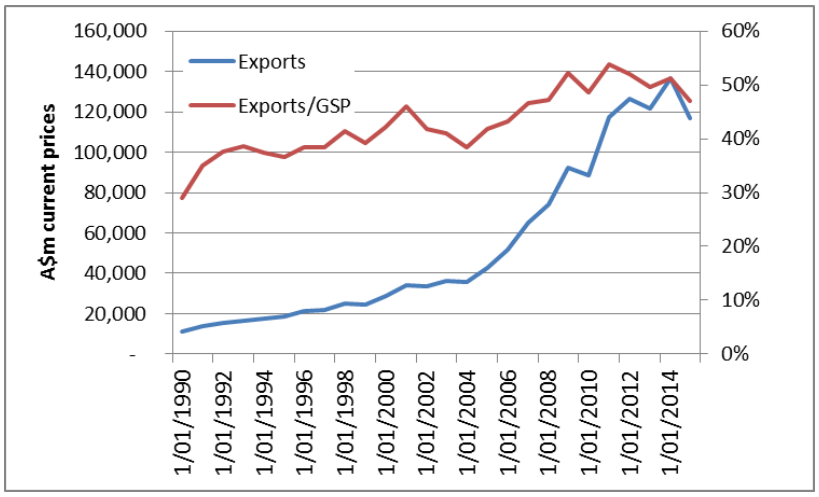

Figure 3 Western Australian export growth

Source: (Australian Bureau of Statistics, 2015a)

In 2012-13, Western Australia accounted for 14% of Australia's value of imports and 47% of Australia's value of exports (ABS 2015). Exports are dominated by three particular commodities: iron ore, gold and hydrocarbons, representing nearly 70% of Western Australian exports in 2012-13 (ABS 2015). Figure 4 illustrates the volumes of those commodities for Australia in total. Iron ore and liquefied natural gas (LNG) have grown strongly, in particular since around 2000. This growth phase coincides with the huge expansion in China's economy over that period (Figure 5), particularly in respect of imports. China (47%), Japan (19%) and South Korea (8%) are Western Australia's largest export destinations by value.

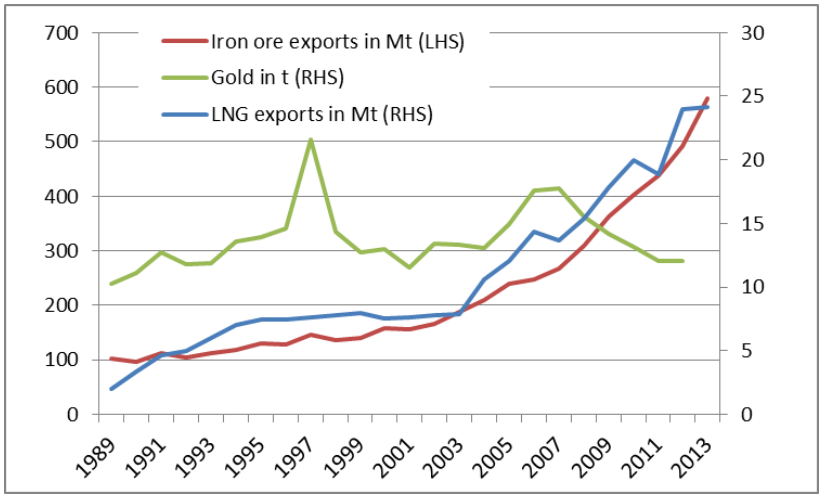

Figure 4 Australian primary exports

Source: (Australian Government, 2014)

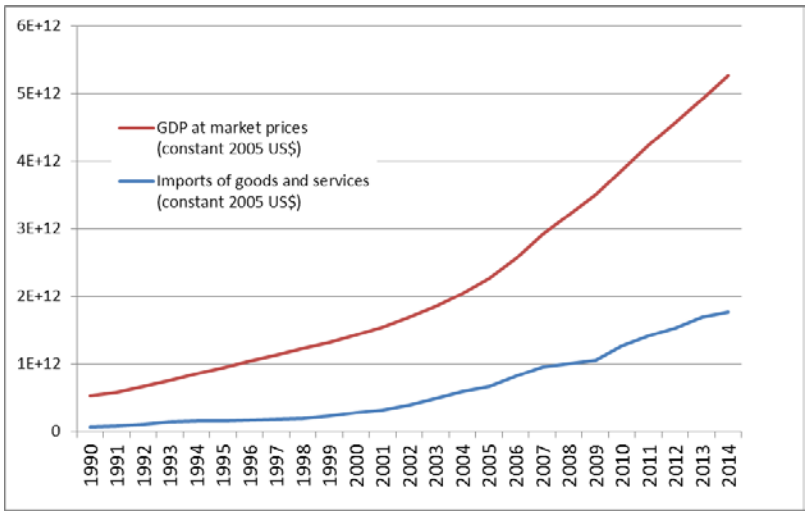

Figure 5 China GDP and imports

Source: (World Bank, 2016)

The Western Australia economy is presently affected by low international prices for both iron ore and petroleum products, although the impact has been somewhat offset by an Australian dollar falling against the currencies of its major partners (Figure 6).

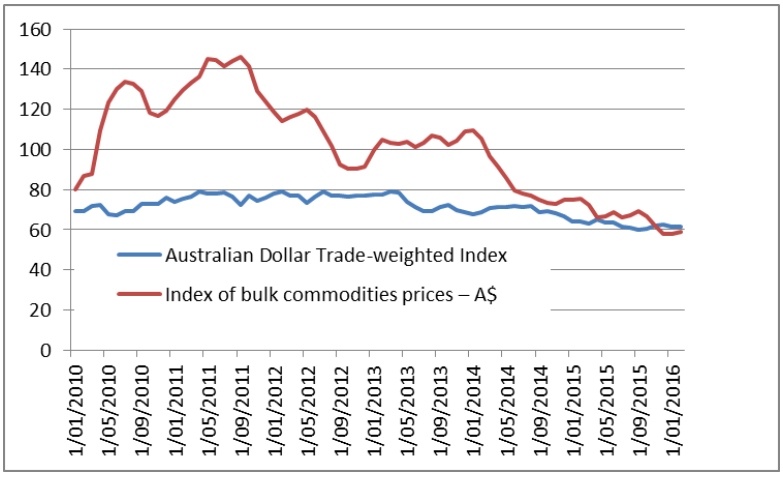

Figure 6 Indices of commodity prices and exchange rates

Source: (Reserve Bank of Australia, 2016)

Notwithstanding current commodity prices, the Western Australian economy is set for a major expansion in exports over the medium term. New LNG capacity is presently being planned / constructed which will ramp up production from around 25 Mt pa to at least 60 Mt pa in the early 2020s. Subject to market demand, remaining resource stocks can maintain that level of production for some decades to come. Even if prices remain depressed, this expansion in volume will add significant export value to the economy. Iron ore is in a similar position. Even though the rate of growth in China's economy will likely continue to slow, demand for steel worldwide will ensure that Western Australia increases production over the medium term.

However over the longer term the outlook is not as rosy. The value of all of Western Australia's main export commodities will likely be severely diminished within 50 years or so, either due directly to resource depletion or the economic and / or environmental cost of ongoing extraction (Grace, 2015).

In the following analysis, a simple system dynamics model is used to explore possible trajectories for the Western Australian economy, population and income per capita over a range of timeframes.

Input output analysis

Using the national input-output data compiled by the Australian Bureau of Statistics, the economics firm Pracsys has produced a Western Australian version of the US cluster dataset. This was achieved through a process of concordance between the Australian and New Zealand Standard Industrial Classification (ANZIC). While the full range of clusters has been identified (see Appendix A), it is the basic disaggregation of the economy into traded and local clusters that is the focus of the analysis reported here. The following table represents 2012-13 data escalated to reflect 2015 prices.

Table 1 Western Australia Input-Output Table (all figures in A$m)

		Industry uses			Final domestic uses	Exports	Total supply
		Traded clusters	Local clusters	Total			
	Intermediate use						
	- Traded clusters	86,274	25,142	111,416	71,102	112,698	295,215
	- Local clusters	31,307	20,017	51,323	84,198	2,719	138,241
	Total	117,580	45,159	162,739	155,299	115,418	433,456
P1	Compensation of employees	51,557	41,600	93,157			93,157
P2	Gross operating surplus & mixed income	88,608	35,747	124,354			124,354
P3	Taxes less subsidies on products	1,338	785	2,123	15,416		17,539
P4	Other taxes less subsidies on production	3,291	3,632	6,923			6,923
	Competing imports	32,841	11,319	44,160	24,041		68,201
	WA Production	295,216	138,241	433,457	194,757	115,418	743,631
	Value Added (P1+P2+P4)	143,457	80,978	224,435			
	Gross State Product						241,974

Source: (Australian Bureau of Statistics, 2015b), Pracsys 2016

Notes:

Final domestic uses include: Final Consumption Expenditure by households and government, Gross Fixed Capital Formation by households and government, Changes In Inventories.

Table 1 and Figure 7 identify the dominant role of traded industries in the Western Australia economy.

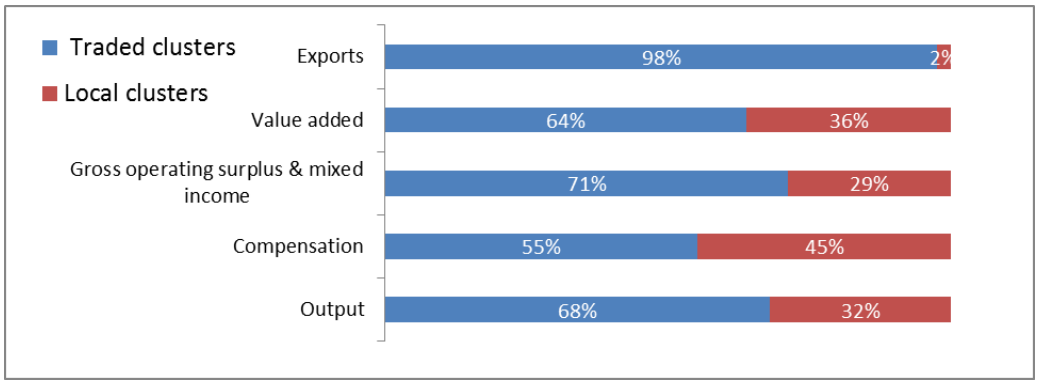

Figure 7 Comparison of traded and local industries in Western Australia

The dynamics of regional economies

The regional economy is comprised of enterprises producing goods and / or services mainly for domestic use (local clusters) and mainly for export (traded clusters).

Consider first an economy where all goods and services produced are used locally and there is no net migration in or out of the region (Figure 8). The final demand for goods and services associated with these local clusters will be some function of the population and the net income (gross value added (GVA)) per capita of the local population. The population will increase naturally (in line with net birth / death rates) and the size of the economy will grow proportionally with population. If real costs rise or fall, this will be reflected in final demand, output and GVA.

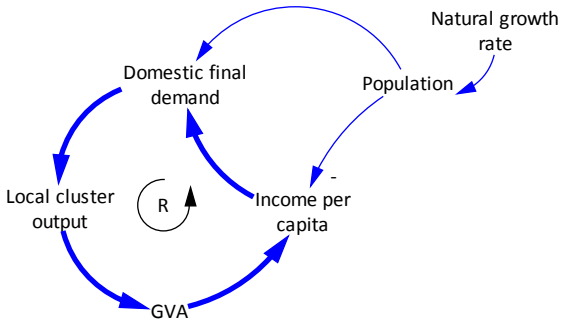

Figure 8 Causal loop diagram of local cluster activity within a regional economy

Now consider the same economy operating in an environment of free exchange of goods and services with other regions in the nation and world (Figure 9). In this case, traded clusters employ local people and purchase goods and services from local clusters to meet export demand (and also contribute to meeting domestic final demand). Export growth will relate to demand from elsewhere and is therefore essentially an exogenous factor, reflecting both volumes and prices for exports. Population changes will reflect the natural growth rate but also the net migration to and from the region. This migration rate is a function of the relative attractiveness of the location for employment, and will therefore reflect changes in the growth of the economy (GVA).

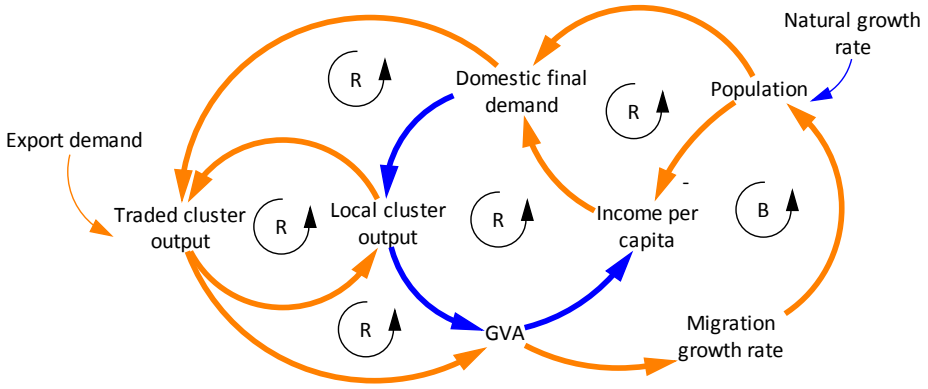

Figure 9 Causal loop diagram of traded and local cluster activity within a regional economy.

These dynamics illustrate why the traded activity is sometimes referred to as the *engine* of the economy. The export trade has a multiplicative effect on the local economy which increases (or decreases) GVA, which in turn attracts (or dissuades) migration.

The model

A simple system dynamics model of the Western Australian economic representing this causality has been developed using the Vensim software. The inputs to the model are derived from the input-output analysis described above. The model ignores inflation and makes several other simplistic assumptions:

- Current exports are modified by a growth fraction which is an exogenous input;
- The inputs to clusters retain their existing relativity to output; and accordingly
  - compensation, imports and GVA remain as a fixed proportion of output;
  - sales within and between traded and local clusters remain a fixed proportion of output.

Domestic final demand (final consumption expenditure by households and government, gross fixed capital formation and changes in inventory) varies in direct proportion to population changes and GVA per capita (which is taken as the sum of employee compensation, gross operating surplus and mixed income, taxes less subsidies on production). This latter assumption simply says that next year's domestic demand is proportional to this year's income. Consumption of fixed capital is ignored in determining income (taken as GVA / capita) but, on the assumption that this is a relatively constant proportion of output, this simplification does not affect the model dynamics.

Population changes are disaggregated between the natural growth fraction and a net (interstate and overseas) migration. Since the 1980s the former has slowly declined while the latter has varied significantly (Figure 10). At its peak in 2011, around 1500 people per week were entering the state.

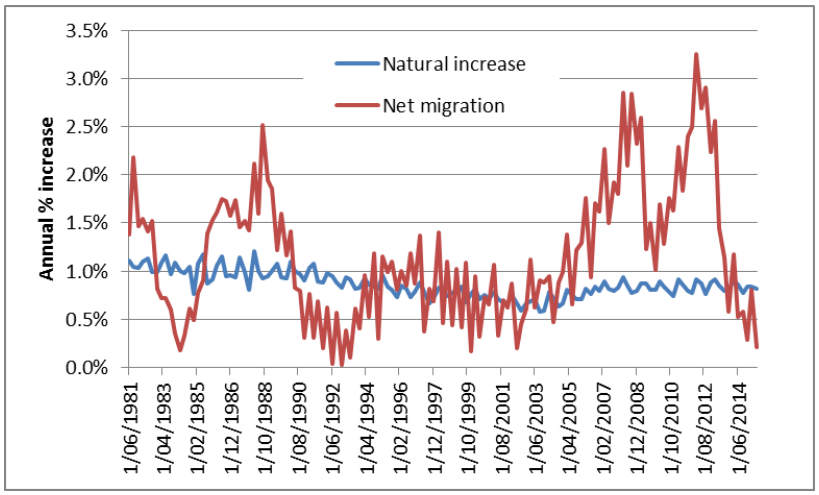

Figure 10 Western Australia population changes

Source: (Australian Bureau of Statistics, 2015a)

The spikes in migration have been caused by the economic cycles of the Western Australian economy. One way this can be seen is by correlating migration changes with changes in GSP over the same period (Figure 11). In this analysis the migration changes are plotted with a one year lag.

This relationship is used in the model to vary the migration fraction in response to changes in overall GSP, which in turn reflect the combined effect of traded and local clusters.

As exports are modelled as an exogenous multiplier on existing demand, and the internal economic relationships are fixed by the input-output multipliers, the causality relating population to migration is the key endogenous feedback in the model.

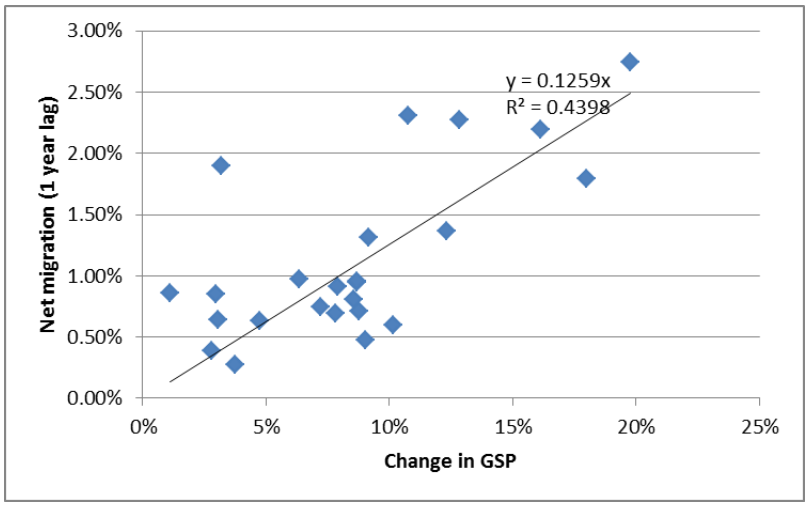

Figure 11 Changes in annual migration and GSP

Model simulations

The model is established in equilibrium based on the 2015 input-output parameters. The dynamics are created entirely by entering a value for the natural population growth (assumed as a constant at the existing rate of 0.84% pa), and experimenting with the export growth fraction.

The influence of exports

Initially the model is used to demonstrate the influence of exports on the Western Australian economy. Consider first a situation where equilibrium is disturbed through 1% natural population growth and there is no net migration. In this case exports are assumed to remain static at the values in Table 1, meaning growth occurs mainly in the local clusters as domestic final demand (including investment) increases. As the traded clusters also serve local demand, growth occurs in those clusters also but at a much lower rate (Figure 12).

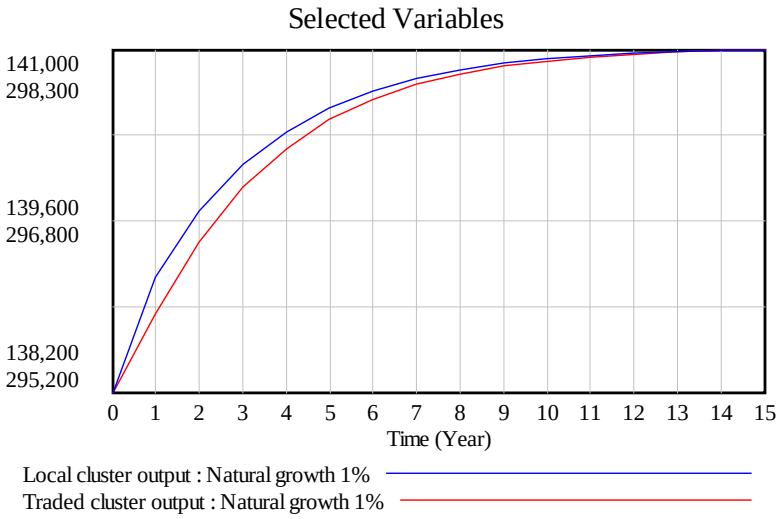

Figure 12 Local and traded cluster output

The effect of this is an initial increase in output and GVA due to the increased final demand associated with population increases. However, without the contribution of export growth, GVA per capita (GVA/c) falls which depresses future final demand per person. The net result is the establishment of a new equilibrium in output and GVA after 15 years but with continuously falling income in the economy (Figures 13a and b).

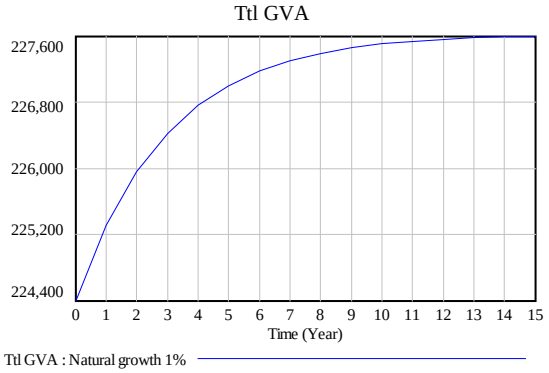

Figure 13 a) GVA without exports

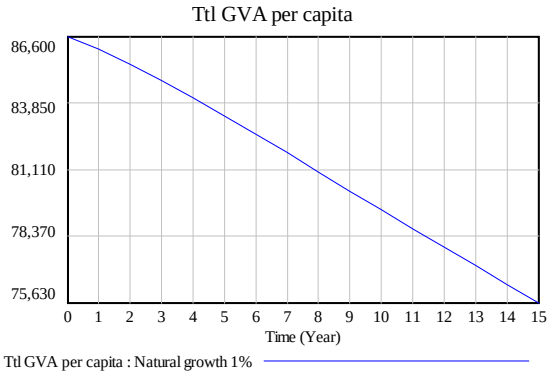

Figure 13b) GVA/c without exports

If export growth is now invoked in the model in addition to natural population growth (but without any net migration) it can be established that approximately 1.125% pa export growth is required to maintain GVA per capita (i.e. income) at or near the initial values (Figure 14 a and b).

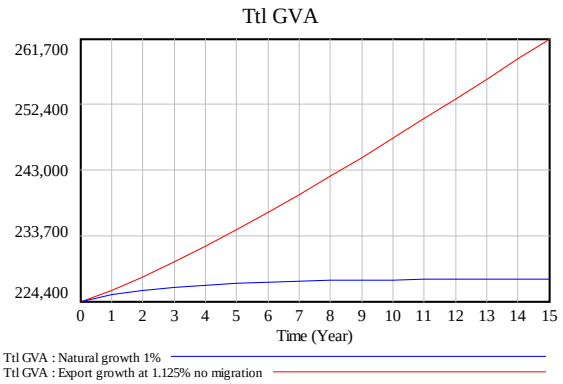

Figure 14a) GVA with exports but no migration

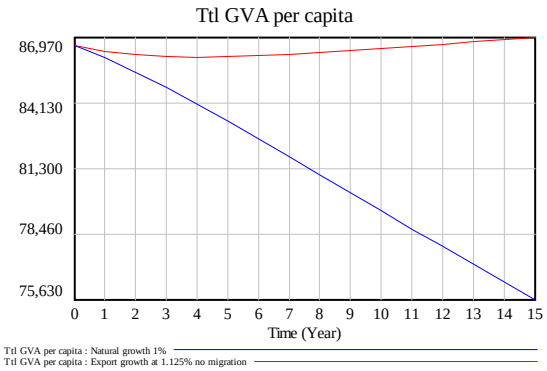

Figure 14b) GVA/c with exports but no migration

However, if the migration effect in the model is invoked (i.e. migration responds to economic growth) then slightly higher export growth (1.25% pa) is required to maintain income per capita (Figures 15a and b).

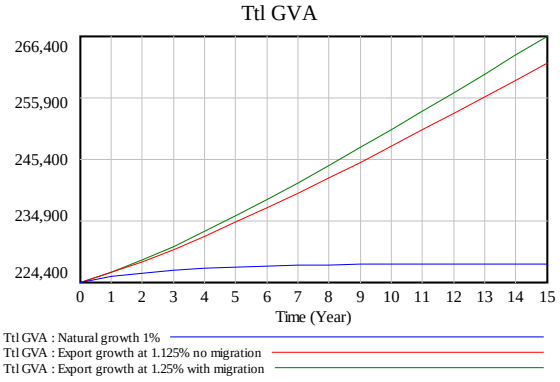

Figure 15a) GVA with exports and migration

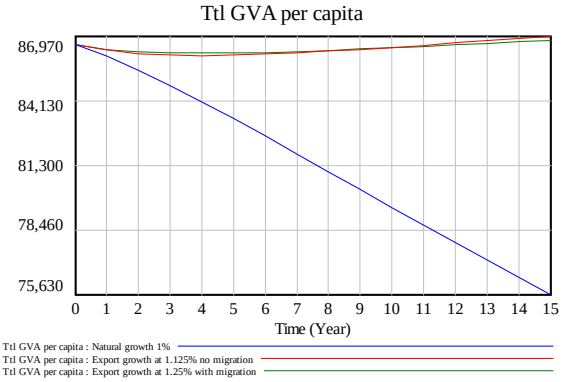

Figure 15b) GVA/c with exports and migration

The effect of these changes in population is set out in Figure 16. This indicates that export growth of 1.25% pa would likely increase the average annual population growth rate over 15 years from 1% to about 1.14%.

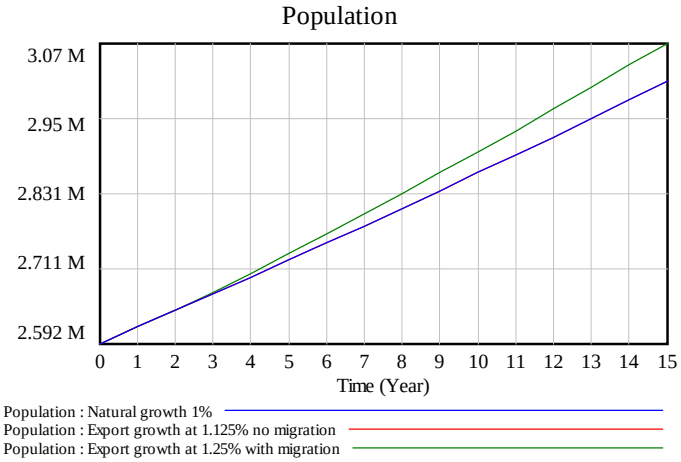

Figure 16 Population with and without exports

Assuming a constant 1% pa natural population growth rate, and migration that reflects economic growth, the influence of export growth on GVA per capita over 15 years can be established (Figure 17).

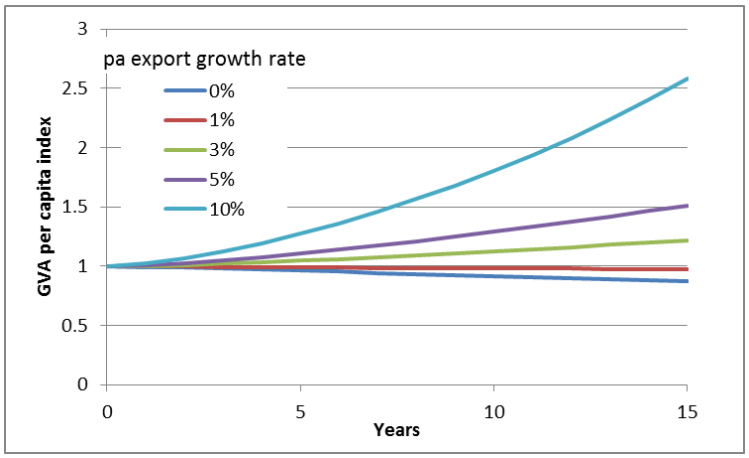

Figure 17 Effect of export growth in GVA/c

The experiments establish the importance of export growth to maintaining income per capita in the economy of Western Australia. In reality, as the following sections illustrate, export growth has been well in excess of that required to achieve this objective.

The trajectory of the Western Australian economy

The following set of runs seeks to explore the immediate future of the state's economy, i.e. over the next 15 years.

Model case 1 – return to recent historical export growth

This case assumes the current downturn (which is price related and essentially due to imbalances in international commodity supply and demand) is short lived and that export growth recovers from 5% (the average value from 2010-2015) to levels observed during the last twenty five years (Figure 18), i.e. around 10% per annum over the next 15 years.

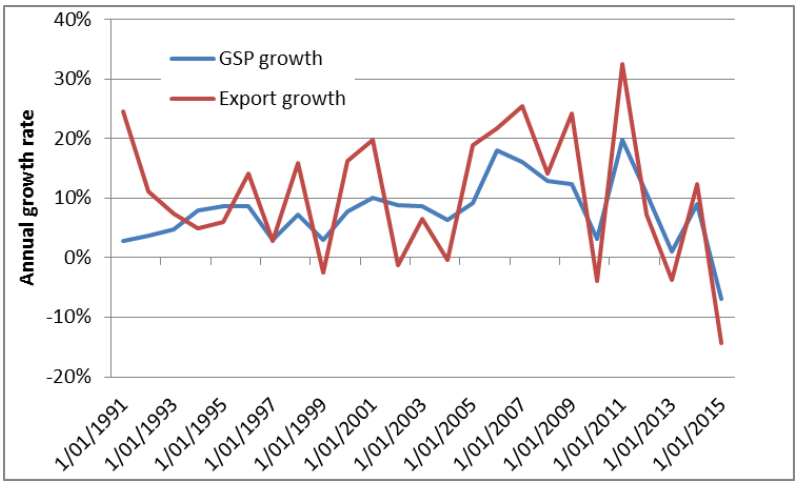

Figure 18 GSP and export growth rates

Source: (Australian Bureau of Statistics, 2015a, 2015c)

Model cases 2 – 4 declining export growth

These cases assume that the current downturn in exports persists, either because production levels are lower than trend, prices remain depressed or some combination of both factors.

Under these assumptions the model commences with export growth of 5% pa (the average value from 2010-2015) but growth declines linearly over fifteen years:

- Model case 2 – export growth declines to 2.5% pa
- Model case 3 – export growth declines to 0% pa
- Model case 3 – export growth declines to -5% pa

The results of these simulations are shown in Figures 19a, b and c.

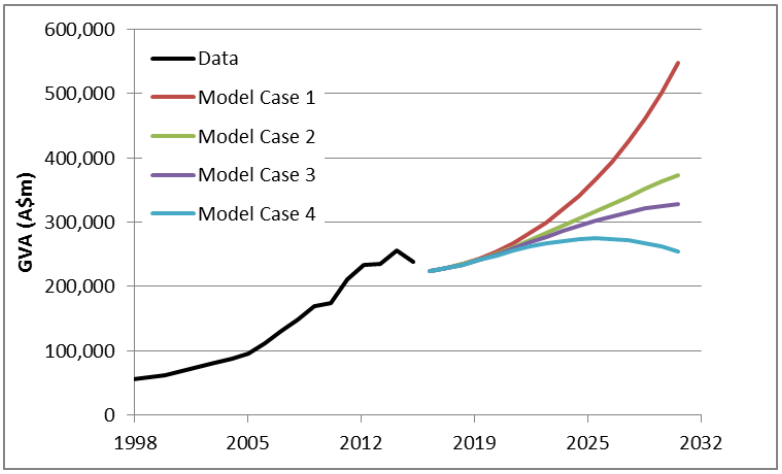

Figure 19a) Future projections - Gross Value Added

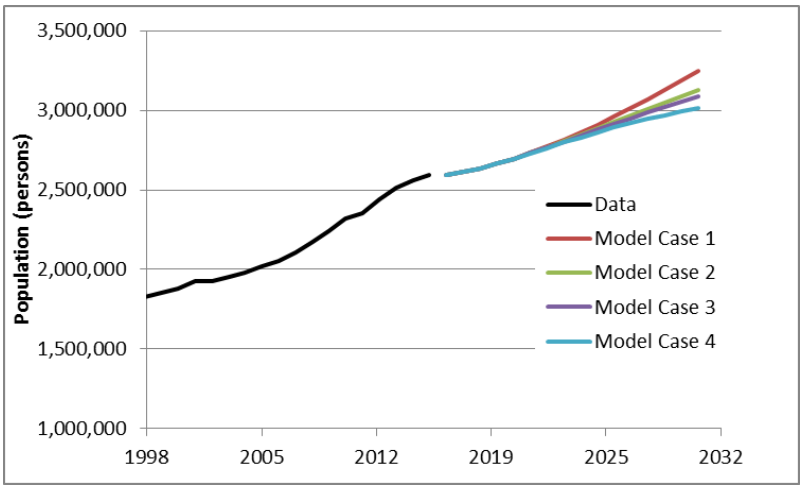

Figure 19b) Future projections - Population

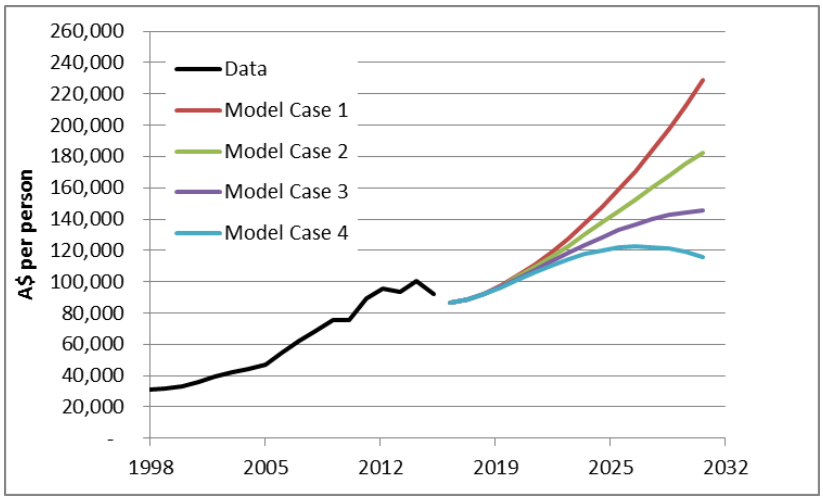

Figure 19b) Future projections – GVA per capita

The long term

Next, a series of experiments were undertaken that examine the implications of declining resource stocks over the longer term (fifty years).

Iron ore

The term Economic Demonstrated Resources (EDR) is defined by Geoscience Australia as '*resources for which profitable extraction or production under defined investment assumptions is possible'*. The world's EDR of iron ore are estimated at 190,000 Mt (Australian Government, 2015) of which Australia holds some 54,000 Mt (29%). These resources are presently being mined globally at a rate of around 3,220 Mt pa (2014 figures (Australian Government, 2015)). Production is driven by steel production which, according to the World Steel Association (2016), is set to increase by 150% by mid-century, i.e. an average annual growth of 1.12% pa. Simplistically assuming a pro-rata increase in global iron ore production, global iron ore stocks would be depleted by around 2060.

Australia's current share of global production (of which the vast majority is from Western Australia) is around 735 Mt or 23% (Australian Government, 2015). In Western Australia production has been expanded dramatically in recent years but this expansion is expected to peak by 2020 at around 800 Mt pa (from 720 Mt in 2015) (Government of Western Australia, 2015a). New capacity additions after this appear unlikely given that iron ore prices are not expected to return to their previous highs as China's GDP growth rate slows. It is therefore possible that iron ore export values could have already peaked in 2015.

However this simulation assumes that:

- prices recover somewhat by 2020 and export values stabilise at around $52 billion pa (800 Mt @ $65 per Mt); and
- production begins to fall in 2050 and by 2065 has reduced to 150 Mt pa.

LNG

Western Australia's current LNG exports are around 20 Mt pa. Projects that are currently under construction or in planning will increase this figure to around 60 Mt pa

by the early 2020s (Government of Western Australia, 2015b). If this production figure then remains static, Western Australia's remaining stocks of gas (2,460 Mt) (Australian Government, 2015) would be exhausted in around 40 years. As Western Australia has a 15% domestic gas reserve, it can be assumed that exports will rise to around 50 Mt pa over the next 10 years or so and remain at that level for 30 years or so. Of course, additional discoveries of both conventional and unconventional gas are likely. It is also possible that LNG exports could be adversely affected by a global shift away from fossil fuels over this period.

In this simulation it is assumed that:

- Export production increases steadily to 52 Mt pa by 2020 and stabilises at that level;
- LNG prices recover by 2020 to previous levels (approximately A$720 per Mt);
- Production begins to fall in 2045 and by 2065 has reduced to 10 Mt pa.

Other exports

International export growth in industries other than mining (which includes LNG) has been minimal (Figure 20) at 0.6% average annual growth in the period 2006-07 to 2013-14 (ABS 2015). Particularly noticeable is the decline of exports in the manufacturing sector.

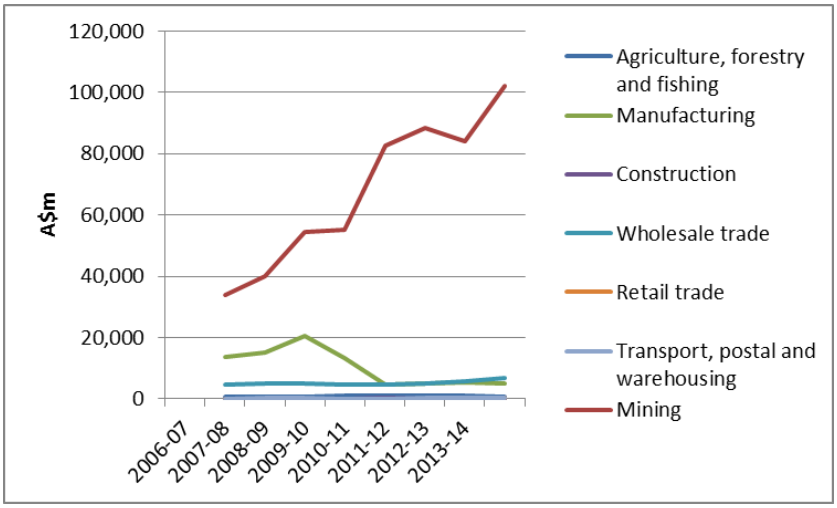

Figure 20 Recent Western Australian export values

Source: (Australian Bureau of Statistics, 2015d)

For the purposes of this simulation it is assumed that all other export values increase by 1% pa throughout the period to 2065 (a total increase of 62%).

The net impact of these assumptions on Western Australian export value is shown in Figure 21.

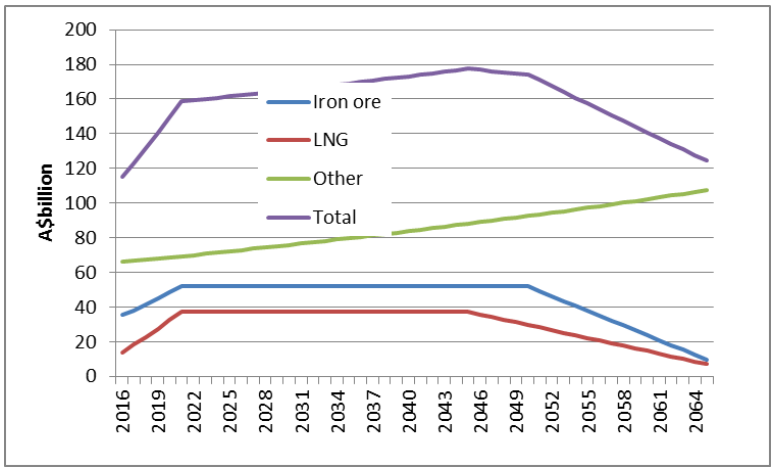

Figure 21 Export projections 2016-65

The results when this data is included in the model are depicted in Figure 22. This shows that a slowing in export growth after 2020 will lead to a peaking in income per capita at something like existing levels, and net reductions in exports around 2050 will likely lead to reductions in GVA in both absolute and per capita terms.

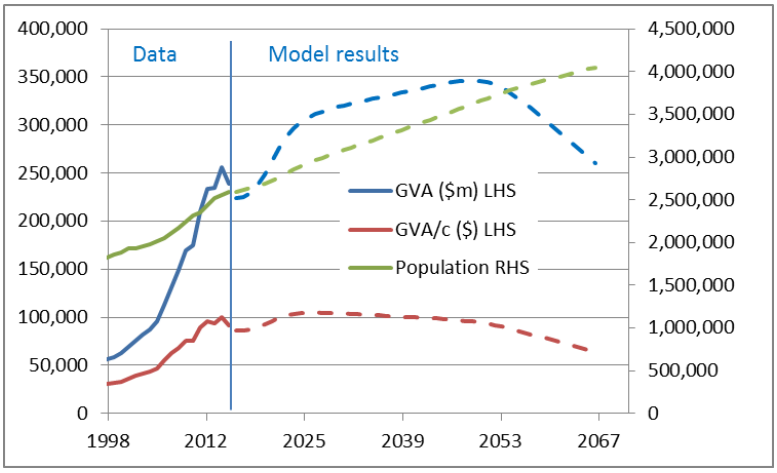

Figure 22 Economy projections 2016-65

Clearly if export growth outside the non-renewable resource sector is less than 1% pa this outcome would occur somewhat sooner. It is also likely that over the medium term, real prices for these commodities will increase as they become scarce. This would increase the magnitude of the peaks in Figure 22 but probably also bring forward the decline (as substitutions become more economically viable).

Discussion

Of course there are many assumptions included in the model which will undoubtedly turn out to be incorrect. However, it is difficult to imagine that the eventual depletion of the state's globally valuable natural resources can be offset with substitutions of other exports. The inevitable result of this will be a reduction in exports and hence output and GVA and with it a net reduction in migration. Most importantly for living standards this will also likely lead to a reduction in income per capita.

In this conference we are encouraged to consider the *Black Swan* effect in modelling the real world. In his book of that name which has created such interest in the topic Nassim

Nicholas Taleb (2007) describes a Black Swan event as having three characteristics, being:

- *an outlier, as it lies outside the realm of regular expectations, because nothing in the past can convincingly point to its possibility.*
- *it carries an extreme impact; and*
- *human nature makes us concoct explanations for its occurrence after the fact, making it explainable and predictable*[3].

The dramatic impact of China's import growth in the period 2000-2012 (Figures 2, 4 and 5) is perhaps Western Australia's Black Swan event[4], assuming a broad interpretation of an 'event' as *something that occurs in a certain place during a particular interval of time.* In fact understanding that it is an event rather than an enduring trend is a necessary precursor to addressing the long term structural implications of an inevitable re-structuring of the economy over the coming decades. Alternatively of course, there could be another Black Swan.

[3] In fact this human trait extends well beyond explaining Black Swan effects as is well established in the psychology literature (Haidt, 2006)

[4] The irony here is that the black swan is the state's bird emblem and features on the coat of arms.

References

Australian Bureau of Statistics. (2015a). Catalog 3101.0 Australian Demographic Statistics, Table 4 Estimated Resident Population, States and Territories.

Australian Bureau of Statistics. (2015b). Catalog 5209.0.55.001 - Australian National Accounts: Input-Output Tables, 2012-13.

Australian Bureau of Statistics. (2015c). Catalog 5220.0 Australian National Accounts: State Accounts, Table 6. Expenditure, Income and Industry Components of Gross State Product, Western Australia, Chain volume measures and current prices.

Australian Bureau of Statistics. (2015d). Catalog 5368055006 - Characteristics of Australian Exporters, 2013-14, Table 7. Value of Goods Exports, by Industry of Exporter and State of Origin of the Exported Commodity.

Australian Government. (2015). *Australia's Identified Mineral Resources 2015*.

Australian Government, D. o. I., Office of the Chief Economist. (2014). Resources and Energy Statistics 2014.

BankWest Curtin Economics Centre. (2015). Tiger, Tiger, Burning Bright? Western Australia's trade and economic development with Asia. Perth: Curtin University.

Buendía, F. (2005). *Increasing Returns to Economic Activity Concentration.* Paper presented at the 23rd International Conference of the System Dynamics Society, Boston, Massachusetts, USA.

Dangelico, R. M., Garavelli, A. C., & Petruzzelli, A. M. (2010). A system dynamics model to analyze technology districts' evolution in a knowledge-based perspective. *Technovation, 30*(2), 142-153. doi: 10.1016/j.technovation.2009.09.006

Duranton, G., & Puga, D. (2004). Micro-foundations of urban agglomeration economies *Handbook of regional and urban economics* (Vol. 4): Elsevier.

Fratesi, U. (2002). *Regional Economies and Innovative Performance as the Source of Competitiveness and Agglomeration: a System Dynamics Representation.* Paper presented at the 20th International Conference of the System Dynamics Society, Palermo, Italy.

Government of Western Australia. (2015a). *2015-16 Budget Fact Sheet - Iron Ore Royalty Revenue*.

Government of Western Australia. (2015b). *Western Australian Mineral and Petroleum Statistics Digest 2014-15*.

Grace, W. (2015). Simulating sustainability: a resources perspective. *Journal of Natural Resources Policy Research*, 1-30. doi: 10.1080/19390459.2015.1050202

Haidt, J. (2006). *The Happiness Hypothesis: Finding Modern Truth in Ancient Wisdom*: Basic Books.

Lin, C.-H., Tung, C.-M., & Huang, C.-T. (2006). Elucidating the industrial cluster effect from a system dynamics perspective. *Technovation, 26*(4), 473-482. doi: 10.1016/j.technovation.2004.11.008

Marshall, A. (1890). *Principles of Economics*. London: Macmillan.

Nathan, M., & Overman, H. (2013). Agglomeration, clusters, and industrial policy. *Oxford Review of Economic Policy, 29*(2), 383-404. doi: 10.1093/oxrep/grt019

Porter, M. (2003). The Economic Performance of Regions. *Regional Studies, 37*(6-7), 545-546. doi: 10.1080/0034340032000108688

Porter, M. E. (1990). *The Competitive Advantage of Nations*. New York: Free Press.

Reserve Bank of Australia. (2016). Statistical tables.

Taleb, N. N. (2007). *The Black Swan: The Impact of the Highly Improbable*: Random House.

World Bank. (2016). World Development Indicators.

World Steel Association. (2016). Steel facts Retrieved 19/03/2016, from https://www.worldsteel.org/Steel-facts.html

Appendix A

Clusters in the Western Australian economy

Agricultural Inputs and Services
Agriculture
Automotive
Business Services
Coal Mining
Construction Products and Services
Distribution and Electronic Commerce
Downstream Chemical Products
Downstream Metal Products
Education and Knowledge Creation
Electric Power Generation and Transmission
Environmental Services
Financial Services
Fishing and Fishing Products
Food Processing and Manufacturing
Footware
Forestry
furniture
Health Services
Hospitality and Tourism
Household Goods
Information Technology and Analytical Instruments
Insurance Services
Jewelry and Precious Metals
Lighting and Electrical Equipment
Livestock Processing
Local Commercial Services
Local Community and Civic Organizations
Local Education and Training
Local Entertainment and Media
Local Food and Beverage Processing and Distribution
Local Health Services
Local Hospitality Establishments
Local Household Goods and Services
Local Logistical Services
Local Motor Vehicle Products and Services
Local Personal Services (Non-Medical)
Local Real Estate, Construction, and Development
Local Retailing of Clothing and General Merchandise
Marketing, Design, and Publishing
Medical Devices
Metal Mining
Metalworking Technology
Music and Sound Recording
Nonmetal Mining
Oil and Gas Production and Transportation
Other Livestock Farming
Paper and Packaging
Performing Arts
Personal Services
Plastics
Production Technology and Heavy Machinery
Recreational and Small Electric Goods
Science and Technology Services
Sheep, Beef Cattle and Grain Farming
Textile Manufacturing
Tobacco
Trailers, Motor Homes, and Appliances
Transportation and Logistics
Upstream Chemical Products
Upstream Metal Manufacturing
Utilities
Video Production and Distribution
Vulcanized and Fired Materials
Water Transportation
Wood Products