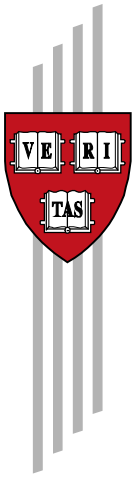
Western Australia Research Findings and Policy Recommendations

Ricardo Hausmann, Douglas Barrios, Ana Grisanti, Semiray Kasoolu, Tim O'Brien, Eric Protzer, Rushabh Sanghvi, Nikita Taniparti, Jorge Tapia

CID Faculty Working Paper No. 395
Completed June 2020
Published April 2021



Working Papers

Center for International Development at Harvard University

WESTERN AUSTRALIA – RESEARCH FINDINGS AND POLICY RECOMMENDATIONS

June 2020

Growth Lab
Center for International Development
Harvard University

GROWTH LAB
Center for International Development
at Harvard University

Table of Contents

Glossary

The following glossary is meant to provide an intuitive explanation for some of the jargon related to the framework of economic complexity found in this document. Additional mathematical detail can be found online at the Growth Lab website: www.atlas.cid.harvard.edu/glossary

Economic Complexity

A measure of the knowledge in a society as expressed in the products it makes. The economic complexity of a place is calculated based on the diversity of products a place produces and their ubiquity, or the number of the places able to produce them (and those places' complexity). Places that are able to sustain a diverse range of productive knowhow, including sophisticated, unique knowhow, are able to produce a wide diversity of goods, including complex products that few other places can make.

Economic Complexity Index (ECI)

An index of places based on how diversified and complex their production basket is. Places that are home to a great diversity of productive knowhow, particularly complex specialized knowhow, are able to produce a great diversity of produce, including highly unique products. The complexity of a place's production is found to be highly predictive of current income levels, or where complexity exceeds expectations for a place's income level, the place is predicted to experience more rapid growth in the future. ECI therefore provides a useful measure of economic development.

Complexity Outlook Index (COI)

A measure of how many complex products are near a place's current set of productive capabilities. The COI captures the ease of diversification for a place, where a high COI reflects an abundance of nearby complex products that rely on similar capabilities or know-how as that present in current production. Complexity outlook capture the connectedness of an economy's existing capabilities to drive easy (or hard) diversification into related complex production. A low complexity outlook indicates that a place has few products that are a short distance away, so it will it difficult to acquire new know-how and increase its economic complexity.

Knowhow

Knowhow is the tacit ability to produce a product. Also known as productive capability, knowhow refers to productive knowledge that goes into making products. Places grow faster by diversifying the productive knowledge they have to make a wider variety of products of increasing complexity. Knowhow, as tacit knowledge that only exists in brains, stands in contrast to embedded knowledge where all knowledge is held in technology (e.g. in an iPhone); and codified knowledge, where all knowledge is explained and detailed in codes or blueprints. Knowhow is better conceived as the ability to walk, as tacit knowledge that cannot be fully explains using words and is the slowest to transfer by requiring time-intensive processes of imitation and repetition. While embedded knowledge (e.g. iPhones) can be shipped across the world and codified knowledge (e.g. Wikipedia) can be accessed through media, we believe it is the slow transfer of knowhow that explains the slow, incomplete diffusion of technology and production around the world and stands at the heart of the economic growth

process. Policies that aim to speed up the diffusion of or diversify the knowhow of a society hold important implications on the pace of economic growth – and its fairness.

Complexity Outlook Gain (COG)

Measures how much a location could benefit in opening future diversification opportunities by developing a particular product. Complexity outlook gain quantifies how a new product can open links to more, and more complex, products. Complexity outlook gain classifies the strategic value of a product based on the new paths to diversification in more complex sectors that it opens up. Complexity outlook gain accounts for the complexity of the products not being produced in a location and the distance or how close to existing capabilities that new product is.

Product Complexity Index (PCI)

Ranks the diversity and specialization of the productive knowhow required to produce a product. PCI is calculated based on how many other places can produce the product and the economic complexity of those places. In effect, PCI captures the amount and sophistication of knowhow required to produce a product. The most complex products (that only a few, highly complex places can produce) include sophisticated machinery, electronics, and chemicals. The least complex products (that nearly all places including the least complex can product) include raw materials and simple agricultural goods. As an example, specialized machinery is said to be complex as it requires a range of knowhow in manufacturing, including the coordination of a range of highly skilled individuals' knowhow.

Revealed Comparative Advantage (RCA)

A measure of whether a place produces a certain good, based on the relative advantage or disadvantage a place has in the export of a certain good. We use Balassa's definition, which says that a place is an effective producer of a good if it produces more than its "fair share," or a share that is at least equal to the share of total world production that the product represents (RCA greater than one). One example: in 2010, soybeans represented 0.35% of world trade with exports of $42 billion. Of this total, Brazil exported nearly $11 billion worth of soybeans. Since Brazil's total exports for that year were $140 billion, soybeans accounted for 7.8% of Brazil's exports. By dividing 7.8% / 0.35%, we find Brazil has an RCA of 22 in soybeans, meaning that Brazil exports 22 times its "fair share" of soybean exports so we can say that Brazil has a high revealed comparative advantage in soybeans.

Matrix Country Product (MCP)

When the RCA is greater than one, this may also be referred to as "MCP" (Matrix Country Product).

Diversity

A measure of how many different types of product a place is able to make. The production of a good requires a specific set of knowhow; therefore, a place's total diversity is another way of expressing the amount of collective knowhow held within that place.

Ubiquity

Ubiquity measures the number of places that are able to make a product

1. Introduction

The Government of Western Australia (WA), acting through its Department of Primary Industries and Regional Development (DPIRD), invited the Growth Lab of the Center for International Development at Harvard University to partner with the state to better understand and address constraints to economic diversification through a collaborative applied research project. The project seeks to apply growth diagnostic and economic complexity methodologies to inform policy design in order to accelerate productive transformation, economic diversification, and more inclusive and resilient job creation across Western Australia. This Summary Report represents the last of three planned deliverables (*Economic Complexity Report*, *Growth Perspective*, *Research Findings and Policy Recommendations Summary Report*). As its name implies, this report aims to summarize the main findings of the previous deliverables and put forth a coherent policy framework that may serve as an organizing mechanism for policy initiatives that seek to promote sustainable growth, systematically address previously identified adverse dynamics, and jumpstart economic diversification.

This report is organized in six sections, including this brief introduction. Section 2 is an Executive Summary. Section 3 explains the methodologies of Growth Diagnostics and Economic Complexity, including its theoretical foundations and main concepts. Section 4 describes the main findings of the *Economic Complexity Report*, including a characterization of Western Australia's complexity profile. This is done at the state, regional, and city levels. Additionally, this section identifies diversification opportunities with high potential and organizes them into groupings to capture important patterns among the opportunities. This section also contextualizes the opportunities further by identifying relevant viability and attractiveness factors that complement the complexity metrics and consider local conditions. Section 5 highlights the main findings of the *Growth Perspective Report*. This section describes the economic growth process of Western Australia — with a focus on the past two decades — and identifies several issues with the way that growth has occurred. This section highlights three key channels through which negative externalities have manifested: labor market imbalances, pro-cyclicality of fiscal policy, and a misalignment of public goods. The section provides perspectives on the ways in which each of these channels have hampered the quality of growth and explores the deep-rooted factors that underpin these adverse dynamics. Section 6 introduces a policy framework that can be leveraged by WA to capitalize on revealed diversification opportunities and address the factors that impact the quality of the growth process of the state.

The Growth Lab visited Western Australia and interacted with stakeholders across public, private, and academic institutions to enrich the analytical findings of this report. The findings and recommendations presented here seek to serve as a basis for further studies and as inputs for the policymaking process.

Finally, a note on COVID-19 is relevant as the pandemic has introduced an unprecedented economic shock during the later stages of this research. The global crisis has had a rapid and profound economic impact in WA over the past few months – jobs have been lost, businesses across all sectors have closed, and some mining operations have been disrupted. This has already translated into substantial impacts on welfare and broader economic development as the virus has caused significant negative shocks to local production and to global demand. It is clear that the global economy will continue to reconfigure itself in the wake of the pandemic but the ways that this will take place are highly uncertain. This adds urgency to the findings of this report. COVID-19 has made it more uncertain whether past drivers of growth in WA will continue to drive growth in the future. At the same time, global shifts in production and consumption that will emerge in the shadow of this crisis will likely create new opportunities for many of the strategic industries identified in this report to emerge. Strategic considerations of global demand as the world recovers COVID-19 may therefore be an important avenue for future work toward acting upon the findings of this report. Meanwhile, as fiscal resources are leveraged to drive the recovery, the policy framework presented in in the final section of this report can help to target coordinated initiatives around catalyzing diversification opportunities while also addressing longstanding policy gaps to ensure more sustainable growth.

2. Executive Summary

This report aims to summarize the main findings of the *Economic Complexity Report* and the *Growth Perspective Report* and, based on these findings, put forth a coherent policy framework that may act as an organizing mechanism for policy initiatives that seek to promote sustainable growth, systematically address previously identified adverse dynamics, and jumpstart economic diversification.

2.1 Economic Complexity Report

The state's overall productive structure is of low economic complexity, meaning that knowhow embedded in industries that are present in WA do not stimulate diversification as easily as other similar states, both in Australia and globally. This reflects a pattern where employment and exports are concentrated in low-complexity sectors overall and in low-complexity activities across all sectors. This helps to explain why diversification of WA's exports has been very limited over the last decade in particular and underscores the need for the state to take a strategic approach to catalyzing economic diversification if the future is to look different. Not surprisingly, Perth's productive structure is by far the most connected to new opportunities among the regions, followed much more closely by South West than the other regions. A close look at Perth's economy shows that the state's economic and population center has a level of economic complexity similar to that of other global cities but somewhat low for its population size. The capability base for economic diversification in Perth appears to be strong. While population growth of the city may aid diversification potential, other global cities of the same size are significantly more diverse.

Despite being at a disadvantage for diversification versus other states, applying a tailored process to identify the most promising industries for diversification still yielded a wealth of promising opportunities. The results of the industry identification process naturally grouped into 20 fairly specific sub-groupings, which we have summarized into these five main groupings:

- **Primary Industries and Related *(~18% of opportunities)*** – This group captures fishing, fruits, food and beverage manufacturing, and wood products. Most of the specific industries included in this group are already produced with a comparative advantage in WA and their inclusion signals that there is high potential that they can grow significantly and that continued diversification opportunities can emerge through the companies that are already active in WA. Production and potential production appear to be spread significantly across the state.
- **Intermediate Inputs and Materials Manufacturing *(~11% of opportunities)*** – This group includes a variety of chemicals, plastics, metals, and construction materials. The products in this group can serve the state's mining and manufacturing industries but can also access much larger markets outside of the state. They represent a mix of products that are already produced to some extent in the state and products which are either nascent or

not yet produced in WA. Based on occupational structure data, opportunities appear to be strongest in regions that are closer to the population centers in the southwest of the state. In the context of COVID-19 these opportunities are especially noteworthy as industries in WA and the rest of Australia may look to secure more domestic suppliers.

- **Technology and Advanced Manufacturing *(~31% of opportunities)*** – This group emerged as one with the largest number of industry opportunities and one where few of the industries identified are currently present in significant scale. The specific products and industries signal many opportunities for existing companies and new entrants, in particular to innovate in serving the unique and changing needs of mining, agriculture, forestry, fishing, construction and healthcare in WA and Australia as a whole. While current occupational structures are most aligned with these opportunities in Perth, the South West, and the Wheatbelt, there is potential across all regions of the state. This group includes the types of products that will provide innovative solutions to the problems that the world faces today, including the current pandemic.
- **Professional Services *(~20% of opportunities)*** – This group includes a range of high-skill services in engineering and architecture, information technology, legal services, design services, and research and consulting. These services go hand-in-hand with more innovation in technology and manufacturing. The majority of these opportunities have a limited foothold in the state at present, suggesting that inter-state and international migration might be important for expanding the diversity of professional services in WA. Modern telecommunications make these opportunities possible even in more remote areas of the state. As a result of the COVID-19 pandemic, it is likely that remote work will be more prevalent in the future as businesses have learned to utilize this option.
- **Tourism *(~21% of opportunities)*** – This group contains not only traditional tourism opportunities and the food and transportation activities that go along with tourism, but also includes education and healthcare opportunities (in the spirit of these as education and healthcare service exports). There are substantial opportunities here to serve the demand of the rest of Australia and international demand for travel experiences, quality education, and healthcare services, especially for ageing populations who may choose to relocate. All regions of the state can capture more of these opportunities but doing so requires significant state-regional collaboration to capture demand and address supply constraints. It is noteworthy that educational services are currently concentrated in and around Perth, which likely limits the state's ability to capitalize on education exports and, perhaps more importantly, limits the innovation potential of regions. Any economic activity that requires global travel is seriously constrained in the short-term by COVID-19, but WA's success in controlling the virus may put it in a promising position to expand these industries sooner than global competitors in the coming years.

Looking across the opportunities identified by the analysis, there is a clear potential for the state to build on its "upstream" innovation capabilities to serve the demand of its biggest industries, including mining and agriculture, as well as healthcare, fishing and forestry, among others.[1] Many opportunities that fall under intermediate inputs and materials manufacturing, technology and advanced manufacturing, and professional services fit this pattern. This makes sense given that the WA's companies and entrepreneurs should be in the best position to develop and re-configure technologies that these industries need to keep up with a changing world and new global challenges, including impacts from climate change. Due to the state's remoteness, it has above average advantages to strengthen backward linkages from its major industries because of the increased advantage of being close to them. It is noteworthy that this pattern appeared across the results rather than "downstream" opportunities that are commonly assumed to exist in resource-rich places. WA's best opportunities appear to center around serving the demand of very productive industries and innovating to serve the future needs of the rest of the world, rather than competing with the rest of the world for expensive raw materials currently exported from the state in order to add value to them.

Finally, the results point to a need to re-imagine the structure of economic relationships between the Perth urban agglomeration and the rest of the state. The best opportunities for diversification and better job opportunities emerge not from one region or another but rather from the interaction between regions. As stakeholders incorporate the results of this report into strategy, policy, and public investment decisions, it will be critically important to focus less on precisely what industries are identified and where, and more on how to catalyze the emergence of these opportunities across the state as a whole. The process of diversification happens through businesses exploring how they can expand on products that they make and services that they provide in a place and, often, through businesses in one place determining that they can do what they currently do in a new place. In both cases, the process involves businesses and entrepreneurs discovering opportunities and taking risks. This report aims to enhance the roles that the state can play in supporting discovery, lowering risks, and providing public goods that the private sector needs in order to succeed in new business activities.

[1] The terms "upstream" and "downstream" refer to supply chain linkages. For example, in the mining industry there are various kinds of machinery, construction materials, automation technologies, and other inputs, including maintenance, that must be produced in order for the mining activity to happen. The companies and jobs that produce these inputs are "upstream" to mining. Likewise, there are "downstream" activities that take place up until the point that something is consumed, like steel production in the case of iron ore or petrochemical manufacturing in the case of oil, and all the varied activities that utilize steel and petrochemicals as inputs. In the presence of one industry, it is useful to understand the "backward linkages" that could be built through the development of upstream industries in comparison to the "forward linkages" that could be built through the development of downstream industries. For example, in the Pilbara, the multinational chemical company Yara is downstream of natural gas (it uses it for production) and upstream of iron ore (it produces explosives used in iron ore mining). Interviews with Yara suggest that its competitive advantage derives much more from its position upstream of iron ore than its position downstream of natural gas.

2.2 Growth Perspective Report

Western Australia is a sparsely populated state, which represents just 10% of the population of Australia; however, it accounts for almost 50% of the country's goods exports. This outsized economic weight is partly explained by the state's vast wealth of natural resources and its competitiveness in the mining sector. These factors allowed the state to benefit significantly from the global commodity supercycle experienced between 2002 and 2014. During this period, WA attracted 270 billion dollars in private investment to expand the state's mining capacity, which was the main catalyst for rapid economic growth, broad-based wage growth, and improved standards of living across the state.

However, the existing productive structure of WA, and particularly its labor market, was not fully prepared to effectively absorb this large investment surge. This translated into increasingly large wage premia that attracted workers from the rest of WA as well as inter-state migrants, but mostly international migrants. Similarly, it translated into a large fiscal expansion, in an effort to retain public sector employees, meet the needs of a rapidly increasing population, and facilitate the provision of productive infrastructure required by remote mining operations. The combination of these factors allowed for a substantial increase in the state's mining capacity and underpinned substantial consumption and real estate booms, but in the process likely worsened a long-term pattern of crowding out non-mining tradeable economic activities. The phenomenon of WA's large fly-in-fly-out (FIFO) workforce sustained a uniquely large geographical mismatch between the places where wealth was created and mining-related construction was concentrated versus where workers spent their earnings and where demand for non-tradable services boomed. This allowed the benefits of resource wealth to be spread across much of the state, but also created location-specific vulnerabilities in several markets (including labor, housing, and financial markets).

As global demand for key commodities slowed in 2013/14, private investment to expand mining capacity came to a halt. The impact of this sudden stop reverberated throughout the economy and across the state, particularly in the labor market. As demand for labor in construction and other mining-related services collapsed, the state lacked supplementary engines of growth that would have been able to absorb these workers. This translated into a sharp increase in both unemployment and underemployment, and a modest downward real wage adjustment. As total household disposable income stagnated as a result of job losses, discretionary consumption contracted, the prevalence of non-performing loans increased, and the housing market saw an overhang. Workers who were hit the hardest tended to be in non-tradable services, mining, and construction, and in parts of the state far from where mining occurs. Shocks to the housing and real estate markets were geographically concentrated.

The impacts of this negative shock could have been reduced with a larger fiscal stimulus than was used, which would have been consistent with counter-cyclical fiscal policy. Given that the state had front-loaded significant investments during its rapid economic expansion, it did not save

during the good times — in fact it borrowed during them. Meanwhile, state revenue sources were structurally pro-cyclical such that when the commodity boom ended and growth slowed down, revenues fell as well. This pro-cyclicality exacerbated WA's fiscal vulnerability during the slowdown. During the slowdown, the state accelerated debt accumulation with little space built into the fiscal system to provide additional counter-cyclical stimulus to smooth the impact of the investment slowdown. Moreover, increasing deficits and rapidly expanding public sector debt accrual — even if at a low level relative to the size of the economy — motivated a response in favor of added fiscal prudence, which in turn enhanced pro-cyclical effects and socialized the cost of the slowdown.

These recent dynamics highlight several key self-reinforcing elements of the WA economy:

- **Labor market imbalances** – namely the relative rigidity of the labor supply vis-à-vis volatile labor demand, which leads to a mismatch between permanent increases in labor supply and temporary increases in labor demand. This results in both a high place-specific wage premium that serves barrier to nascent economic activities and in vulnerability to sudden labor market dislocations.

- **Pro-cyclical revenue sources and public spending** – which limits the ability to introduce timely stimulus initiatives to help smooth sudden demand shocks and diminish the ripple effect to the rest of the economy.

- **Misalignment of public infrastructure investment with the needs of a diversified economy and implicit subsidization of public service** – which leads to additional frictions in the labor market, increases fiscal pressures, and hampers the performance of nascent industries that are necessary for economic diversification and overcoming the boom-bust dynamics.

WA has grown over the long-term without significant economic diversification, and this has made workers and firms more vulnerable to periods of sharp economic downturns when exogenous variables influence either the price of commodities or the flow of new business investment in the mining sector. Moreover, these adverse effects have been exacerbated by self-reinforcing negative externalities from the growth process.

2.3 Policy Framework

In this report we introduce a policy framework that seeks to serve as an organizing mechanism for policy initiatives across multiple stakeholders and levels of government. The ultimate goal of the framework is to foster the development of alternative engines to growth, address factors that underpin suboptimal growth dynamics and enhance resilience of the State to exogenous shocks. It considers three main policy goals – labor market balance, counter-cyclical fiscal policy and, better alignment of goods provision – to address each of the main channels identified in the *Growth Perspective Report*. For each policy goal, the framework lays out a mission statement, which

introduces the overarching objective of diminishing and reversing the adverse dynamics that affect the channel. It then considers a set of principles that aim to address the underlying factors and brief list of potential policy initiatives that would fall under each principle. Relevant principles for each of the main policy areas include:

- **Labor market balance** – Developing regional labor markets, increasing immigration flexibility, and optimizing skills acquisition strategies.
- **Counter-cyclical fiscal policy** – Introducing mechanisms for fiscal impulse stabilization, strengthening inter-temporal savings mechanisms, setting objective rules for deficit spending and debt accumulation.
- **Better alignment of goods provision** – Expanding state-level authority over public good investments, expanding capabilities to develop a pipeline of projects and solve system-wide issues, reducing (explicit/implicit) subsidies large private stakeholders that generate strains on the system.

The three main policy goals are complemented by one cross-cutting policy goal – **fostering the development of new engines of growth**. This goal cuts across the scope of the channels identified in the *Growth Perspective Report* and is important for achieving all of the main policy goals. Additionally, it benefits from progress made in achieving the main policy goals, which introduces a positive reinforcement dynamic. The policies considered under this framework can be leveraged by WA to alleviate the adverse dynamics outlined in the *Growth Perspective*. Solving these problems would help WA catalyze faster diversification of the non-mining economy – including the opportunities identified in the *Economic Complexity Report* – while maintaining the benefits of its natural resource wealth. The ongoing COVID-19 pandemic not only increases the urgency of utilizing this framework but also paves the way for policy innovations developed in response to the current crisis that follow the principles we outline.

3. Methodological Framework

This sections briefly described two methodological frameworks – Growth Diagnostics and Complexity Analysis – that aim to: (i) generate a holistic picture of the adverse dynamics playing out in the Western Australian growth process that impede diversification and sustainable growth, and (ii) identify potential avenues of productive diversification. These methodological frameworks were leveraged to arrive at the main findings of the two previous reports, the *Economic Complexity Report* and the *Growth Perspective Report*. In turn, these analyses are the basis for the policy framework presented in this report.

3.1 Growth Diagnostics

The Growth Diagnostics methodology is leveraged to identify the main constraints to growth faced by a place, taking account of historical patterns of growth and by testing potential roadblocks in the present. Since not all constraints are equally binding an economy, policy reforms will be successful only if those issues that are most binding are understood and addressed. Here we will focus on describing the main elements of applying the Growth Diagnostics framework and we will end this sub-section highlighting how these methods were utilized for Western Australia.

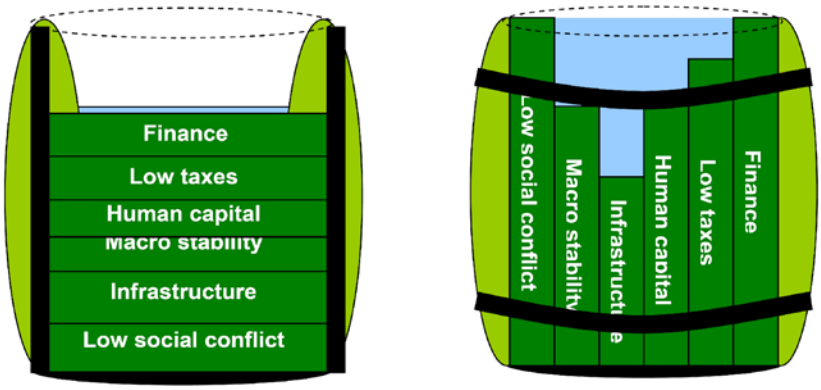
Some of the guiding principles behind on the Growth Diagnostics include:

- **Economic growth is key**: Improving people's standards of living should be the main goal of economic and social reforms enacted by governments. In some places, economic growth may be too sluggish, may be unsustainable, or may be inequitable. Understanding a place's specific growth problem is important, but in any case, standards of living cannot improve if the economy does not expand.
- **Adequate prioritization:** A long list of structural reforms is rarely much use for governments, particularly given the administrative, political, and budgetary restrictions they face. The Growth Diagnostic method prioritizes those aspects of the economy were a greater sense of urgency is required.
- **Focus on local problems:** Reforms based on one-size-fits-all approaches or on international best practices have a high probability of failure. The Growth Diagnostic methodology is an approach that allows all aspects of economic theory and empirics to be leveraged based on the needs of local context, rather than blindly applying theory or one set of models over another.

In identifying which of the many possible elements of an economy is constraining, the framework recognizes that factors that influence growth are complements rather than substitutes. The contrast can be visualized by through the structure of the two barrels in Figure *1*. The left-hand barrel has horizontal wood slabs, while the right-hand side barrel has vertical slabs. The volume in the first barrel depends on the sum of the width of all slabs. This visualizes the concept of substitutes.

Increasing the height of any slab will increase the volume of the barrel. For example, if an economy has poor infrastructure, this could simply be offset by funneling in access to more finance to businesses. The volume in the second barrel is determined by the length of the shortest slab. The impact of a change in a slab on the volume of this barrel depends on whether it is the binding constraint or not. If not, the impact is zero. If it is the binding constraint, the impact will depend on the distance between the shortest slab and the next shortest slab. In other words, the impact of a relaxation of the binding constraint is not just some estimated coefficient multiplied the magnitude of the change. If the change is large enough, the distance to the next binding constraint will matter too. In general, economies are more like the second barrel. To go back to the example, more finance in a place where businesses to do not have adequate access to fundamental infrastructure they need to be productive – like electricity or transportation networks – will not improve the places growth prospects. In fact, it could harm them.

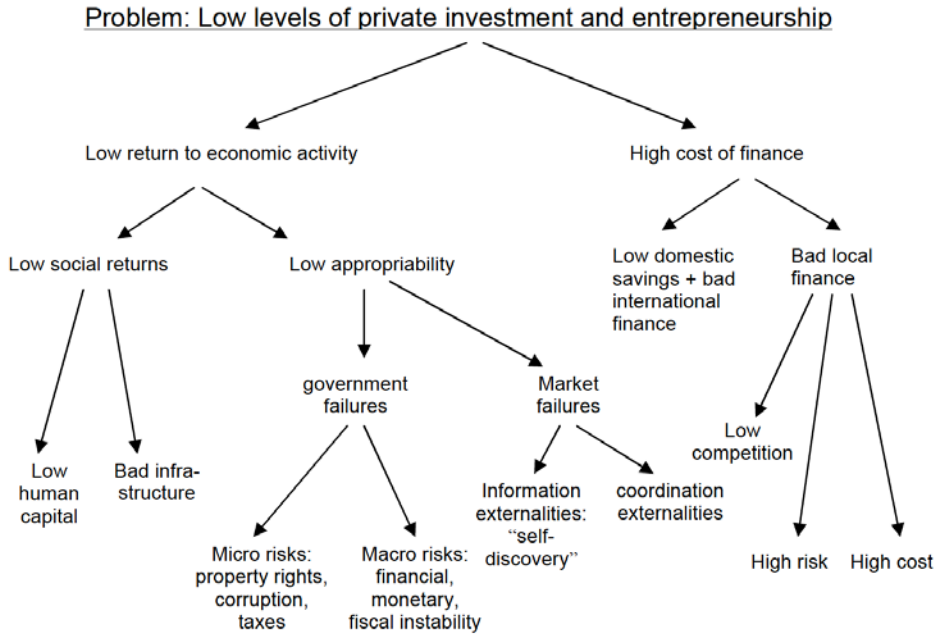
Figure 1: Determinants of Adequate Growth – Complements or Substitutes?



Source: Hausmann, Klinger and Wagner (2008)

To identify the most relevant restrictions (the shortest slab), the methodology hinges on applying tests to understand if issues in the economy are binding. To apply tests, one first has to identify what to test. In practice, this is done by going down a decision tree, exemplified in Figure ***2***, that organizes potential issues that can bind growth in an economy. This tree is meant to be instructive but not complete, as local conditions can introduce any number of issues that can be tested to evaluate if they are binding a better growth process. To go down the decision tree, we start by asking one principal "growth question" — in this example, we want to answer "why do we observe low levels of investment and entrepreneurship?". The decision tree starts with an important question of whether an economy is productivity-constrained or finance-constrained. In other words, "Is there low productivity or returns to economic activity?" or "Are returns high, but access to finance is prohibitive?" Depending on which more closely describes the economy, the decision tree outlines possible reasons to test.

Figure 2: A Growth Diagnostics Decision Tree



Source: Hausmann, Klinger and Wagner (2008)

To answer these questions, the growth diagnostics methodology leverages the four principles of differential diagnosis developed by Hausmann, Klinger and Wagner (2008):

- **The shadow price is too high:** A high shadow price indicates that relieving that constraint would have a large impact due to a scarcity of that factor in the economy. It is important to consider the measuring scarcity via *price* as well as *quantity*, since low quantity alone can be a signal of either low supply of something or low demand for it. Some inputs to production have an actual price that can be measured, such as the price of electricity, while others, such as corruption, are not so straightforward but may result in a very important shadow price that lowers productivity.
- **Movements in the constraint versus movements in the objective function:** By definition, if a binding constraint is relaxed then this will increase the value of the objective function. In the context of growth diagnostics, if a particular constraint is relaxed, then this should have a payoff for growth, investment, job creation, or whatever the specific economic objective is. Taking the example of finance as a potential binding constraint, it must be observed that increases in the availability of finance through a reduction in interest rates should have a positive impact on the investment rate of the country. Though this is often an implicit assumption for an economy, in practice it is rarely the case because many other factors may be binding.
- **Agents in the economy should be attempting to overcome or bypass the constraint**: Private sector actions signal the constraints holding back their economic progress, even if

those constraints may not be well understood or vocalized by the private sector. If agents in the private sector from a variety of industries are observed attempting to overcome a particular problem related to a factor in the decision tree, it is a signal that the factor is a binding constraint to the economy as a whole. For example, if firms are investing heavily in capacity to pump water, this is a signal that water may be a constraint to production, even if firms do not report it as a constraint because they see this investment as a normal cost of doing business.

- **Agents less intensive in a binding constraint should be more likely to survive and thrive:** Looking at the nature of the most successful parts of the economy can be informative of the constraints that affect others. We would expect to observe that those who are either structurally less intensive in the constrained factor, or at least more able to bypass it, will be doing comparatively well. Conversely, those sectors most intensive in the constraint will be doing relatively poorly. For example, if electricity is a binding constraint, one would see that the sectors of the economy that are more electricity-intensive factor (e.g. manufacturing) might struggle in comparison to sectors that are less intensive in the use of electricity (e.g. financial services).

The Growth Diagnostics methodology is a means of organizing an investigation into what holds an economy back from better growth performance and, ultimately, slower improvement in living standards. It allows for the use of many economic disciplines and tools in a practical and place-focused way. For some economies, it is useful to work explicitly through the entire decision tree to test competing theories for why an economy remains poor. The process allows for a focus on evidence rather than instincts and can help policymakers focus scarce resource – including human resources – on solving problems most critical to growth that may have been poorly understood prior to the exercise. It is sometimes the case that multiple constraints are critical and that the underlying forces that have allowed these constraints to fester are deeply related. Therefore, it is encouraged to work to identify a "growth syndrome" that explains why these constraints persist and have not been solved before.

Such explicit use of the tree was not used for Western Australia, which has enjoyed growth over the long-term and a high standard of living. However, the fundamental motivation and tools of Growth Diagnostics were heavily utilized in research to produce the *Growth Perspective Report.* The report explored the question of why WA's economy remains exposed to the volatility of boom-bust cycles and why it has failed to diversify over the long-term. The *Growth Perspective Report* ultimately identified a syndrome that explains these patterns of growth by using a variety of evidence to trace cause and effect relationships in the economy and over time. As is the case in medicine, where diagnostic tools are used to identify a syndrome that can then be cured through a treatment plan that attacks the entire disease (and just the symptoms), this report aims to outline a treatment plan for the economic syndrome of WA in the form of a complete policy framework.

3.2 Economic Complexity[2]

The theory of economic complexity, introduced by Hausmann, Hidalgo et al. (2011), is based on the realization that the development of products and services not only requires raw materials, labor and machinery, but also tacit knowledge (or "knowhow") of how to put inputs together to produce things and run business operations. This tacit knowledge tends to be the limiting factor for diversifying economic activities, because it is the most difficult component of production to transfer. Whereas many other inputs to production – including materials, tools, and blueprints – are relatively easy to trade and transfer, tacit knowledge of how to combine inputs efficiently and effectively can only be acquired through experience. Moreover, modern production requires far more knowhow than any single individual can acquire. Therefore, tacit knowledge is necessarily spread across many individuals who coordinate across teams and organizations.

To illustrate this dynamic, one might consider a hypothetical example of the barriers a company might face when trying to manufacture a sophisticated technological good – say, a cellphone – in a particular place. The company in question may very well be able to obtain blueprints and scientific documents that explain how to create a cellphone and its principles of operation. The company may be able to import the required raw materials and intermediate inputs used to construct a cellphone into the place where it operates, as well as the tools needed to put them together at a reasonable cost. It can even obtain an actual cellphone to examine its functionality. If all of this is eminently possible, why do so few places have companies that actually manufacture sophisticated goods such as cellphones? The answer is that few places have practical experience related to manufacturing cellphones competitively. This makes it very difficult to start producing cell phones in a place where they have not been produced before, especially by a company that has never produced cell phones before. Meanwhile, existing cell phone manufacturing companies tend to locate in places that have practical experience all along the production process, or across multiple places that each have different tacit knowledge, prolonging the first-mover advantage. However, once a place does produce a sophisticated product like a cell phone, it establishes a set of capabilities that can be repurposed for other similar products as well as for new products that are similar but have not been invented yet.

Some products and services incorporate large amounts of knowhow and types of knowhow that are valuable for multiple uses. In contrast, other products and services incorporate much less knowhow and/or knowhow that is not transferable for other valuable uses. As an analogy, different products and services can be understood as "words" whose production requires "letters" (knowhow-based capabilities), like in a game of *Scrabble*. The production of long and sophisticated words requires many letters, including some high-value letters, while few are needed to generate short and simple words. The knowhow embedded in places varies in terms of type and

[2] Additional details on the methodologies used can be found in the *Economic Complexity Report for Western Australia*. These include adjustments to conduct complexity analysis at a state and sub-state level, regional exports prediction, and adjustments to incorporate services in the analysis.

quantity. That is, some places have many diverse letters, which they can use in many combinations to make many different and valuable words, while others have few letters and letters with limited uses, which limits the possibility of creating new words. The differences in productive capacities brought by uneven "endowments" of letters are further amplified by the fact that the number of words that can be constructed increases exponentially as new letters are added.[3]

Ultimately, places develop the products and services (words) that their knowhow-based capabilities (letters) can support. Tools of economic complexity aim to measure and utilize the patterns that result. By observing patterns of production across places and time, we can infer and mathematically construct quantitative measures that capture the diversity of knowhow embedded in a place (Economic Complexity Index, ECI) and how much knowhow specific goods and services require (Productivity Complexity Index, PCI). For definition of these and some other terms that concern economic complexity, please refer to the glossary at the beginning of this report. Places with a high ECI are able to support a diverse set of economic activities, including activities that are not common across places, while places with low ECI support a less diverse set of activities, and those activities tend to be ubiquitous across places. Note that "complexity" is not the same as "sophistication," and we strive to not confuse the two words. Products and services can be sophisticated in that they are complicated to produce but can still be non-complex if the capabilities required to produce them are not able to be redeployed for many other products and services. Likewise, places can be sophisticated in that they produce complicated and high-value products but can still have low complexity if the capabilities required to produce their products cannot support diverse economic activities.

Given that economic complexity reflects the amount of knowhow that is embedded in the productive structure of an economy, it is not surprising to find a strong correlation between measures of complexity and income. Figure *3* shows the relationship between per capita income and economic complexity across all countries of the world. At the same time, given that complexity and sophistication are not one in the same, it is also a fact of the world that some countries (Australia included), appear far away from the regression line.

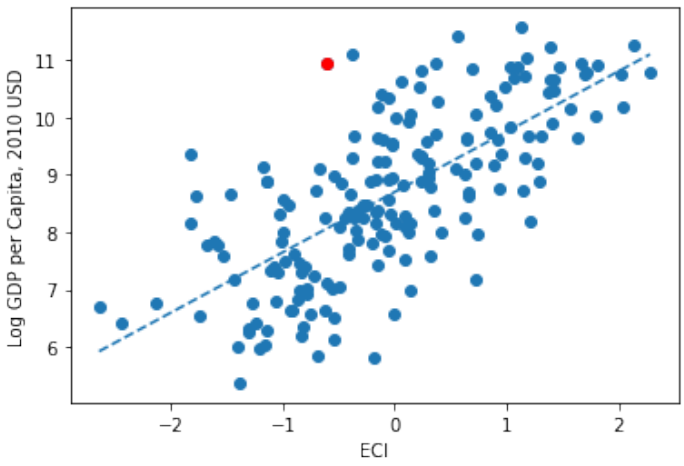
Hausmann, Hidalgo et al. (2014) also found that the prediction errors in Figure *3* – i.e. the difference between a country's actual income levels and those predicted by its complexity – tend to be predictive of future growth dynamics. Countries with an economic complexity greater than expected given their level of income tend to grow faster than countries that display a level of income that is higher than expected for their current level of economic complexity. In other words, countries positioned below the regression line are often poised to enter long periods of sustained growth, because if key constraints (such as infrastructure, access to financial capital, or institutional gaps) can be overcome then they can translate their existing stock of knowhow into

[3] Thus, for example, in the English language, with 1 letter, "a", one word can be formed of up to 1 letter; with 3 letters, "a", "c" and "t", you can form up to 4 words of up to 3 letters ("a", "at", "cat" and "act"); with 4 letters, "a", "c", "t" and "r", you can form 9 words of up to 4 letters ("a", "at", "cat", "act", "rat", "car", "art", "tar" and "cart"); and with 10 letters, "a", "c", "t", "r", "o," l "," g "," s "," n "and" i ", you can form 595 words of up to 10 letters.

higher output. Meanwhile, places above the regression line tend to be in a more precarious position (in terms of long-term growth) as they may be benefitting from a temporary positive shock, and if this boom is not leveraged to increase the sophistication of the economy to a level consistent with the current level of income, they run the risk of having their level of income fall toward the regression line when the boom ends.

The implication for developing countries (that are not as industrialized as Australia or WA) is that long-term growth and corresponding improvements in wellbeing tend to require a process of structural transformation where the private sector gradually gains productive capabilities. This allows the revealed comparative advantages of the economy to evolve and diversify over time. Countries that have transitioned from low-income to high-income economic systems have tended to diversify from primarily agricultural production into particular types of labor-intensive manufacturing (like garments) and onward to more sophisticated manufacturing and tradable services. As they grow, they do not give up most of the economic activities of the past but rather become more productive in those activities as they add new industries. This diversification process leads to rising wages across both old and new industries and makes countries more resilient to a variety of shocks – whether natural, macroeconomic, financial and technological – as economic activity and jobs are less concentrated and therefore less vulnerable to a single shock.

Figure 3: Income per Capita and ECI by Country (2017), Australia in Red



Source: Own calculations based on World Bank WDI and the Atlas of Economic Complexity

The implications for industrialized economies – including Australia as a whole and WA as a state – that find themselves above the regression line are quite different. Many of these countries benefit from substantial resource wealth and some benefit also from very strong institutions that diminish the negative impacts of resource wealth, including a tendency toward inequality and boom-and-bust cycles. However, these countries stand to benefit from recognizing the risk inherent with resource-driven wealth: if the resources lose their value, national wealth will contract. Additionally, some of these countries struggle with the subnational implications associated with

these types of economies. For instance, stabilization mechanisms that work well at a national level, may be more difficult to use at a subnational level. Countries and states like these often struggle sharing the benefits of that wealth, as in many instances rents from natural resources don't always translate into long-term material benefit for places they were extracted from. Finally, places blessed with natural resource wealth face challenges for diversification of job opportunities that derive from the distorting macroeconomic influences that natural resources can have. Most commonly, this wealth can appreciate national currencies, which can crowd out the emergence of other economic opportunities that would provide more and better jobs.[4] Such places may want to actively pursue diversification for the benefits of resilience and inclusiveness, but the nature of their diversification paths will be necessarily different than developing economies.

A final critical theoretical foundation of economic complexity was introduced by Hausmann and Klinger (2006). They showed that the probability that a place develops the ability to produce a new product varies based on the set of products that it already produces. This allowed for the measurement of the similarity between products based on their shared capabilities. Based on this pattern, they proposed a measure of similarity or proximity between products. In essence, they measure the "proximity" between any pair of products based on the probability that countries are intensively engaged in both. The collection of all the resulting proximities can be visualized as a network connecting pairs of products based on their tendency to be co-exported by countries. They refer to this network as the "Product Space" and use it to study the productive structure of countries.

The structure of the Product Space, and a country's position within it, is crucial because it affects the ability of countries to move into new products. A highly connected position in the Product Space reflects relatively easier paths to diversification than a sparse position. Hausmann and Klinger (2006) find that the Product Space is highly heterogeneous: some sections are composed of densely connected groups of products whereas others are more loosely connected. This heterogeneity has significant implications for the speed and patterns of structural transformation: the ability of countries to diversify and to move into products that are more complex is crucially dependent on their initial location in the Product Space. The complete Product Space and Australia's position in the space are shown in Figure 4 and Figure 5.

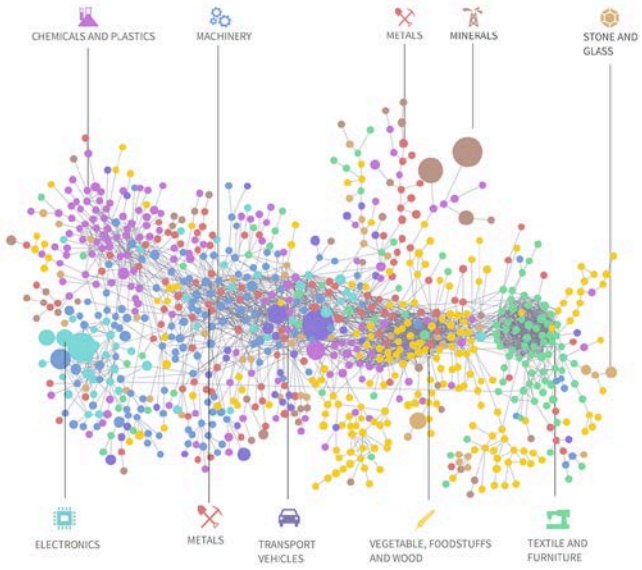
The location of a country's production in the Product Space captures information regarding both the productive knowledge that it possesses and the capacity to expand that knowledge by moving into other nearby products. The strategic positioning of a place in the Product Space can be leveraged as an insightful tool for formulating economic diversification strategies.[5] This tool is

[4] The appreciation of the Australian dollar due to the boom in exports of its natural resources has certainly contributed to the rise in the real purchasing power to import. While this had implications on the economy in terms of the diversification of the export basket, the evidence is mixed, and ultimately WA's path to diversification was hindered by a range of structural features.

[5] Harvard CID's Growth Lab developed a free, online tool for Product Space analysis of any country in the world. See http://atlas.cid.harvard.edu/.

equally applicable for both developing countries seeking to accelerate structural transformation and industrialized countries that want to diversify beyond their natural resources. What differs is the initial position in the Product Space for the countries and the type strategies that result. Australia's position in the Product Space is noteworthy for its sparseness for an industrialized country. This is the result of very large export concentrations in three products – iron ore, coal, and natural gas – together with limited exports in a wide range of manufactured goods ranging from machinery to electronics to transport vehicles.

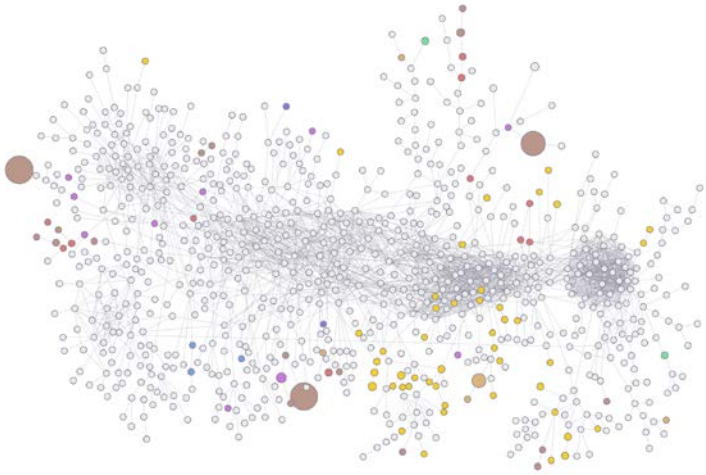
Figure 4: Product Space with All Products



Note: Circle size weighted by world trade

Source: Atlas of Economic Complexity

Figure 5: Product Space with Australia's Products



Note: Circle size weighted by Australia's export value.
Source: Atlas of Economic Complexity

3.2.1 The Application of the Economic Complexity Methodology to Western Australia

As a state with an economy dominated by mineral and mining-related activity, Western Australia has much to gain by applying the concepts of economic complexity to understand its existing capability set and to expand its comparative advantage. Because the complexity framework was intended to be applied in the context of entire countries, a number of adjustments had to be made to be able to conduct the complexity analysis at the state and sub-state level.

Prior to the impacts of the COVID-19 pandemic, the state economy was rebounding from a significant and extended slowdown in construction related to the mining sector, which has had reverberating negative effects on labor market outcomes, the health of the housing market, and the state's finances. Such slowdowns, and larger boom-bust cycles are a risk faced by under-diversified economies like that of the state. The *Economic Complexity Report* aimed to help understand ways that state can accelerate economic diversification such that residents gain more from boom periods and so that job opportunities are more resilient to the bust. In order to take full advantage of this analysis, it is crucial to emphasize some important nuances concerning how economic complexity methodology fits into the Western Australian context.

First, it must be again emphasized that all discussion of "complexity" specifically refers to a place's or economic activity's tacit knowledge that is useful for economic diversification. This is a technical term that may not correspond with how one might conceptualize "complexity" in common discussion – such as logistical or technical sophistication. It is critical not to automatically assume an economic activity is "complex" simply because it appears to be logistically or technically sophisticated. For example, there is a burgeoning off-grid solar energy industry in Sub-Saharan Africa, in which many families use mobile money to access electricity from solar panels. This process certainly uses technologically sophisticated tools, but these tools are largely imported from developed countries and then simply used locally as is – without deep practical comprehension of their operating principles. This economic activity does not require or impart a great deal of complex tacit knowledge and cannot be considered a driver of knowhow required for economic diversification.

Second, it is useful to understand economic diversification in Western Australia in terms of complexity – that is, building on and expanding tacit knowledge. This should be especially contrasted with the common but misguided perspective that economic diversification is about value addition to a place's raw materials. Complexity is grounded in real patterns of global economic activity that show that diversification happens through places adding to their capability set as opposed to their raw materials. When diversification is thought of as adding value to raw materials, the scope of what is deemed possible is extraordinarily limited. In reality, high value economic activity is about adding value to *any* materials – not just those which are produced locally. Access to raw materials is only as far as a place's nearest port.

Third, it is important to keep in mind that higher economic complexity helps an economy to move into new products, but economic complexity is not a magic bullet for every economic problem. It is entirely possible for a country to produce a wide variety of highly complex products but still

experience any number of issues ranging from micro-level regulatory deficiencies to macro-level monetary or fiscal imbalances, which can structurally hamper its growth. By the same token, some forms of economic production may not enable economic diversification but still be eminently useful in other ways. Western Australia's iron ore boom, for instance, was a critical factor which supported Australia through the Global Financial Crisis, even if it did not lead to much economic diversification.

Fourth, the goal of applying the economic complexity methodology is not to halt or replace any part of economic activity, but to build on it. Economic complexity is about enabling diversification through the accrual of knowhow in the economy, and for this purpose one should not seek to destroy knowhow. Economic complexity must thus be viewed as a tool to expand upon Western Australia's existing modes of economic production. It must absolutely not be viewed as a method of displacing Western Australia's current forms of economic production, as that would be inaccurate and counterproductive.

Western Australia's mining and minerals sector should be understood in light of the above discussion. Mining activities can certainly be logistically sophisticated and use high-end technology, but economic complexity methodology empirically finds that mining activities tend to have very low complexity. In other words, the sector on the whole tends to create few capabilities that lead to economic diversification. Critically, this does not mean that mining and minerals should be viewed negatively or that the aim of a complexity analysis is to replace mining and minerals. The sector is crucial to the state's economy and has provided many benefits to its population. It merely means that this report strives to identify opportunities that can grow alongside mining in the WA economy to diversify job opportunities and better position the economy to be more resilient to boom-and-bust cycles. Additionally, the analysis does not restrict itself to exploring opportunities for downstream production from mining and minerals, which would be highly limiting. In fact, by evaluating the tacit knowledge that exists in Western Australia, the *Economic Complexity Report* finds a much wider spectrum of opportunities than commonly assumed.

4. Economic Complexity – Main Findings[6]

The Economic Complexity of Western Australia is analyzed at state and sub-state levels, leveraging both export and employment data. A number of substantial technical hurdles had to be overcome to perform this analysis, the details of which are presented in the *Economic Complexity Report.* As a summary, state-level export data was drawn from the Australian Bureau of Statistics; regional export data was projected using a machine learning approach; and employment data at all geographic levels is drawn from database compiled by the company Dun & Bradstreet. Concordance was applied as necessary to match Australian data to world data, in order to facilitate valid international comparisons.

Analysis for Western Australia's economic complexity is performed separately on export and employment data, each of which offer complementary insights. The export approach arguably uses a stricter bar for determining whether Western Australia has a comparative advantage in any particular good, because exports must be globally competitive. The employment approach, however, is especially useful in that it covers service industries for which international trade data is not available. The export analysis compares Western Australia to other populous Australian states. The employment analysis compares Western Australia to a number of subnational entities from Australia, Canada, the US, and Japan. These international peers were selected based on the similarity of their industrial, demographic, and geographic (with regard to remoteness) characteristics vis a vis Western Australia. See the *Economic Complexity Report* for the full details of this selection procedure.

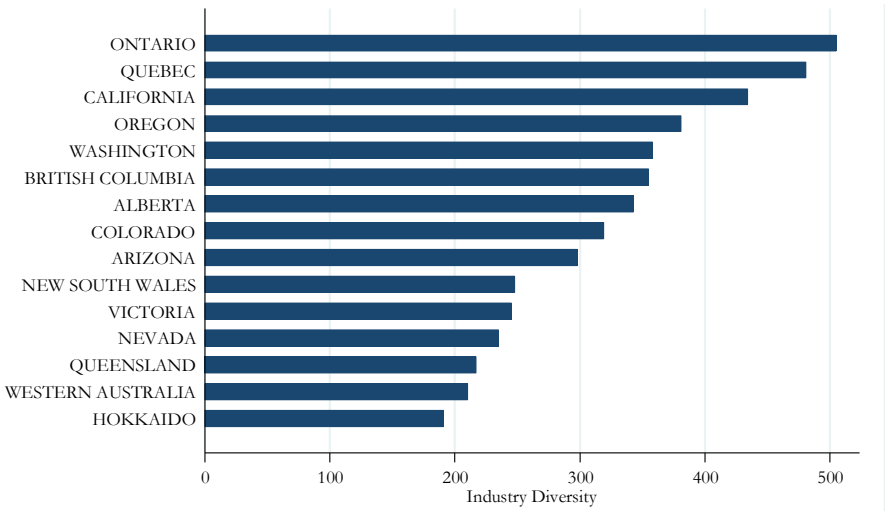
4.1 Diversity of WA's Economic Structure

Western Australia specializes in a small number of industries and has experienced little diversification into new industries. In terms of employment, WA is one of the least diverse states of the peer group. Although it is true that other Australian states in the peer group are located in the lower part of the spectrum, WA's employment is less diverse than each of them and more diverse than only Hokkaido, Japan. WA's employment structure is intensive in approximately 200 industries, less than half the diversity of places like Ontario, Quebec and California, as shown in Figure 6.

WA's export basket has likewise displayed consistently low diversity. During the 2008-2016 period WA's export diversity averaged 32 products, the lowest of any large Australian state and comparable to that of Saudi Arabia. This translates into a sparsely populated Export Space, which is shown in Figure 7. Note that this Export Space takes a different shape than the Product Space because of the unique analysis to apply the methodology at the state-level.

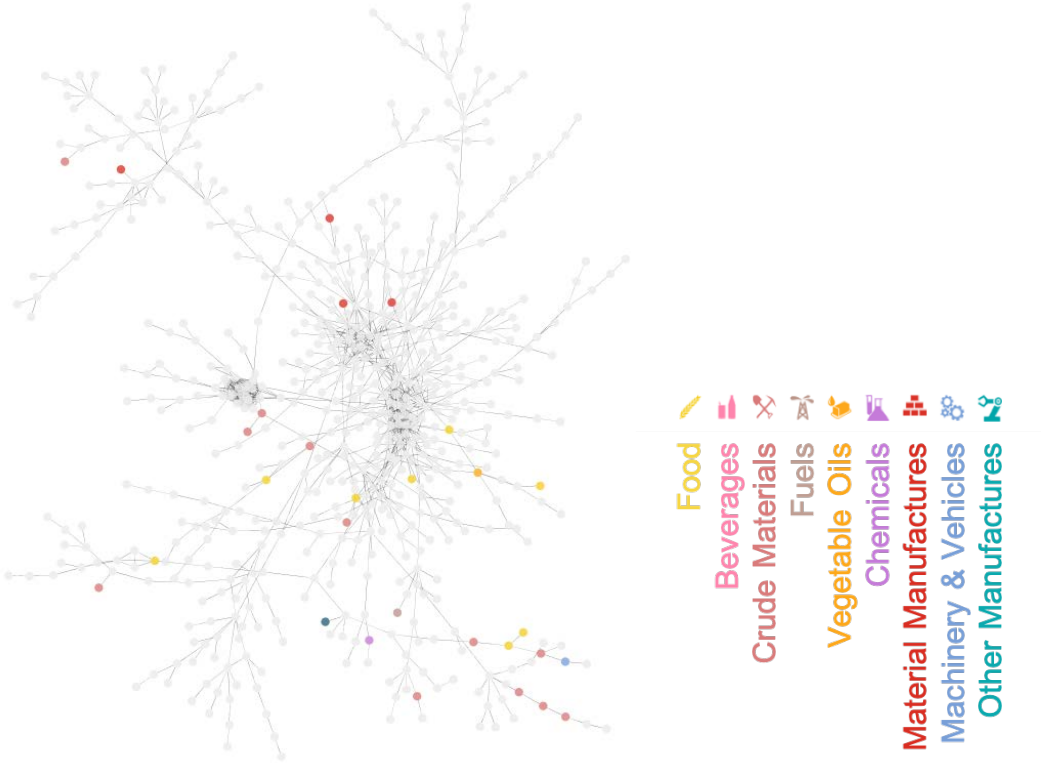
[6] Additional information on the economic structure of Western Australia and the characterization of its complexity profile can be found in the complete *Economic Complexity Report for Western Australia*

Figure 6: Employment Diversity, WA and Peer States (2019)



Source: Own construction based on D&B

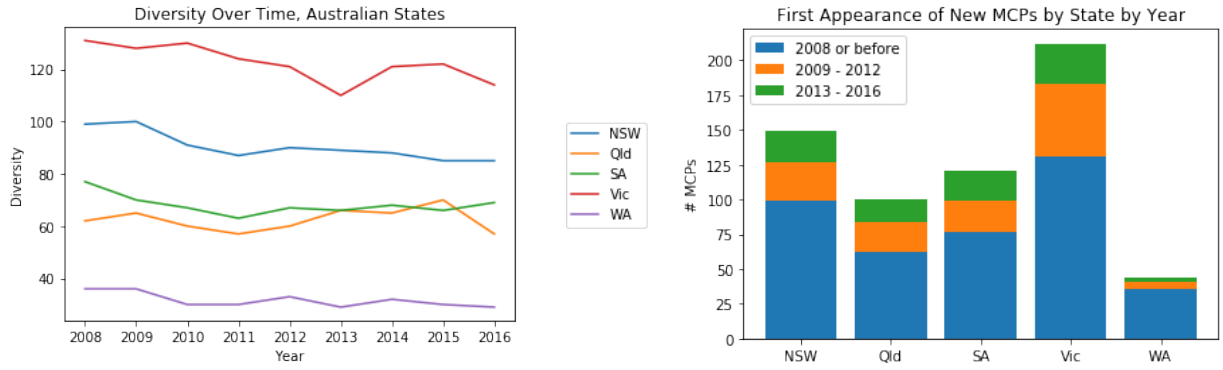
Figure 7: WA's Export Space (2016)



Source: Own construction based on ABS and COMTRADE

WA's low diversity reflects the cumulative result of difficulty in adding new products to its export basket over time. As shown in Figure 8, WA's diversity over 2008-16 was on average 27% of that of Australia's most diverse state, Victoria. Over this period, WA added only three new products (as measured by RCA>1),7 the lowest total of any state. By contrast, Victoria added 76 products over the same time period. It is noteworthy that WA did not diversify into products that are exported intensively by other mainland Australian states. Note that the graph on the left captures both product appearances and disappearances, while that on the right counts only appearances.

Figure 8: States' Exports Diversity over Time and New Export Appearances (2008-16)



Source: Own construction based on ABS and COMTRADE

4.2 Economic Complexity of WA's Economic Structure

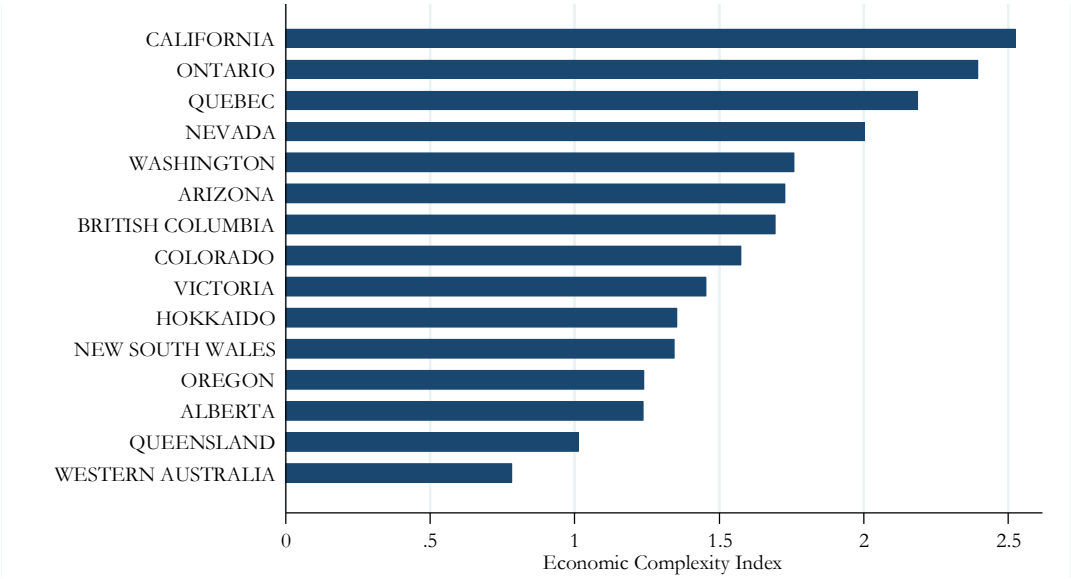
WA has a low level of economic complexity, which is explained both by its concentration in low-complexity industries and its low-complexity activity across a broad variety of industries. WA shows the lowest level of economic complexity of any peer state based on the employment approach, as shown in Figure 9. This reflects that the state's employment sources have both low diversity and relatively high average ubiquity. The export analysis yields similar conclusions. As shown in

Figure ***10***, WA has the lowest complexity of any large Australian state, only comparable with Queensland and at a considerable distance behind Victoria, New South Wales, and South Australia. Although ECI has jumped around somewhat, WA has had low export complexity consistently over the past decade.

[7] These new products were also directly from the mining industry: (1) ores and concentrates of precious metals, waste and scrap; (2) ores and concentrates of other non-ferrous base metals; (3) silver that is unwrought, unworked or semi-manufactured.

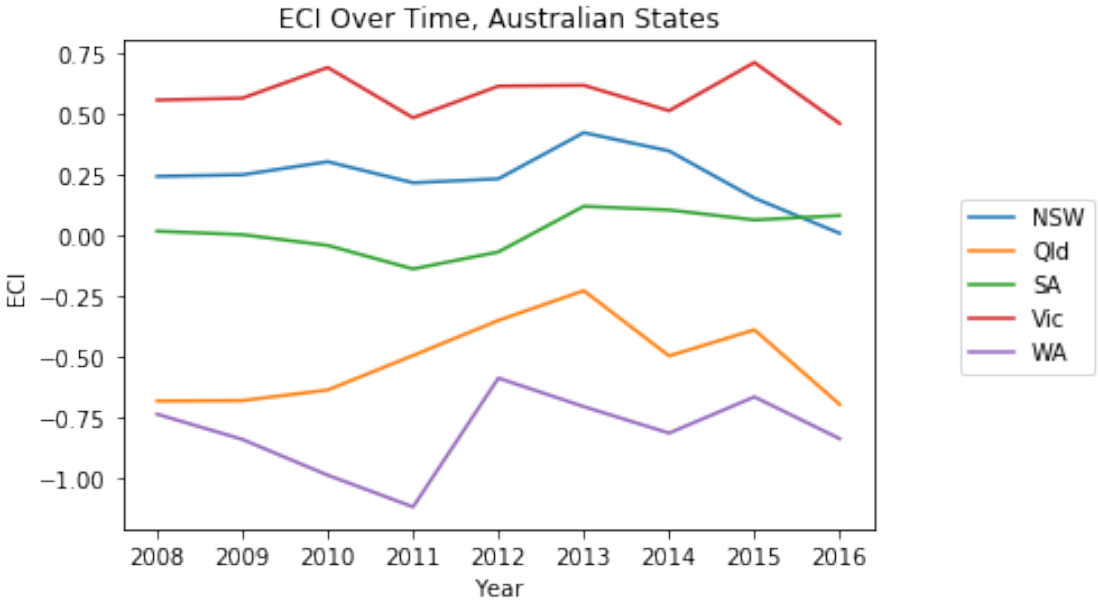
It is useful to also observe these patterns in WA's overall export and employment volumes. In 2016, only 7% of WA's exports were in products with positive (above-average) PCI, as shown in Figure 11. Meanwhile, less than 2% of WA's overall employment in 2019 was in industries that were in the top 30% of complexity, as shown in Figure *12*.

Figure 9: ECI Based on Employment, WA and Peer States (2019)



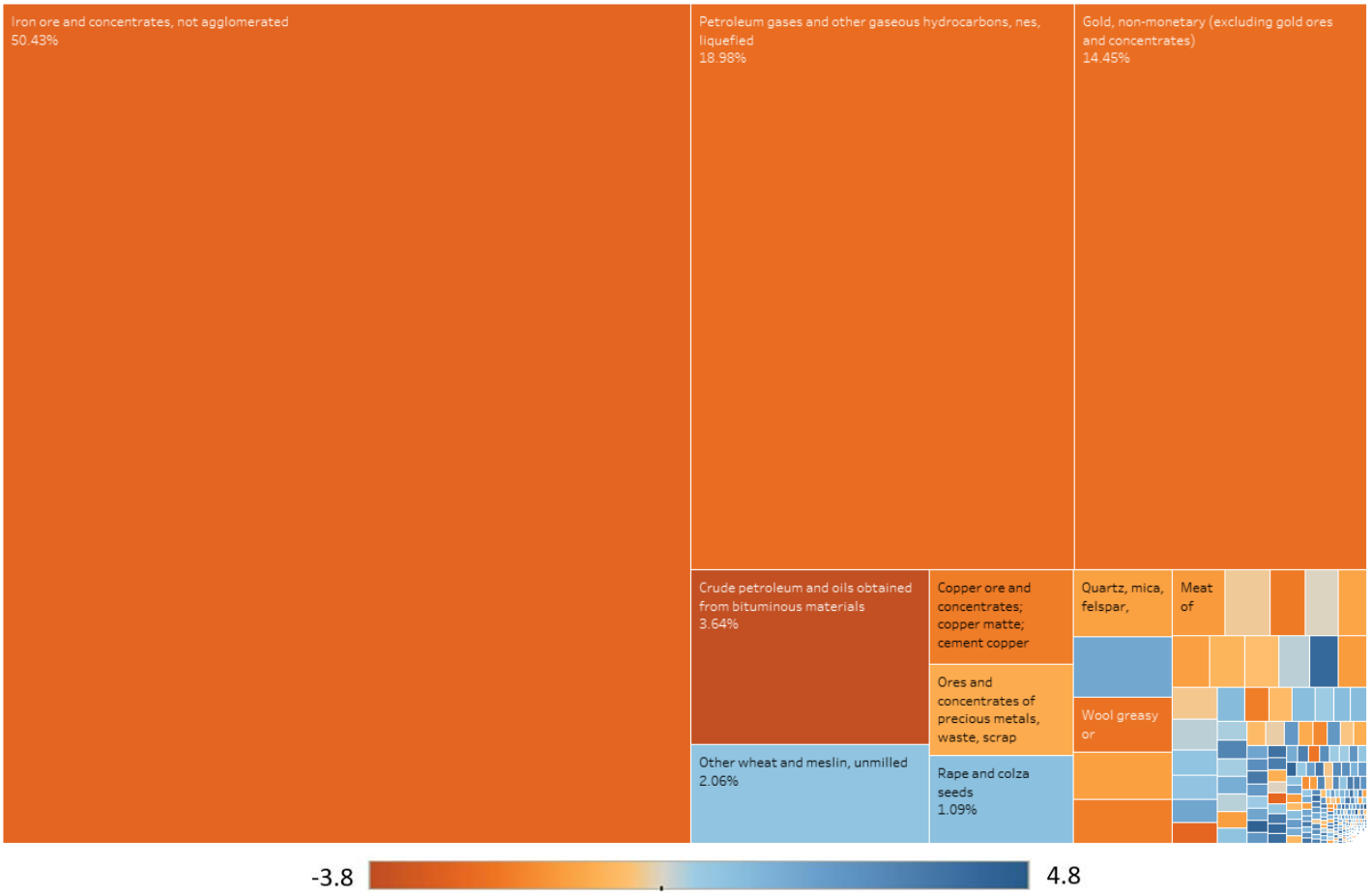
Source: Own construction based on D&B

Figure 10: Evolution of ECI Based on Exports over Time, Australian States (2008-16)



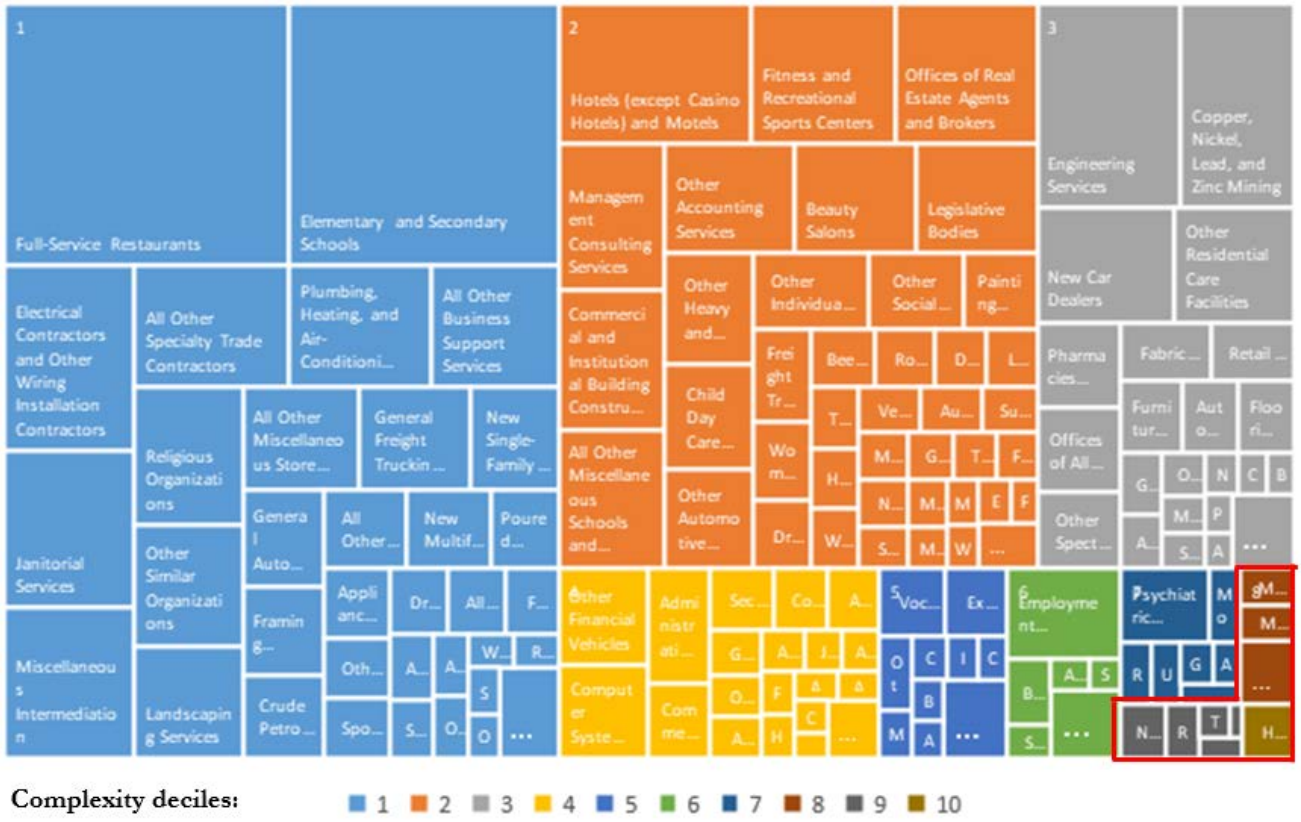
Source: Own construction based on ABS and COMTRADE

Figure 11: WA Exports Colored by PCI (2016)



Source: Own construction based on ABS and COMTRADE

Figure 12: WA Employment Colored by PCI Decile (2019)

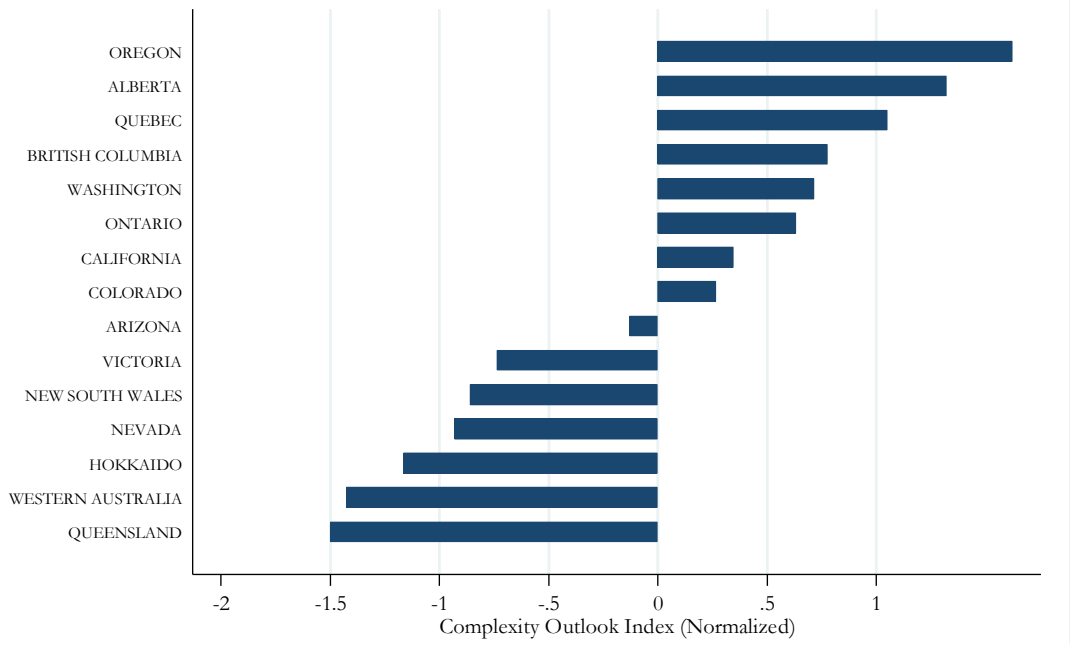


Source: Own construction based on D&B

4.3 Complexity Outlook of WA's Economic Structure

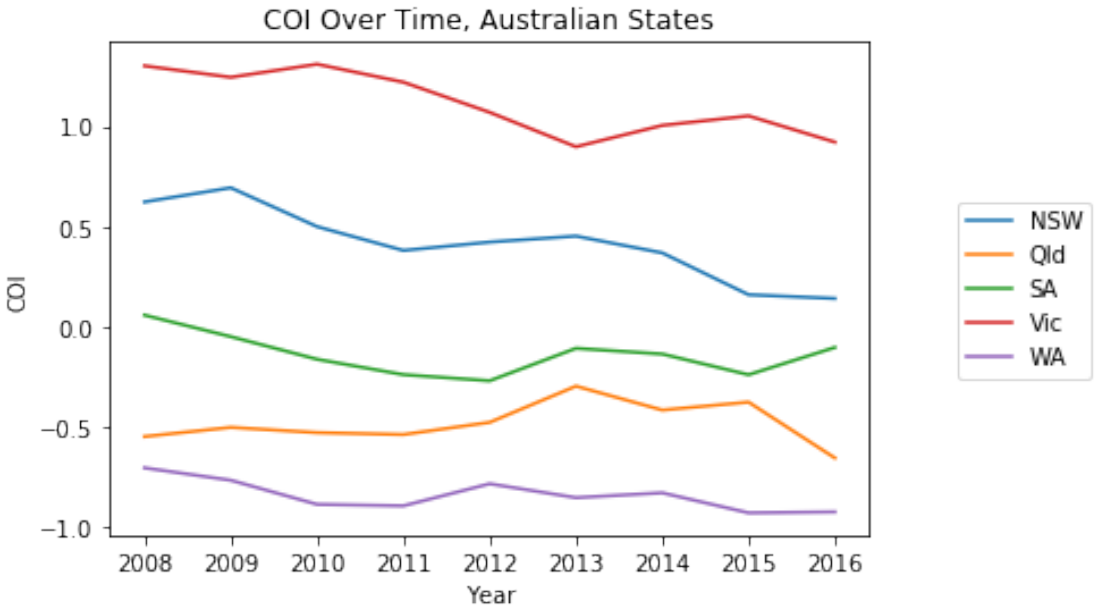
WA not only has low complexity, but also faces difficulties increasing its complexity because it has a low complexity outlook index (COI). WA's productive capabilities do not put it in a position that is well "connected" to more complex activities. Regardless of whether we measure WA's capacities based on employment or exports, the state ranks poorly in the COI metric. When calculated based on employment, shown in Figure 13, WA ranks second to last within the peer group, only ahead of Queensland. When using exports, shown in Figure *14*, WA has the lowest COI of any large Australian state. As with ECI, this low COI has been consistent throughout the past decade. As a result, we can conclude that status quo strategy is not leading to significant diversification.

Figure 13: COI based on Employment, WA and Peer States (2019)



Source: Own construction based on D&B

Figure 14: Evolution of COI Based on Exports over Time, Australian States (2008-16)

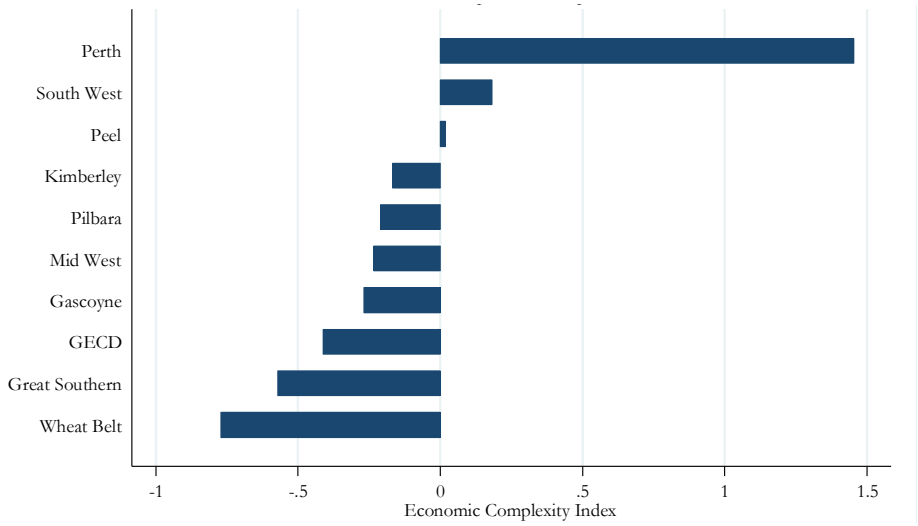


Source: Own construction based on ABS and COMTRADE

4.4 Economic Complexity Indicators at a Sub-State Level

Perth is by far the most complex region of WA and is best-connected to new diversification opportunities. The employment analysis shows that Perth's complexity is far larger than any other region (Figure 15), while the South West and Peel also have an above average complexity. On the other hand, the Wheatbelt, Great Southern, and Goldfields-Esperance have much lower (and below average) complexity.

Figure 15: ECI Based on Employment, WA Regions (2019)

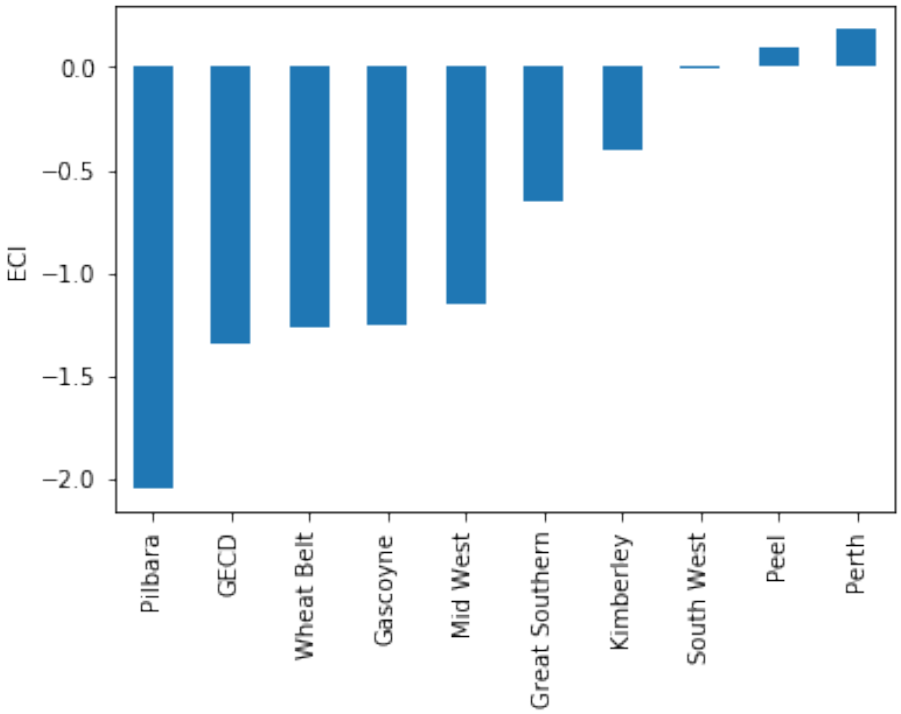


Source: Own construction based on D&B

In terms of exports, Perth remains the most complex region, although the gap between it and the next several regions (again Peel and South West) is smaller, as shown in Figure 16. Perth registers as the most complex region both because it is highly concentrated in complex sectors (manufacturing and machinery & transport equipment) and because it shows high levels of product complexity across various sectors (beverages, crude material, manufactures).

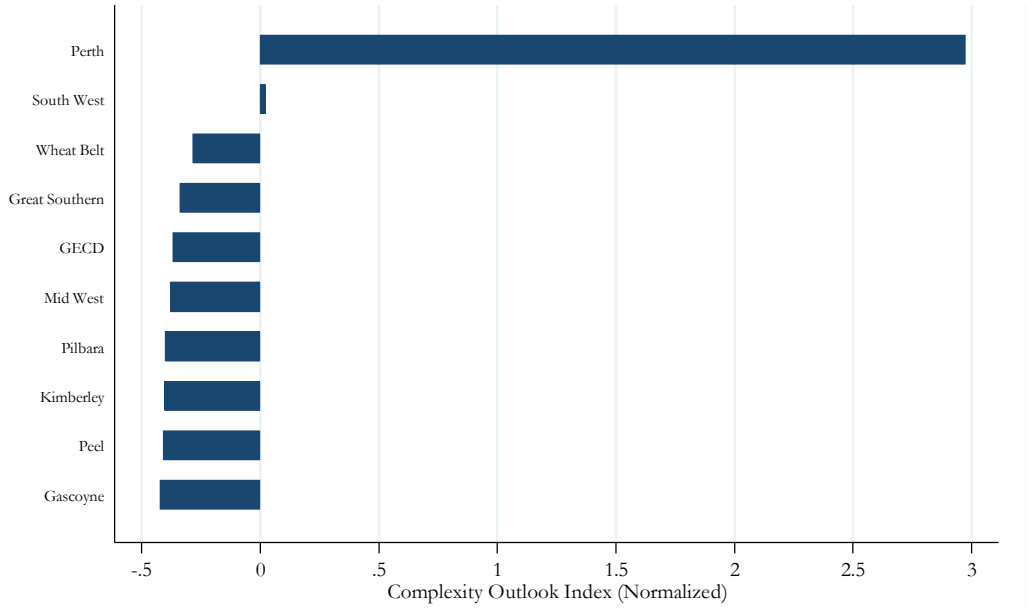
At the same time, Perth is in a much more advantageous position to improve its complexity than the rest of the state, as shown in Figure ***17***. The employment analysis for Perth yields a very high COI, while nearly all other regions have a low COI. Using the exports approach, Perth once again has the highest COI but the gap versus other regions is smaller. The South West also scores quite well in export-derived COI, while the Great Southern has a COI above the global average and the Mid West has a COI just under the global average. More remote regions have much lower COIs, especially Pilbara, Gascoyne, and Goldfields-Esperance.

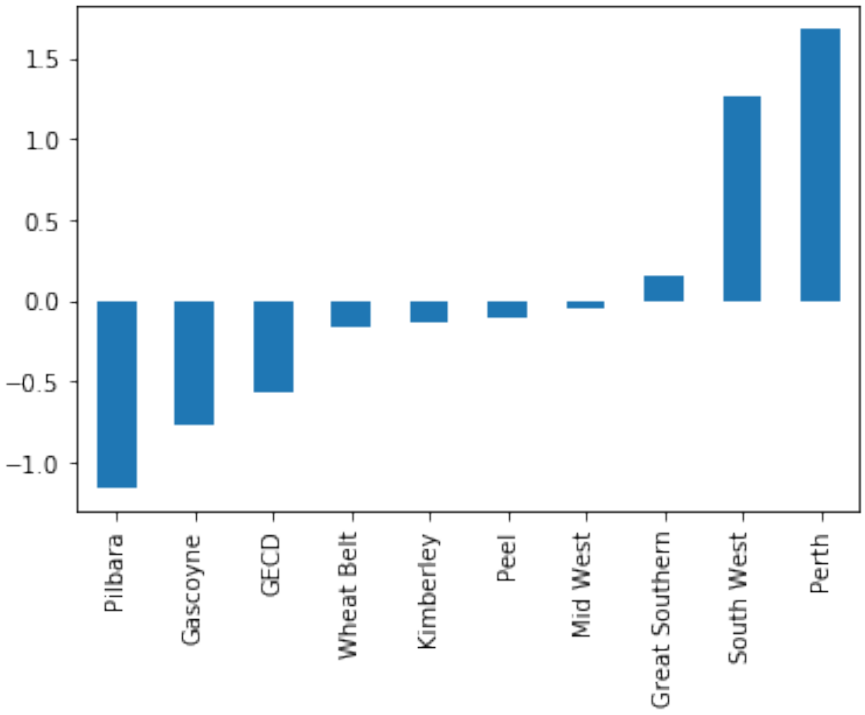
Figure 16: ECI Based on Exports, WA Regions (2016)



Source: Own construction based on ABS and COMTRADE

Figure 17: COI Based on Employment (2016) (top) and Exports (2019) (bottom), Regions



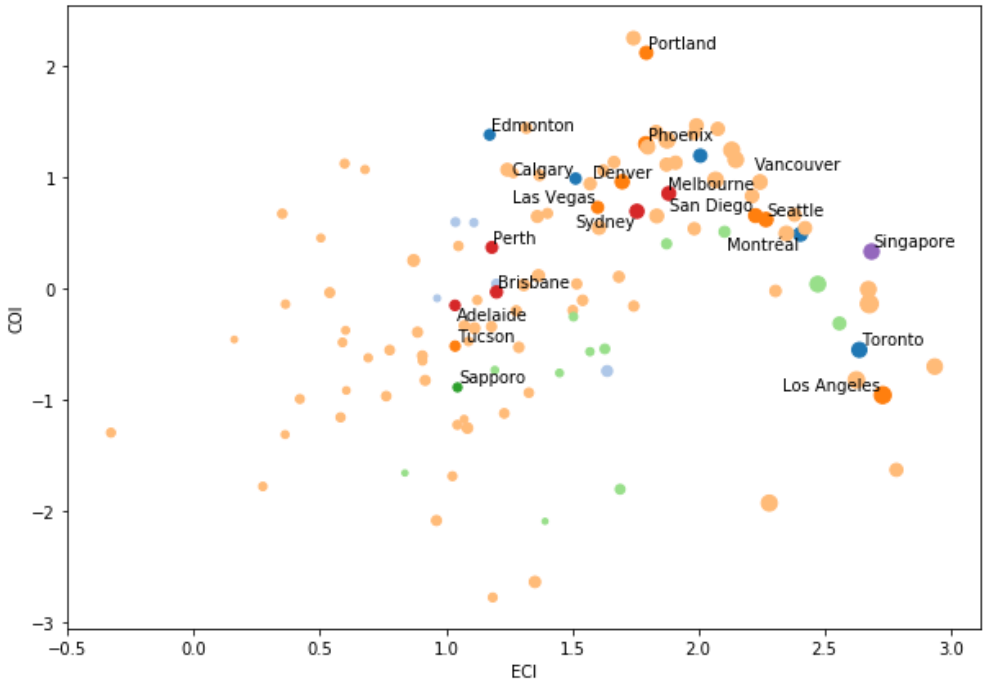


Source: Own construction based on D&B, ABS and COMTRADE

While the above analysis is useful for comparing Perth's economic structure with other regions of the state, it does not yield insights of Perth in comparison to other global cities. However, this perspective can be gained by through extending the employment analysis based on D&B data to other cities in the world. Compared to global cities, Perth is reasonably complex overall. It has somewhat low complexity for its size, but its complexity outlook index is more encouraging. As shown in Figure 18, Perth skews towards the lower-middle part of the ECI distribution among cities from peer states. Importantly, its ECI is very similar to a number of cities it outperforms in terms of diversity and average ubiquity (not shown), such as Adelaide, Brisbane, Tucson, and Sapporo. This indicates that while Perth may engage in a wider variety of activities, and those activities may be less common, it is specialized in somewhat low-complexity employment. More encouragingly, Perth's COI is more towards the middle of the distribution for its level of ECI.

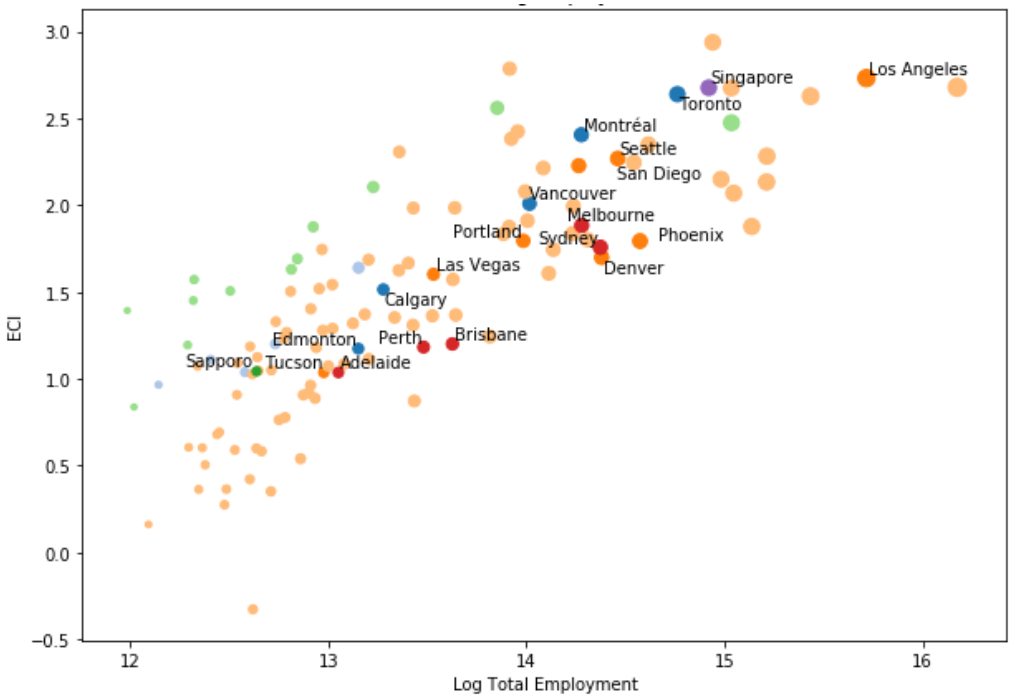
Figure 19 shows total the natural logarithm ("log") of employment versus ECI, to give a sense of how the sheer size of a city comes into play. While there is an obvious positive relationship between larger total employment and higher ECI, there is also a lot of variation in ECI at each size. Perth skews towards the bottom of the ECI distribution versus cities of a similar size, suggesting that there may be paths to higher complexity that do not necessarily depend exclusively on a higher population. Interestingly, this pattern appears to hold for Australian cities in general. Perth's COI is somewhat higher compared to cities with similar total employment, as shown in Figure 20. It still, however, is geared towards the lower-middle of similarly sized cities. Overall, this suggests that Perth has some latent potential to increase its complexity.

Figure 18: ECI vs. COI for Global Cities, Size by Population, Color by Country (2019)



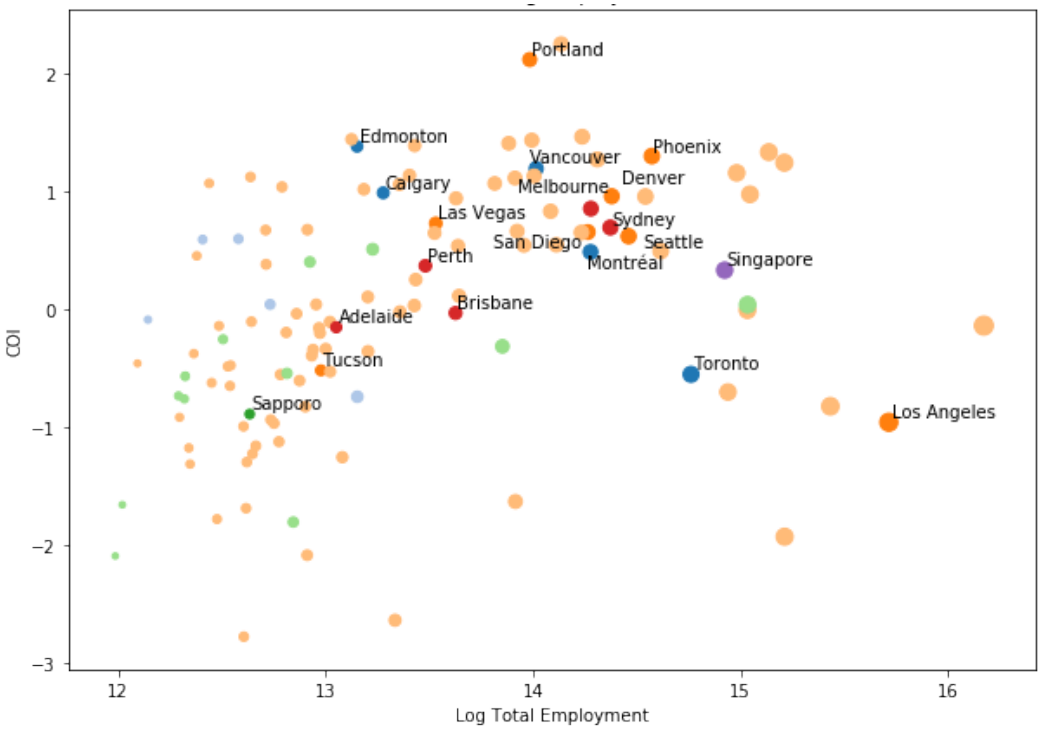
Source: Own construction based on D&B

Figure 19: Employment (log) vs. ECI for Global Cities, Size by Population, Color by Country (2019)



Source: Own construction based on D&B

Figure 20: Employment (log) vs. COI for Global Cities, Size by Population, Color by Country (2019)



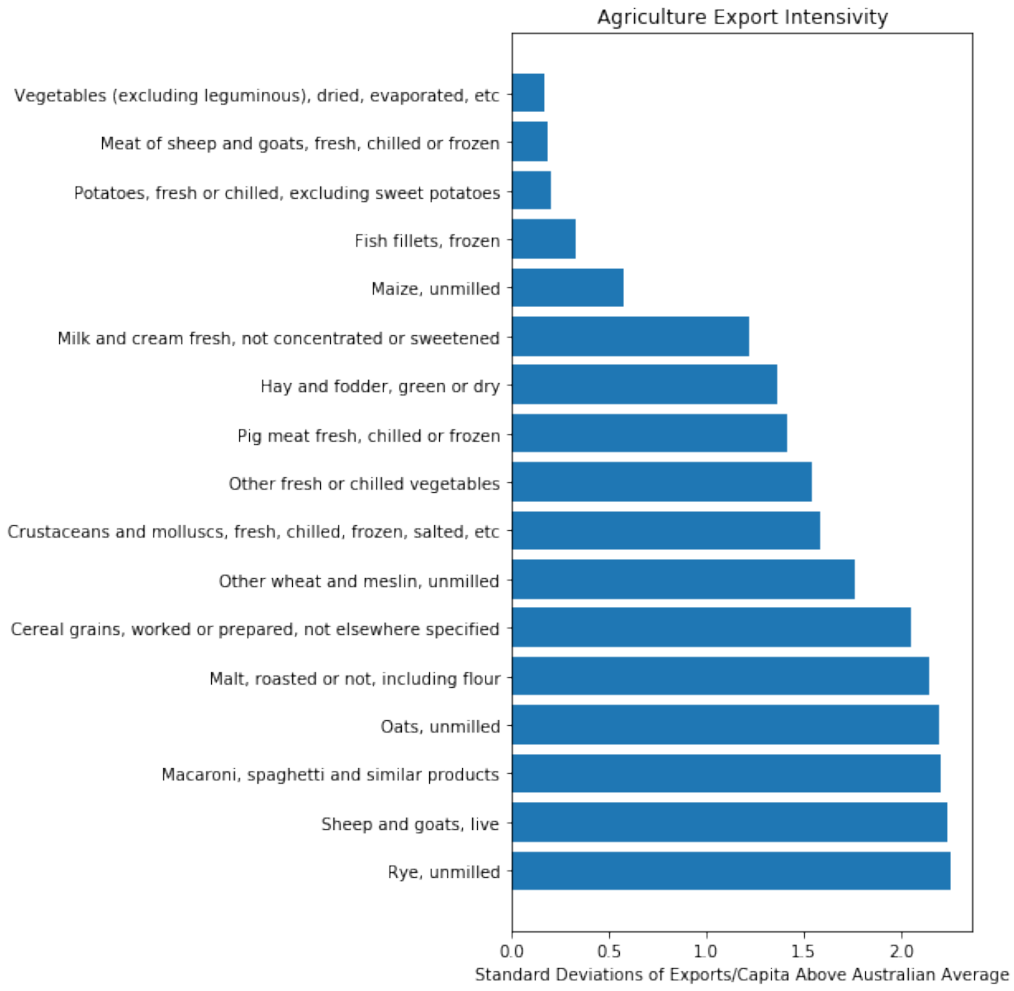
Source: Own construction based on D&B

4.5 WA's Nascent Capabilities in Key Sectors

Despite Western Australia's low Economic Complexity, it appears to have nascent capabilities in key sectors. In some cases, WA's agricultural exports per capita are substantially higher than what is found in other Australian states (Figure 21). Examples include milk, pork, vegetables, cereal grains, and sheep. Although these agricultural exports outside of wheat are dwarfed in size by the mining economy, it is clear that WA has comparative advantages across a range of agricultural activities versus elsewhere in Australia.

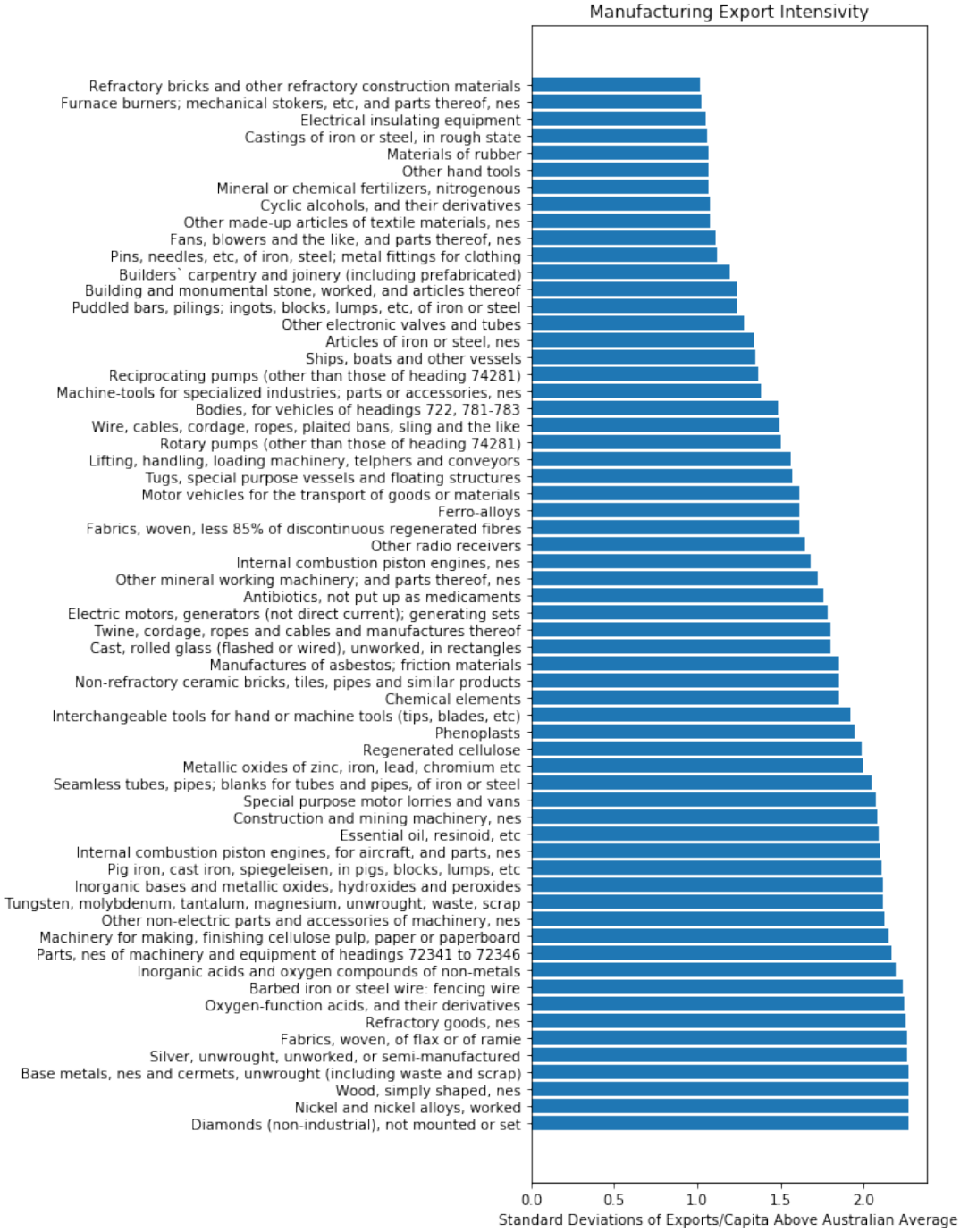
Western Australia's per capita manufacturing exports also, in many cases, substantially exceed levels found in other Australian states (Figure *22*). While many of these industries are relatively small in terms of their volumes, their presence may be encouraging for future diversification efforts, since the list reflects a wide range of established capabilities to produce manufactured goods in at least some locations in the state.

Figure 21: WA Agricultural Exports Above Australian Per Capita Average (2016)



Source: Own construction based on ABS and COMTRADE

Figure 22: WA Manufacturing Exports Above Australian Per Capita Average (2016)



Source: Own construction based on ABS and COMTRADE

4.6 Identification and Evaluation of Diversification Opportunities

The resources developed above can be deployed to understand existing and latent areas of comparative advantage that build on the knowhow, skills and capacities that are already available in Western Australia. Given the relatively small size of the state population and its exposure to sector-specific external shocks, it makes sense to focus efforts on export growth and diversification. All things equal, industries that serve both the domestic and external markets have more potential to grow independently of what happens with WA's mining sector. While the export-based approach necessarily focuses on tradable goods, the employment-based approach can deliberately filter out non-tradable industries. Once the tradable pool of industries is identified, it is possible to consider export growth along two dimensions: the intensive margin, where existing industries can be scaled up; and the extensive margin, where new or nascent industries can be entered. Industries to be targeted on the intensive margin are taken from the pool of industries where RCA is greater than one, while industries to be targeted on the extensive margin are taken from the pool of industries with an RCA less than one.

Strategic industries are selected based on economic complexity metrics – distance, PCI, and COG – in different ways for the intensive and extensive margins. Distance indicates how "nearby" an industry is to industries already present in the state; PCI measures how complex a certain industry is; and COG captures how much closer developing an industry would bring WA to other, more complex industries. All other things equal, out of two industries with the same distance and PCI, the one with a higher COG will be more strategic. While PCI and COG can be positively correlated, there tends to be a negative correlation between distance and each of these variables in places that are not highly complex. This reflects an important trade-off: the most complex industries and those with the best strategic positioning tend to be further away from existing capabilities, while less complex industries tend to be closer.

Below we simply present the results of the analysis of diversification opportunities, and we refer the reader to the *Economic Complexity Report for Western Australia* for the details of the procedure used to produce them. Ninety-seven strategic industries emerged from this analysis. These industries are sorted into five strategic groupings, which provides an initial list of opportunities to support economic diversification. These strategic groupings are the following: Primary Industries and Related; Intermediate Inputs and Materials Manufacturing; Technology and Advanced Manufacturing; Tourism; and Professional Services. Figure 23 summarized the narrower thematic sub-areas (sub-groupings) that fall under each of these, and the number of specific industries in each grouping and sub-grouping.

Figure 23: Identified Groupings and Sub-Groupings

Grouping / Sub-Grouping	# of Industries
Intermediate Inputs and Materials Manufacturing	**17**
Chemical Manufacturing	3
Metal and Metal Products Manufacturing	9
Nonmetallic Mineral Product Manufacturing	5
Primary Industries and Related	**11**
Beverage and Tobacco Product Manufacturing	2
Fishing	3
Food Manufacturing	2
Fruit and Tree Nut Farming	2
Wood Product Manufacturing	2
Professional Services	**19**
Consulting and Research Services	5
Engineering and Architectural Services	4
IT Services	5
Legal Services	2
Specialized Design Services	3
Technology and Advanced Manufacturing	**30**
Computer and Electronic Product Manufacturing	9
Health Product Manufacturing	2
Machinery Manufacturing	13
Transportation Equipment Manufacturing	6
Tourism	**20**
Educational Services	5
Food and Transportation	9
Health Services	6

Source: Own construction

Having identified several key economic activities in which WA may be able to diversify its economy, it is useful to quantify the strategic opportunity they offer in more depth and the role individual regions could play in a state-wide strategy. In particular, it can be useful to evaluate how viable and how attractive each diversification opportunity is and how they fit with each region's current base of productive knowhow. The objective here is two-fold: (i) to offer an initial analysis of relevant preliminary viability and attractiveness factors that are informed by Western Australia's comparative advantages and disadvantages, features of the labor market, and geography; and (ii) introduce useful information that could be used to explore opportunities and challenges of pursuing a state-wide diversification strategy with a substantial footprint across all regions.

Below we describe and quantify several factors that could provide practical insights for further evaluating the viability and attractiveness of the industry opportunities identified based on complexity variables. These are based on observations of WA's factors of productivity and known differences between industries, but this list could be greatly enhanced by incorporating strategic priorities, existing capabilities, and other concrete constraints in the state. The viability factors aim to capture indicators that the industry is likely to thrive in the state (or a specific region in question), while the attractiveness factors aim to quantify ways in which some industries may be more desirable to the state for the benefits that they would be likely to provide.

The *viability factors* proposed are the following:

- **Current presence in WA:** Industries that have already achieved some scale in WA, even if with RCA<1, are likely to be easier to develop further, and furthermore can be investigated to ascertain the barriers to their expansion. The existing presence of an industry can be measured with RCA is therefore used again here as a viability factor.
- **Current presence in peer states:** If an industry has been developed successfully in similar contexts, it is likely to be relatively easier for WA to develop as well. A high presence in peer states does not guarantee the success of the industry in WA, but it should make it more likely. The average RCA in peer states is used to measure this factor.
- **Dependency on utilities:** Preliminary analysis carried out by the Growth Lab team identifies water and electricity may be scarce factors in WA, and particularly in several regions of the state. Industries that are not intensive in these utilities may therefore be more viable. To get an indication of this factor, the percentages of intermediate consumption from water and electricity in each industry is tabulated based on data from the US Input-Output Tables. Similarly, the dependency on other missing key inputs could be considered in further iterations.
- **Ability to access occupational inputs***:* Developing a new industry requires access to a labor market that can support it. To measure performance in this variable, the scheme considers the number of occupations estimated to be (i) intensively required by the industry in question, and (ii) are (implicitly) missing or not accessible in the state. Of course, if certain types of workers are not available at present, they may migrate to the state to fill these jobs or workers with similar skill sets may be retrained. But, all things equal, industries that closely match the current occupational vector will be more viable.
- **Ability to access intermediate inputs:** A crucial element for the development of any productive activity is the ability to access the non-labor inputs it requires. To measure performance on this variable, the scheme considers the number of inputs estimated to be (i) intensively required by the industry in question, and (ii) (implicitly) missing or not accessible in the state. It assumes that if other activities that demand the same inputs have a significant presence in WA, then it is likely that the new industry will also be able to

access them. WA can also import some of the inputs that are not currently available. But, again, all things equal, industries where inputs are currently available will be more viable.

The *attractiveness factors* proposed are the following:

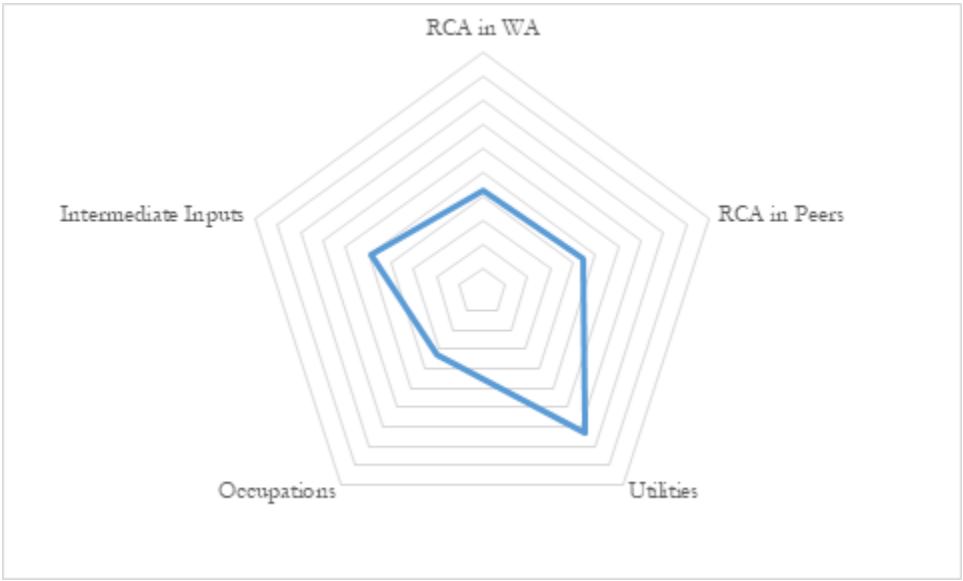
- **Ability to pay high salaries:** Attracting industries that pay high wages would be beneficial for Western Australian workers. To this end, the wage that each industry pays relative to the average of the rest of the U.S. economy is calculated using information from the Bureau of Labor Statistics (BLS).
- **Ability to translate into an export activity:** Given the small size of the state population and the non-tradable economy's vulnerability to the boom-bust cycle and external shocks, it makes sense to focus efforts on export growth and diversification. All things equal, industries that serve both the domestic and external markets have more potential to grow independently of what happens with WA's mining sector. This is partially accounted for earlier in the analysis but can be further explored here. The scheme thus considers each industry's propensity to export by observing percentages of worldwide employment in each industry that is concentrated in exporting firms, which is calculated using data from Dun & Bradstreet.
- **Global FDI flows:** Foreign Direct Investment (FDI) can have multiple benefits, including a high degree of knowledge spillovers. This alone makes industries with high rates of FDI more attractive. The relative size of FDI flows globally is also a useful proxy for global demand for the industry, as FDI is responding to an expectation of growing demand. This factor is measured according to the total value of the FDI that worldwide has gone to each diversification opportunity in recent years (2003-2015). Data from fDi Markets is used to construct this measure.
- **Knowledge-intensive FDI flows:** FDI is especially useful if it directly fosters the development of new capabilities in the investment destination. We therefore include a measure that is similar to the previous FDI metric, but only considers FDI flows that involved setting up an office in the investment destination, engagement in R&D activities, or engagement in design, development, and testing activities.
- **Ability to thrive in remote places:** WA is a remote state with many very remote regions. For some industries, remoteness can be a limiting factor (for example, if transportation costs are high or if close geographical proximity to other industries). Therefore, industries that are generally able to succeed in remote places may be more attractive for state-level policymakers. We estimate this ability by calculating a "remoteness coefficient," which is a statistical association between industry RCAs and the remoteness of places to population centers using D&B information at a U.S. county level. Note that this may be considered an attractiveness feature at the state level (out of a desire to develop industries that can succeed

in regions) but would become a key viability factor if a similar analysis were conducted for a remote region.

After normalizing these variables, it is possible to visualize how potential diversification opportunities score on them. As an example, Figure *24* and Figure *25* show the performance of the industry "Electromedical and Electrotherapeutic Apparatus Manufacturing" in the various viability and attractiveness factors, respectively. On the one hand, electromedical device manufacturing is relatively consistent with WA's utility costs. However, the low RCA of WA and peers in electromedical device manufacturing suggests that some capabilities and comparative advantages may not be well-supplied. In terms of attractiveness, electromedical device manufacturing scores fairly well on the wages, remoteness, and FDI knowledge factors, and very highly on the export factor.

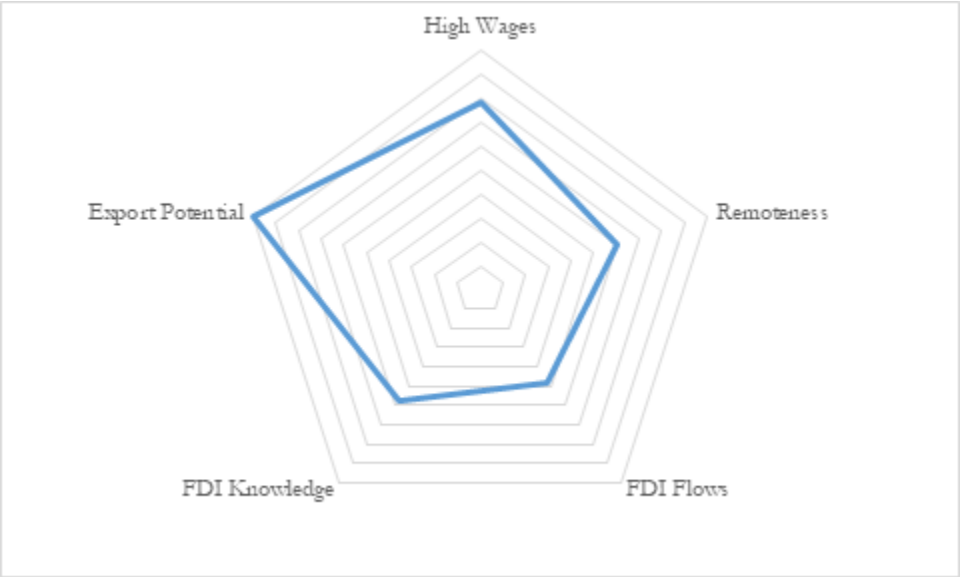
Systematically repeating this exercise across all potential industries, may inform the strategic prioritization of these potential industries. However, as previously stated, the value of this approach could be greatly enhanced by considering other context specific variables, current capabilities and strategic priorities. The full data necessary to perform these visualizations, along with more analysis exploring industry matches to regions within WA, is presented in the *Economic Complexity Report*.

Figure 24: Viability Factors, Normalized Values – Electromedical Device Manufacturing



Source: Own construction based on Dun & Bradstreet and U.S. Input-Output Table

Figure 25: Attractiveness Factors, Normalized Values – Electromedical Device Manufacturing



Source: Own construction based on Dun & Bradstreet, U.S. BLS and fDi Markets

5. Growth Perspective – Main Findings

Since the late nineteenth century, the mining sector has played a major role in shaping WA's economy and its development (Department of the Treasury and Finance, 2004). The discovery of gold in Halls Creek (1885) and Mt. Charlotte (1893) attracted a large amount of investment in mining ventures and triggered the arrival of thousands of immigrants from other colonies and parts of the world. Between 1890 and the early 1900s, the population grew four-fold (ABS, 2004). The Gold Rush also triggered unparalleled levels of public infrastructure expenditure in order to facilitate the expansion of the mining activity (i.e. Fremantle Port) and enable access to key infrastructure in remote regions (i.e. Goldfields Water Pipeline). However, after two decades of unprecedented growth, WA's economy struggled to manage the concurrent end of the gold mining boom and major external shocks (First World War, Spanish Flu Pandemic, Great Depression, etc.). In the absence of equally productive alternative engines of growth, GSP per capita levels observed in 1913 were not attained again until the 1950s (Snooks, 1981). Unlike other regional economies around the world such as those on the west coast of North America that were able to complement mining with other new sources of growth such as the aviation industry, the global film industry, technological innovation, and thriving tourism, WA's economy continued to be built largely on new waves of mining and extractive industries — chiefly iron ore, liquified natural gas (LNG), petroleum, gold, alumina, and nickel — and efficiency improvements in the production of other primary goods, including agriculture and fishing. While this did not prevent WA from growing to achieve a high level of income and living standards, it made workers and firms more vulnerable to negative external shocks.

For the last two decades, mining industry trends have continued to drive WA's economic trajectory. While the world experienced an extended period of high global commodity prices throughout 2002-2014, known as the "global commodity supercycle", WA experienced a surge in investment as mining operations expanded capacity to keep pace with growing global demand. WA's average growth rate of 3.1% per capita per year in real terms over this period (Figure 26) was mainly driven by this investment, which grew on average by 11.1% per year (Figure 27). This investment led to more jobs and rising wages across various sectors of the economy, which supported strong growth in household consumption (4.9% CAGR). During 2002-2012 in particular, 18% of all new jobs in Australia were created in WA — an outsized effect given that WA accounts for approximately 11% of Australia's population — and annual real wage growth was as high as 5% in 2012. Real household disposable income grew by an average of 7% per year over 2002-2012 (OECD). This was above and beyond a statewide increase in the cost of living as prices rose and the Australian Dollar appreciated, which translated into an additional boost to consumption and real estate prices. In some places, these trends were unsustainable. Interviewees in Karratha described the severe shortage of housing during the boom: prices increased rapidly as workers slept in makeshift places due to a shortage places to rent. This led to an expansion of the expensive housing stock, with high construction costs driven by expensive labor and materials.

Figure 26: Compound Annual Growth Rates of Real GSP Per Capita, WA vs. AUS

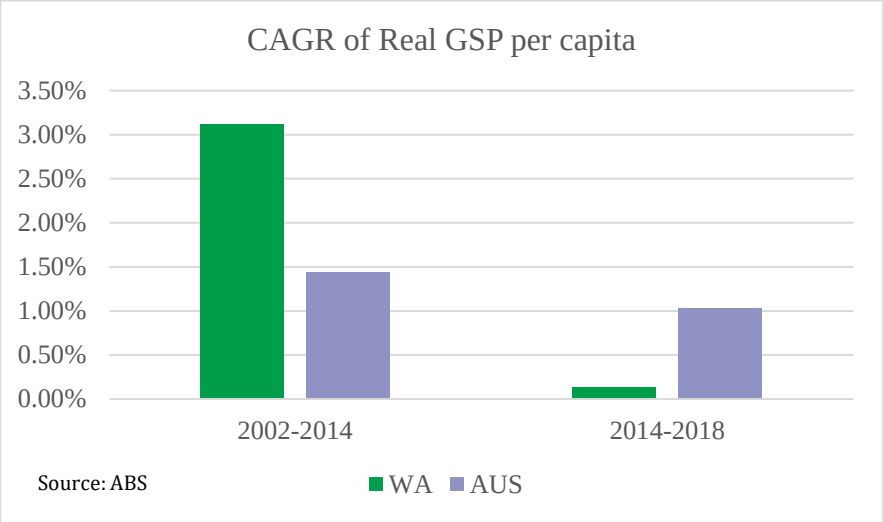
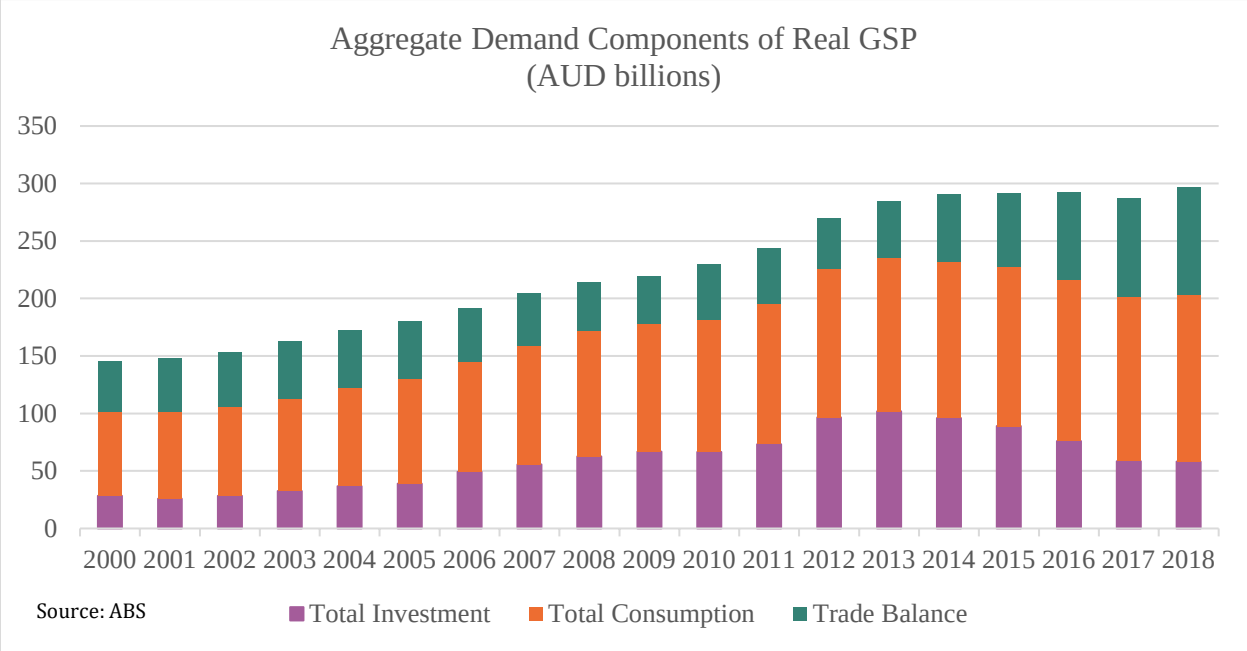


Figure 27: GSP Decomposed by Components of Aggregate Demand (2000-18)



From 2012-2014, investment leveled off, but net exports jumped. As mining output expanded at still high global prices, WA continued to witness economic growth until 2014, when a fall in global commodity prices triggered a fall in WA's economic growth for the next four years, with an absolute fall in real GSP in 2016/17. Mining exports, particularly for iron ore, remained high but at reduced prices. Iron ore alone accounted for more than half of WA's goods exports in 2016, and roughly half of all Australian mining jobs were still in WA in 2019. However, without other sources of growth, a large gap was left in WA's economy.

The sharp slowdown in investment that began in 2014 drove lower per capita growth and accelerated labor market dislocations. Sixteen of the eighteen major industrial sectors displayed a lower growth rate in 2013-2018 than they did in the previous five-year period. This was particularly acute in mining, which contracted on average 5.9% (Curtin, 2019). In parallel, wage growth stagnated, seasonally-adjusted unemployment rose above 5% and reached above 6% in 2018, and labor underutilization simultaneously rose to over 15% — levels that WA had not experienced in decades and from which it has not yet fully recovered from even today (Figure 28). Moreover, as their income fell or stagnated, households exercised restraint and discretionary consumption per capita contracted. Similarly, real estate prices fell statewide (including by 8% in Perth), leading to a rate of mortgage delinquencies of nearly 2.5% in 2019 — far above the national average of approximately 1% — and the approval of new dwellings fell by more than 50% between 2013 and 2019. Anecdotal evidence from regional WA described a soft housing market that suffered because the collapse of prices left many residential properties worth less than the cost to construct them. Some regions and occupations were especially hard hit by the changing labor market and subsequent contraction. The downturn was deepest in Perth, the Southwest, and Kimberley, which all had lower real per capita incomes in 2018 than they did in 2014 (Figure 29). Meanwhile, even as real per capita growth remained high in the Pilbara and Gascoyne, regional employment levels shrank.

Economic diversification could have helped buffer the contraction and the job losses experienced by WA workers, absorbing excess capacity, repurposing existing skills and laying the groundwork for a post-boom recovery. However, just as it has been the case in the past, economic diversification failed to take root in WA over the course of the commodity supercycle. A handful of companies shared examples of developing complex capabilities over time by buying unique machinery, learning new ways of using old infrastructure, and innovating within the current value chain. However, this was mostly concentrated in process improvements to output in the mining sector and was less evident during the slowdown.

As discussed in the *Economic Complexity Report for Western Australia*, WA began and ended the 2008-2016 period with a low number of exported products in which it expressed a revealed comparative advantage.[8] It added only three new products to its export basket in this time frame, which in 2016 collectively accounted for approximately 1% of the value of its goods exports. In contrast, Victoria added 76 new products to its export basket over the same period. Similarly, when considering gross value added (GVA) composition, the WA economy is now more concentrated — both in absolute and relative terms — than it has been in the past 25 years (Curtin, 2019). On

[8] Growth Lab, Center for International Development at Harvard University. *Economic Complexity Report for Western Australia*, March 2020.

the whole, WA persistently exhibits low economic complexity and low complexity outlook, and thus requires a strategic approach to overcome diversification challenges

Figure 28: Unemployment and Underutilization Rates in WA and Australia Overall

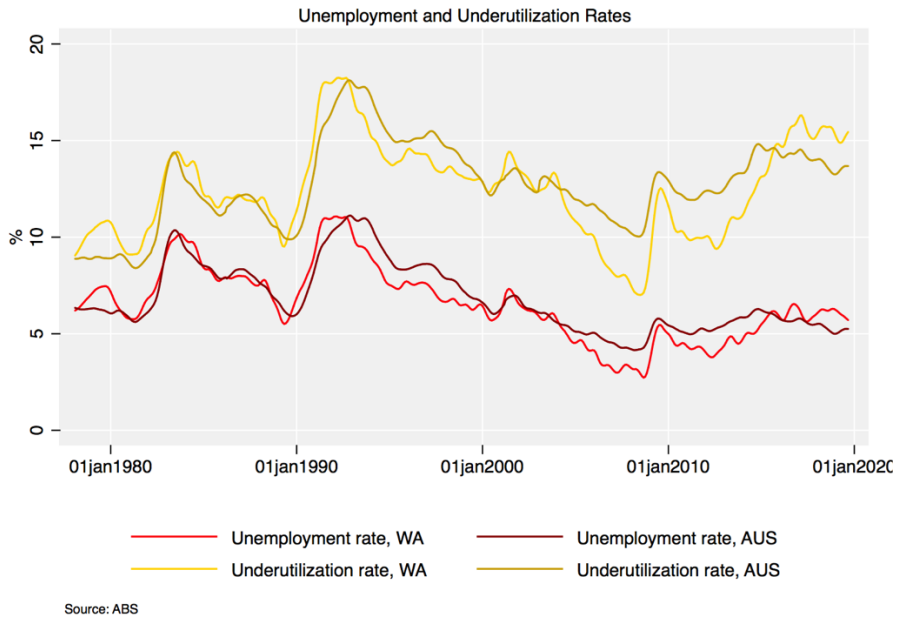
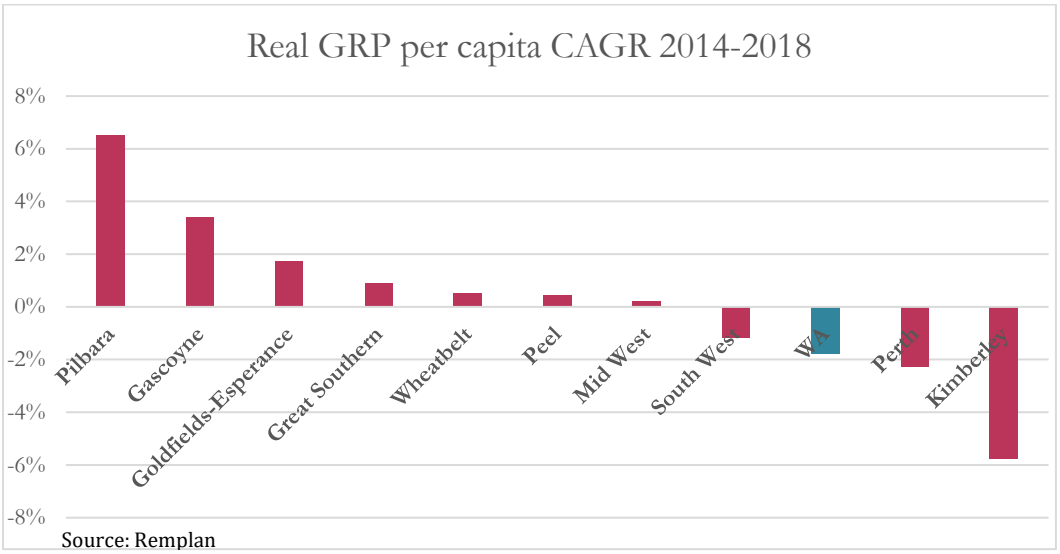


Figure 29: Real Per Capita Growth Rates by Region (2014-18)



Even though WA's recent growth trajectory has significantly outperformed the rest of Australia in terms of GSP per capita growth, its trend has been more volatile. Thus, its trajectory has potentially been suboptimal in three complementary ways. First, it built up economic pressures that led to sharp corrective forces in the form of job losses, underutilization, wage stagnation, and other abrupt market adjustments at the end of the commodity supercycle. Second, its recovery

performance hinges on a factor — high levels of new investment in the mining sector and related industries — that is heavily influenced by exogenous variables. Third, it failed to create the economic robustness that could have shielded against those forces. In combination, these trends resulted in an economic recession that had serious consequences across a variety of WA locations and industries. Importantly, this was to some degree an avoidable outcome. Natural resource economies are notoriously volatile and difficult to manage, but there are policy mechanisms that have been developed in other national and regional circumstances to manage this volatility by focusing on "internalizing externalities" of mining-driven growth. The next sections will discuss key externalities that persist in WA.

5.1 Labor Market Imbalances

The costs of WA's undiversified growth are ultimately felt by workers, who are at a heightened risk of experiencing job loss and wage stagnation when exogenous factors dampen either new investment in the mining sector or global demand for relevant commodities. The patterns of the recent slowdown not only exemplify this, but also signal how two externalities — high wage levels as a barrier to the development of new industries and a systemic spread of labor market vulnerabilities — that emanate from the growth trajectory in one sector play a larger role in the rest of the economy. The first externality refers to the way other tradeable industries and potential diversification opportunities in WA face barriers to global competitiveness as a result of the high-wage equilibrium driven by the heightened labor demand in mining and construction during the boom. The second externality refers to the fact that when mining investment suddenly contracts, non-tradeable industries that had expanded to meet the rapid increase in demand also contract, resulting in job losses and wage stagnation that are actually more severe in industries far removed from mining and construction and in parts of the state far from where mining occurs.

Recent Patterns of Employment and Wage Growth

To better understand these externalities, it is useful to examine the economic forces that drove labor market imbalances during the most recent boom and slowdown phases. A simple but illuminating approach is to analyze the pattern of employment growth and contraction in terms of labor supply and demand, since bottlenecks to healthy equilibria in the labor market may point towards relevant constraints. During the boom years of the commodity supercycle, labor demand grew at a very fast pace that translated to a rapid acceleration in wage growth starting in 2006. By 2007, WA became the Australian state with the highest relative wages, a fact that remains to this day. The wage premium paid in WA versus the rest of Australia has been attributed to many causes, but empirically speaking, it reflects a pattern in which labor demand growth was not fully met by labor supply growth during the boom years.

The existing labor supply responded to new job opportunities during the boom period, evidenced by rising employment and labor force participation rates, and unemployment rates that fell to

record low levels for the last three decades. Employment in the mining sector grew at a compound annual growth rate of 16.8% between 2003 and 2012, while employment in other sectors related to the mining expansion (i.e. utilities and construction) grew rapidly as well (10% and 5% CAGR, respectively). The mining expansion and its associated operations also demanded a variety of professional services (legal, engineering, accounting, etc.) which supported a CAGR of 8% for professional, scientific and technical activities. As jobs grew and wages rose, higher disposable income in the state led to increased demand for non-tradable services (including retail, restaurants, hospitality, and real estate), and hence demand for workers in these industries rose as well.

Employment grew substantially across the board. The pace of this employment growth is perhaps best captured by comparing rates of growth with the rest of Australia. WA's employment growth in utilities was 60% faster than that of the rest of the country, while mining, construction, professional services, and real estate all grew by around 30% more than the rest of the country. Overall employment growth for each of WA's regions was faster than the Australian average as well. As non-mining regions supplied workers to mining sites through the FIFO model, and as those workers spent their disposable incomes far from where they physically worked, the drivers of employment growth across regions varied.[9]

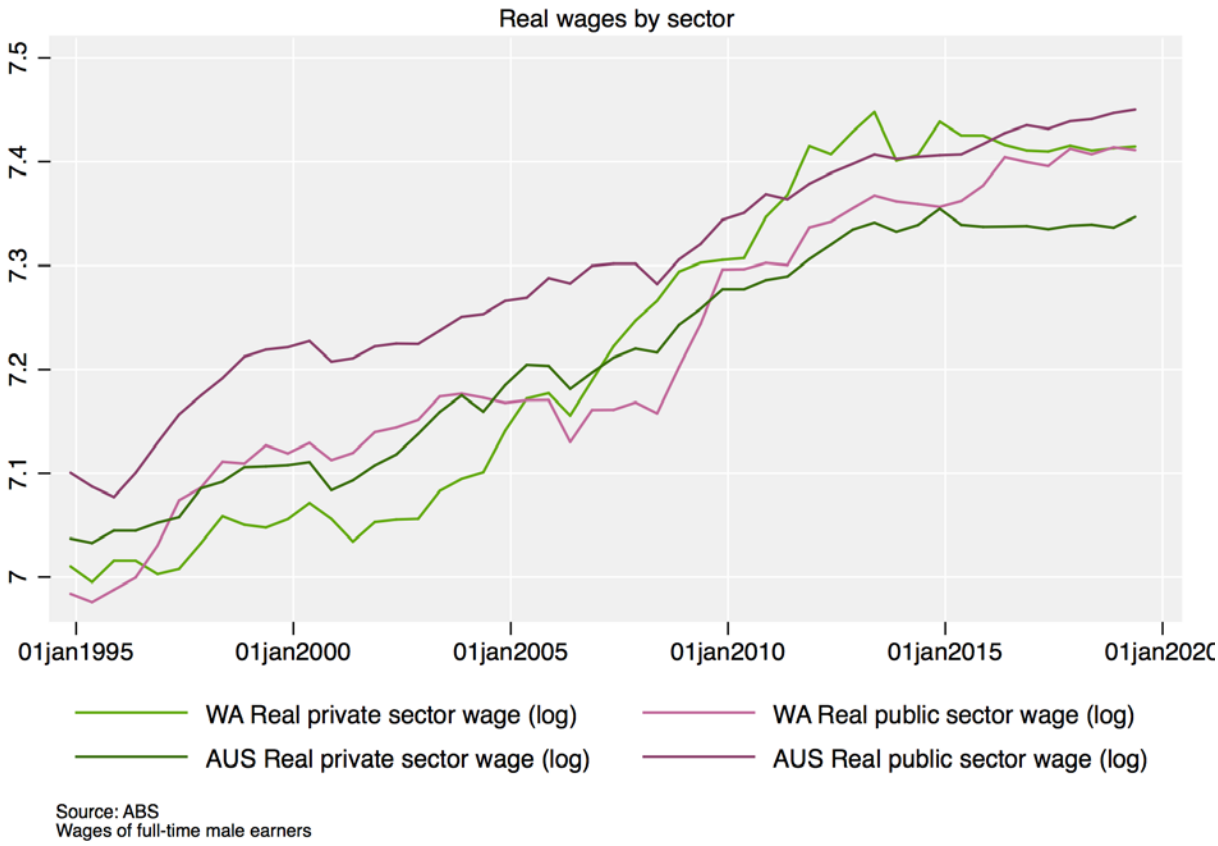
Despite this expansion in employment, sustained wage growth and rising occupation- and industry-specific wage premia show that the expansion in labor supply was not fast enough to keep pace with demand. Importantly, structural features of WA also contributed to the wage pressures, especially remoteness, lack of connectivity between regions, and cost of living pressures. The mining sector paid a wage premium of 27% in WA versus other Australian states as early as 2006, which grew to 33% in 2011. Similarly, construction in WA paid a growing premium versus other states of 13% in 2006, and then 39% in 2011. These wage premia extended to a variety of occupations related to mining operations. For example: laborers received a wage premium of 13%, technicians a premium 21%, and machinery operators a premium of 18%.[10]

Sectors unrelated to mining likewise saw large wage gains, as average real private sector wages grew broadly and public sector wage hikes were instituted in order to attract and retain employees as well as to compensate for the rising cost of living in WA (Figure 30). Regionally, these premia manifested themselves differently depending on the remoteness of the region and its population base, but it is fair to say that the wage pressures spread across the state. For example, based on qualitative evidence, wages to work in the mines were almost 60% higher than employment in heavy manufacturing in other regions. Real wage growth as of 2012 was fastest in Perth, followed

[9] For example, machinery operators and laborers each grew rapidly in the Pilbara; machinery operators and technicians grew rapidly in Peel; and professionals and managers grew rapidly in Perth.
[10] Results from an interval regression using 2011 Census data on wage brackets controlling for age group, industry, gender and educational attainment.

by Peel (especially among sales workers, technicians and managers), and the Pilbara (especially among technicians and trades workers and laborers).

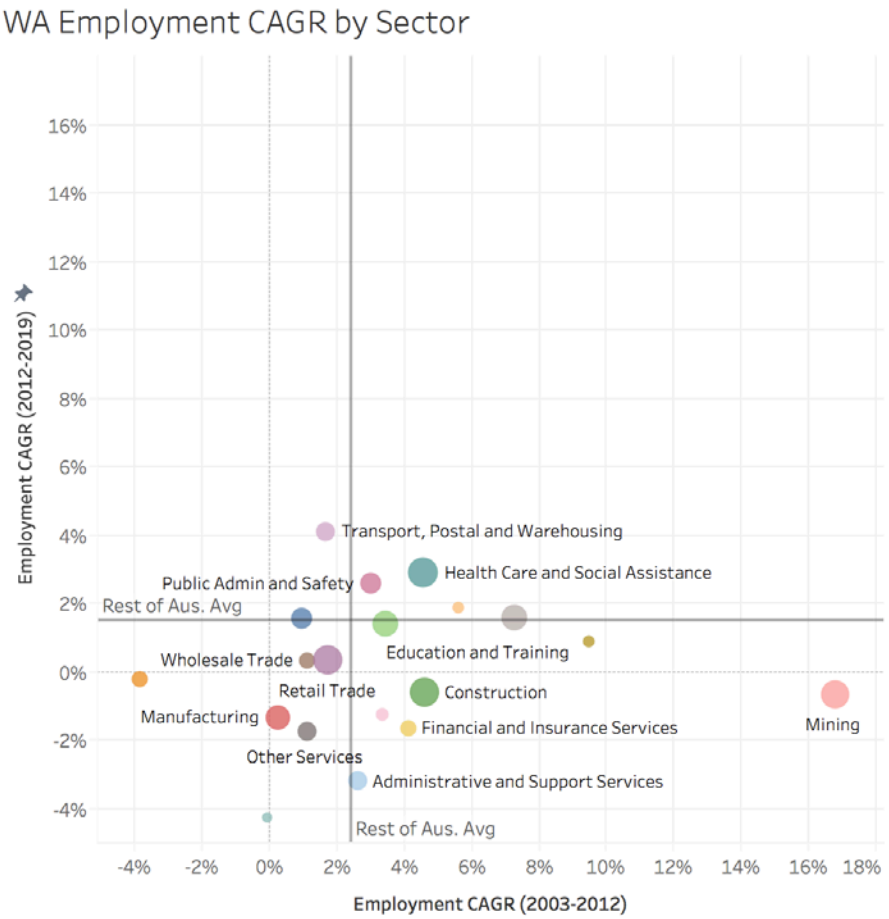
Figure 30: Public and Private Sector Real Wage Growth, WA vs. Australia (1995-2020)



Weaknesses in the labor market started as early as 2012/13, notably preceding the slowdown in GSP, but coinciding with the contraction in new business investment. Wages stagnated but were not the main source of labor market adjustment. Because wages are sticky, employers responded by cutting down either jobs or hours or both. Unemployment rose above 5% and reached 7.4% in 2018. Underutilization, which captures the involuntary reduction in work and work hours, shot up from below 10% to above 15%. Employment in mining contracted by 0.7% between 2012-2019 (CAGR); however, contractions were felt across WA's entire labor market. Nearly all sectors experienced lower job growth than the national average over this period, and many sectors experienced outright job losses (Figure *31*). The construction sector's workforce shrank by 0.7% CAGR, and rental and real estate activities shrank by 1.3% CAGR. Finance and insurance downsized its workforce by 1.6% CAGR, while administrative and support services lost jobs by 3.2% CAGR, and the small information media and telecommunications sector by 4.2% CAGR. Even beyond absolute job losses, there was a significant rise in part-time employment as opposed

to full-time employment across sectors, and this was especially prominent for finance and insurance and accommodation services. No region in WA escaped this downturn in labor market outcomes. Moreover, the skill match of the workforce was also a pressure point; businesses in regional WA described the difficulty in attracting and retaining skilled workers in sectors like manufacturing and tourism. Employment shrank in Perth, the Pilbara, the Mid West, Goldfields-Esperance, and Kimberley. Additionally, between 2012-2016, real wages contracted across regions, most notably in Goldfields-Esperance, the Mid West, Perth, and the South West, while it was less severe in the Wheatbelt.

Figure 31: WA's Employment Growth Rates During the Boom and Bust versus Australia



Source: ABS, Detailed Quarterly Labor Force

These dynamics were agnostic of the educational attainment and skills composition of the WA workforce. When compared to the rest of Australia, the educational attainment of workers in WA is not significantly different. On its own, education does not explain the observed wage premium between WA and the rest of the country. However, the observed wage premium is relatively smaller for occupations associated with higher levels of educational attainment. This might signal

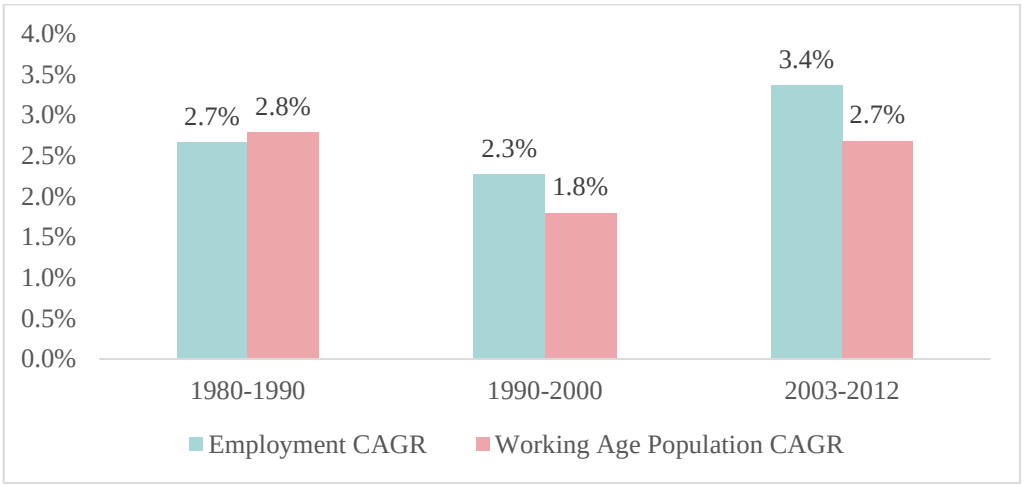
that, in the context of a mining boom, WA is better suited to meet a surge in labor demand for occupations associated with higher levels of educational attainment than it is to meet the surge in labor demand for those with lower levels. Moreover, the relative availability of a well-educated workforce will likely play a role in the feasibility of potential diversification opportunities. *Ex-ante*, given the high premia for occupations with lower levels of educational attainment, it is possible that diversification opportunities more intensive dependent on a highly-education workforce are more feasible.

Nonetheless, the unfortunate scale of job losses occurred even as the state's wage levels remained the highest in Australia. While the growth in wages was obviously beneficial to workers in these industries and occupations, it caused two interrelated problems. First, the growth in wages during the boom actively worked against the potential for more diversification into other tradeable industries, as any such industry would have to pay high WA labor costs while remaining competitive with global markets. Visits to abandoned factories in the regions illustrate how labor-intensive manufacturing (e.g. wool products, food products) could not compete with lower-cost Asian producers. Second, as the commodity supercycle reached its end and mining expansion subsided, many of the jobs gained were then lost as firms could not retain workers at such high wage levels when state final demand contracted; this was particularly true for non-tradeable industries that either served mining operations or benefitted from the multiplier effect of investments and wage growth. This raises the question of why this rapid wage growth occurred in the first place. In other words, why did labor supply not expand at the same pace as labor demand? Although some degree of wage growth was desirable and inevitable, the extreme pace of growth worsened the short-term negative outcome of widespread job losses at the end of the commodity supercycle and further hampered diversification efforts.

Factors that Influenced the Limited Labor Supply Response

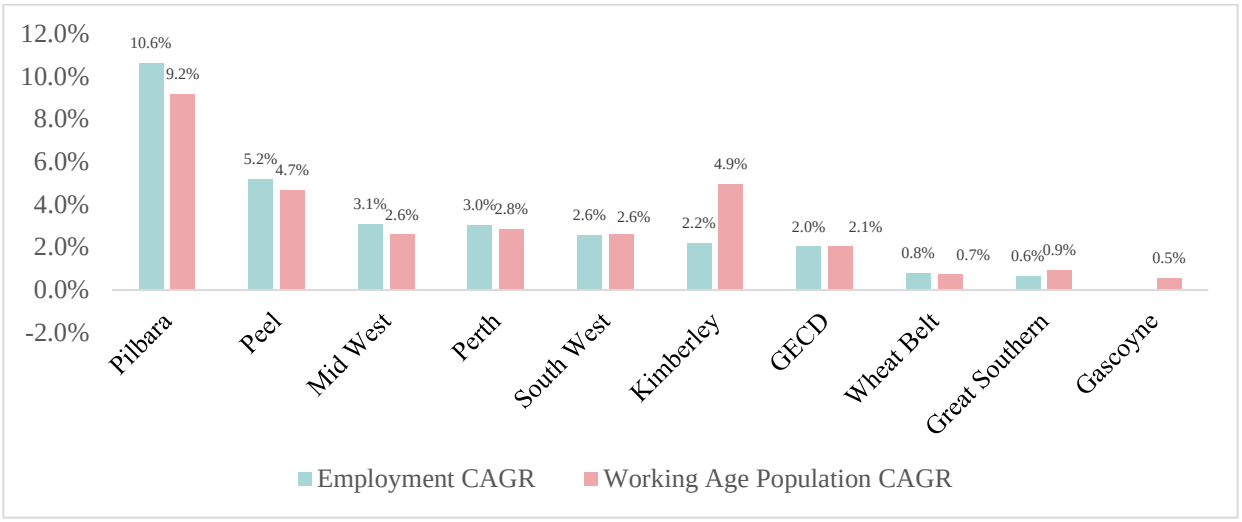
A close look at the evidence shows that the labor supply response was smaller than needed because existing channels had three problems: (i) a small population base, (ii) rigidities that limited a larger migration response, and (iii) geographical distance and a lack of connectivity. WA was not well positioned to respond to the historical expansion in labor demand because of structural misalignments. From a historical perspective, the expansion of labor demand during the commodity supercycle was dramatic, and while population growth increased significantly through immigration, it could not match the growth in labor demand (
Figure ***32***). The under-supply of labor was more dramatic in some regions than in others, especially in the Pilbara, followed by Peel, the Mid West and Perth (Figure 33). Interviews in different regions highlight the varying degrees to which regions were insulated from this dynamic: while the collapse in wage and population in the Mid West was severe, the Great Southern experienced less drastic swings.

Figure 32: Employment and Working Age Population Growth in WA by Period



Source: ABS, Labor Force

Figure 33: Employment and Working Age Population Growth in WA's Regions (2006-11)



Source: ABS Census 2011, 2006. LGA level data based on place of usual residence.

WA entered the boom period with a somewhat small population. Queensland serves as a key point of comparison here. The mining investment boom in Queensland proceeded along a very similar timeline to that in WA, and the magnitudes of the total investment received were reasonably comparable in absolute terms. In per capita terms, however, WA received much higher mining investment than Queensland, or any other Australian state for that matter (55% more in aggregate terms and 3.3 times more in per capita terms).[11] Queensland's comparatively deeper labor market left it better positioned to absorb this shock, and the subsequent volatility of its economic growth was noticeably lower than that of WA's. Since WA had a small starting population in comparison

[11] Peak-to-peak comparison

to the size of new demand, it required workers to migrate in to fill these jobs. International immigration accounted for roughly 60% of WA's net population increase between 2003-2012, while net inter-state migration supplied a much smaller share of labor (Figure 34).

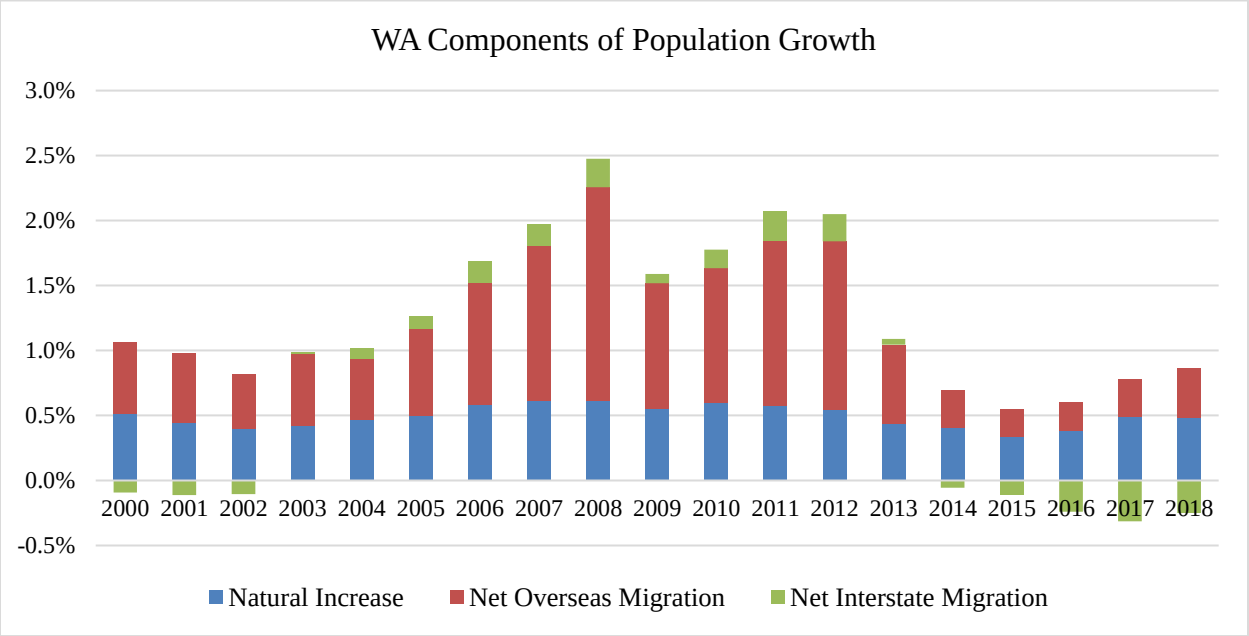
Since the state was the epicenter of the resources boom in the country, immigration was essential in meeting the heightened labor demand. WA received more than its fair share of international migration during the boom: it received roughly 20% of all permanent and temporary visas, while accounting for approximately 11% of Australia's population.[12] However, the immigration system – mostly managed at the level of the Commonwealth – was not designed to sufficiently meet the high surge in the demand for labor. International immigration was responsive to the growth in the economy, as annual international immigration to WA increased annually almost uninterruptedly until 2012;[13] however, national-level policy introduced caps and frictions on the labor supply channel (Figure 35). For example, relevant visa types can be granted only for certain occupations, determined at the level of the Commonwealth, with minor input from states. Moreover, there are certain requirements for English-language proficiency and a minimum wage level for temporary skilled visas. This is all compounded by quotas for the annual total number of visas at a national-level. The result is that national policy determines the potential for immigration to adequately respond to surges in labor demand at a state level; however, players within the state, either at an industry-level or employer-level, could take proactive steps in attracting overseas workers. Firms cited these challenges, and in addition mentioned the added risk for small and medium firms in taking on these high (direct and indirect) costs. One interviewed firm sent recruiters to the Philippines to recruit employees in-person to screen for the specific skills-requirements they needed.

Meanwhile, inter-state migration to WA, though positive, was comparatively small. Given that domestic migration is substantially less expensive than international immigration — both financially for migrants and politically for policymakers — it is surprising that it only accounted for 8% of WA's population growth during the boom. While inter-state migration is by definition a zero-sum-game between states, WA could have potentially absorbed more inter-state migrants than it received. During the commodity supercycle, WA received only 10% of all Australian inter-state migrants, while Queensland received 27% of them.

While international immigration policy at the national level limited WA's ability to attract sufficient from abroad, inter-state migration policy was passively pursued. There was a lack of concerted effort to coordinate a State-level initiative to attract Australians from the rest of the country to meet the rising labor demand in WA.

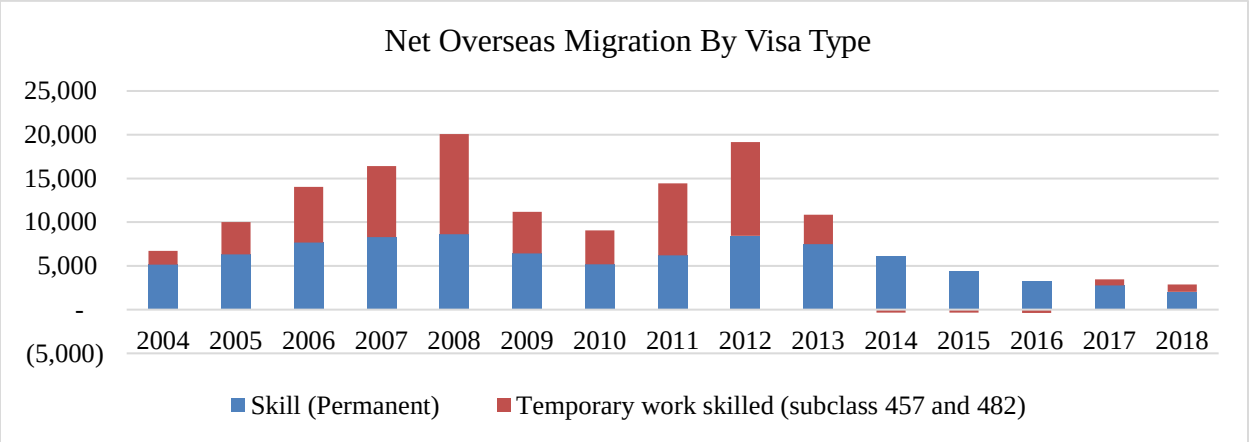
[12] Data source: ABS, Overseas Migration Data
[13] With the exception of 2008

Figure 34: WA's Population Growth Decomposed by Year (2000-18)



Source: ABS, Australian Demographic Statistics

Figure 35: Supply of Skilled Work Visas to WA by Year (2004-18)



Source: ABS, Australian Demographic Statistics

Low inter-state migration to WA may have had much to do with the third factor that likely constrained the labor supply response — that WA's dense population base in the southwestern part of the state is geographically concentrated far away from the areas with the mining investment, particularly the Pilbara. This distance amplified the disconnect between mining labor demand and the labor supply, enhance demand for FIFO workers, and further drove up wages. This distance factor likely reduces the preference of inter-state migrants to permanently move to WA. It is telling that inter-state FIFO workers made up 41% of all inter-state workers in WA. Economic reasons

and pragmatism appear to have been important motivating factors for the mining and resource sectors to establish and then expand their FIFO operations. Meanwhile, workers in the sector may choose to commute for both economic and social reasons: accessing a well-paid job while at the same time retaining family and friendship ties in their home communities. The prevalence of FIFO workers is a relevant channel of externalities, as these workers distribute both the socio-economic costs and benefits of the supercycles across numerous communities, regions, and states (McKenzie, 2011).

In terms of wages, the remoteness of non-city Australian Local Government Areas (LGAs) relative to population centers was associated with higher mining wages in 2011 and 2016, even after controlling for the total mining employment in each LGA. A basic multivariate regression also indicates that the fraction of workers earning more than $100,000 is nearly twice as high in the most remote versus the least remote LGAs. Similar effects have also been exhibited in the literature.[14]

Queensland serves as an intuitive counterfactual here, too. Not only does it have a larger population than WA, but its population is more widely distributed throughout the state and on the whole its population is more proximate to mines. That is why drive-in-drive-out (DIDO) mining work is considerably more prevalent in Queensland than WA, compared to FIFO. This geographic proximity allows mining demand in Queensland to be met more flexibly, reducing wage pressure for the broader state economy.

This relatively small response in the labor supply in comparison to the expansion of labor demand leaves the WA economy with the challenge of very high wages today. As few sustainable drivers of growth have emerged to absorb the shock of falling commodity prices, WA has suffered high underemployment and job losses, and downward adjustment of wages to readjust. At present, if WA was to experience another surge in labor demand set off by global commodity prices, the same patterns would likely reoccur. Reflections from both businesses and government institutions predict a similar cycle to repeat itself in the next mining-related investment boom in WA. In fact, it is possible that if demand coincided with a more restrictive national stance on immigration, the supply channels would be more even limited than they were in the past. Therefore, the negative externalities associated with the commodity supercycle would be even more damaging.

Thus, in order to minimize the labor externalities associated with commodity cycles, it would be beneficial to adopt labor market policies that would enhance both the baseline labor supply and the effectiveness of its response. Relevant policies that would advance this goal are discussed further in the policy recommendations section of this report.

[14] Paredes, Soto and Fleming (2017) find that extra commuting time increases wages for FIFO workers in Chile.

5.2 Pro-Cyclical Fiscal Policy

Fiscal policy in resource-rich economies follows the same broad principles as in other economies — to promote macroeconomic stability, sustainable and inclusive growth, and fiscal sustainability. The quintessential challenge for resource-based economies is how to manage the impact of volatile and uncertain resource revenues on macroeconomic and financial stability. Fiscal volatility often reflects resource revenue volatility and frequent exogenous shocks in the context of a highly concentrated export basket. When fiscal policy is unable to manage this volatility, it can have its own negative externalities on short-term job losses and pressures against long-term diversification. Forward-thinking economic planning requires counter-cyclical fiscal policy, such that the state saves resources in boom periods and spends more during slowdowns. This is particularly relevant for the mining-rich context of WA because of the importance of resource revenues. WA, however, has seen the opposite trend during the course of the boom-slowdown cycle: its state finances have, on the whole, been structurally pro-cyclical.

Recent Evolution of the Fiscal Balance

Western Australia witnessed a rapid economic expansion during the mining boom, where GSP per capita increased by almost 45% in real terms over the period 2002-2014. The state economy grew faster than Australia as a whole over this period, at an annualized rate of 3.1% per capita in real terms. This unusually long and widespread boom in commodity demand — particularly for iron ore — manifested in higher mining export profits for a prolonged period of time, and a large surge in construction and investment to expand mining capacity. While GSP (and GSP per capita) is a useful measure to compare changes in overall output, it also comes with important caveats. The dominance of the mining sector works through the primary channels of investment and exports to contribute to GSP. Therefore, the profits from the boom accrue to multinational private companies and the majority of the taxing rights to this sector reside with the Commonwealth. An alternative metric to reflect the welfare of the population is real household income. Compared to domestic and international peer states, WA's real disposable household income grew the most between 2001-2011, by over 40% (OECD).

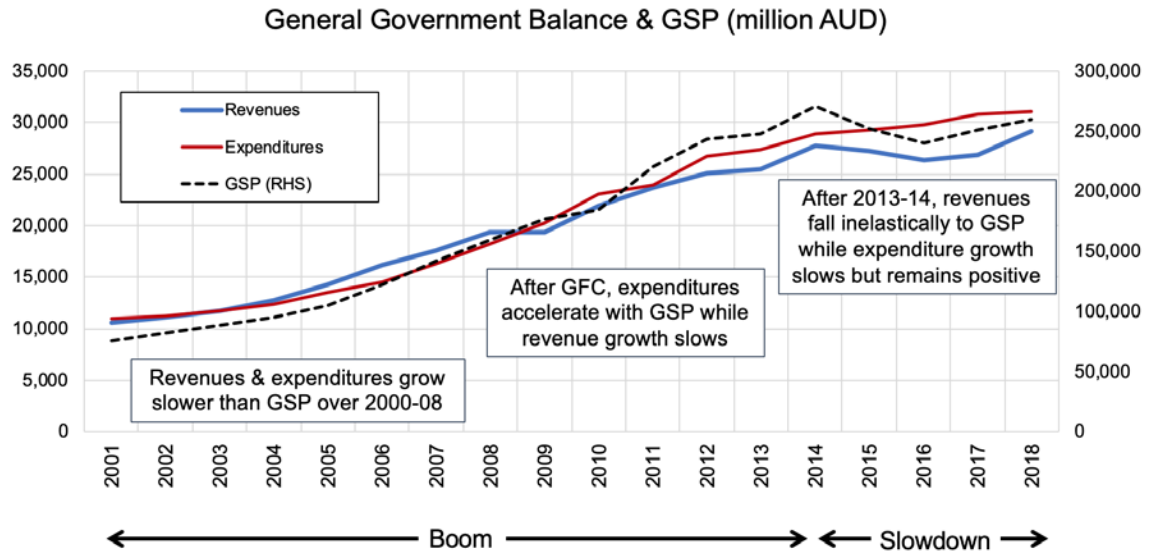
The commodity boom naturally led to a rapid expansion in state revenues. Over the first half of the boom period, from 2002-2008, government revenues grew at almost 10% per year on average, slower than GSP growth over the period of 11.8% per year on average, but a very rapid increase nonetheless. Expenditures, meanwhile, likewise grew, but did so at a slower pace than revenues (8.4% per year on average). This resulted in a modest fiscal surplus in the first half of the boom period (Figure 36). However, the 2008-2014 period saw substantially reduced revenue growth driven by stagnating non-resource revenues (6% average annual growth), while expenditures continued to grow steadily (8% average annual growth). By 2014, state expenditure was more than two-and-a-half times higher than what it was in 2002. Much of this expenditure growth was necessary to provide public services to a growing population and public goods to support

productive investments, including in remote regions of the state. Part of this also funded an expanding public wage bill and entitlement programs. Much of the State's expenditure is pre-determined by Federal mandate, inevitably decreasing the ability of WA to rapidly influence largescale spending on key infrastructure priority projects. Nonetheless, the nature of such spending increases left the state's finances more vulnerable to fiscal shocks, such as the downturn in resource revenues due to a negative commodity price shock. Spending had become sticky, and future prudence with expenditures proved, understandably, challenging. Overall, after saving a little during the first half of the commodity boom, WA incurred substantial fiscal deficits during the second half. While during the boom the state had to spend more to cater to the growing population, and faced some federal disincentives against inter-temporal savings, the state would have benefited from having access to a stabilization mechanism given the sheer scale of revenue increases over the boom period.

State revenues fell at the end of the boom, exactly when WA needed to boost fiscal spending to combat the slowdown. Royalties from mining output had grown elastically during the good years — by an average of 21% per year between 2002-2014 — but also fell elastically during the slowdown — by an average of 5% per year between 2014-2018 (Figure *37*). By 2014, royalties constituted 22% of overall revenues, the highest of any Australian state, so Western Australia was destined to face a revenue shock immediately when commodity prices fell, particularly so for iron ore. Tax revenue also fell in 2016-2017 due to lower transfer duty revenue (from commercial property transactions, as well as a soft residential property market), and lower land tax (as a result of lower land values).

Additionally, federal GST transfers to the state, though small as a share of revenues, were also a pro-cyclical contributor to state finances during the slowdown as a result of the time lag in the adjustment of the "relativity" component of the transfer formula. The horizontal fiscal equalization process presents challenges to the state's budget management due to the lagged nature of the formula to determine the payout. At the onset of the boom, GST transfers represented a significant share of total revenues, almost 24%. As the state's windfall royalties accrued, GST transfers were adjusted over time and by the downturn, the share that WA received relative to its population was the lowest in Australia. As illustrated in Figure *37*, as GSP fell during the slowdown, GST transfers fell more than proportionally. This motivated an overhaul in GST distribution and a reform to the equalization principles. The implementation of a minimum floor in the amount of transfer will bring to keel some of the pro-cyclicality in GST for WA. Now, WA will receive top-up payments to make up for some of its lost revenues, but during the slowdown, the structure was not in the state's favor. In sum, the recent reforms offer greater opportunities to pursue stabilization funds.

Figure 36: Nominal GSP, Revenues, and Expenditures during the Boom and Slowdown[15]

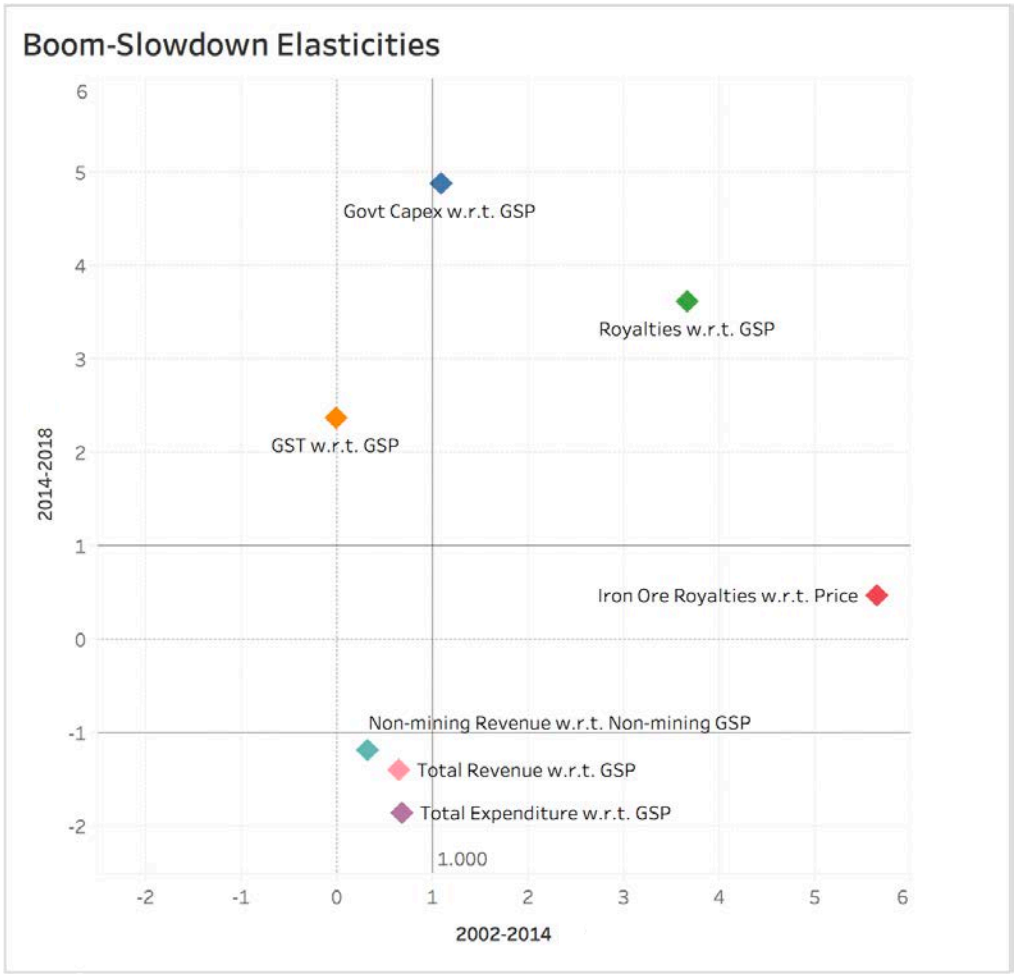


Source: ABS

While expenditure continued to grow during the slowdown, it grew at a diminished pace of 1.7% (CAGR), which meant that fiscal stimulus to support depressed demand was muted at best. Government expenditure on non-financial assets fell elastically with GSP, and operating costs also grew at a much slower rate than during the boom (Figure 37). Grants from the Commonwealth – both specific purpose payments and general-purpose grants – also fell, limiting the fiscal space to bolster the struggling economy. The non-tradable economy suffered from a sharp reduction in aggregate demand that could have been better mitigated by counter-cyclical fiscal policy. Additional detail on the challenges that WA has faced in terms of its non-resource fiscal sustainability are provided in Box A.

[15] Overall Fiscal Balance is calculated as net operating balance less general government gross fixed capital formation.

Figure 37: Select Elasticities of Relevance to Fiscal Balances[16] (2002-18)[17]



Source: ABS and DMIRS

[16] Elasticities are calculated as a ratio of percentage changes. For example, Royalties w.r.t. GSP represents the percentage change in royalty revenues relative to the percentage change in GSP between 2002-2014 on the horizontal axis, and the percentage change in royalty revenues relative to the percentage change in GSP between 2014-2018 on the vertical axis.

[17] "W.R.T." denotes "with respect to."

Box A: Non-resource fiscal sustainability

Fiscal policy in resource-rich economies is crucial in allocating revenue from resource exports into the domestic economy. Exogeneous commodity shocks have a significant impact on fiscal sustainability due to the heavy dependence of state revenues on the mining sector. Therefore, the non-resource balance (NRB) and non-resource gross state product (NRGSP) are particularly important indicators to take into consideration to smooth fiscal volatility and for short-, medium-, and long-term macroeconomic management. The NRB is the estimated difference between non-resource revenues and non-resource expenditures.

In Western Australia, as in other resource intensive economies, fiscal planning and overall output is closely tied to the performance of the mining sector. At the onset of the commodity boom, royalties comprised 6% of total revenues, and the state relied mostly on grants and subsidies, and tax revenues. With the boom in iron ore extraction, the state's revenue composition shifted, and royalties came to constitute 22% of total revenues (**Figure A1**). Royalties from mining activities are largely concentrated in iron ore, and, to a lesser extent, LNG, which is primarily routed through North West Shelf grants from the Commonwealth (**Figure A2**). WA's royalty legislation is almost 40 years old, and the fiscal volatility associated with resource booms is a decades-long phenomenon.

Government expenditures evolved pro-cyclically with the boom in resource revenues. Towards the end of the boom years (2008-2014), public investment and recurrent spending grew faster than revenues. The overall fiscal balance went into a deficit, which continued to worsen through later years of the boom and into the growth slowdown. Fiscal policy should consider the volatility and uncertainty of resource revenues, so as to smooth public finances. This volatility is a key risk affecting public finances in resource-rich economies and is unfortunately often overlooked in favor of short-term horizons of annual budgets. This exacerbates fiscal vulnerabilities to future downturns due to pro-cyclical expenditure patterns.

This is largely because the NRB becomes exposed to shocks over time. Without generating the potential for future non-resource revenue sources, WA was left overly vulnerable to the commodity price shock in 2014. The concentration of resource revenues in iron ore further deepens the correlation between iron ore prices and the fiscal balance. This unsurprisingly holds true for GSP growth as well (**Figure A3**) — high growth years are correlated with increases in the price of iron ore, while the growth slowdown corresponds with a fall in the price.

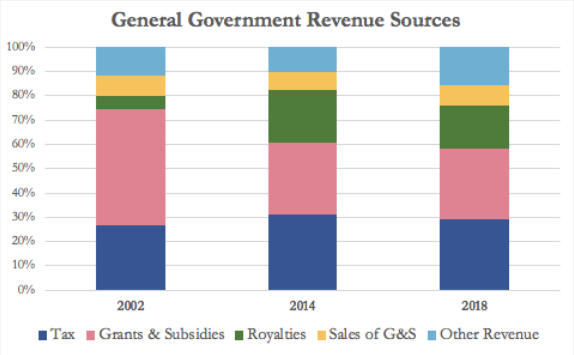
This is further illustrated when comparing the overall fiscal balance with the NRB (**Figure A4**). After 2008, while the government incurred a modest fiscal deficit (as a share of GSP), the NRB (as a share of NRGSP) was much higher: as a share of the non-mining sector, the non-resource

fiscal balance deteriorated quickly. The elasticity of non-mining revenues with respect to the non-mining GSP underscores this differential trend during the boom and slowdown years (

Figure 37). During the boom, non-mining revenues grew inelastically relative to the non-mining economy. At the same time, small changes in the price of iron ore were correlated with disproportionately larger changes in iron ore royalties. By the time of the slowdown, these royalties had become inelastic to changes in the price, and the state was able to rely on continuing resource revenue.

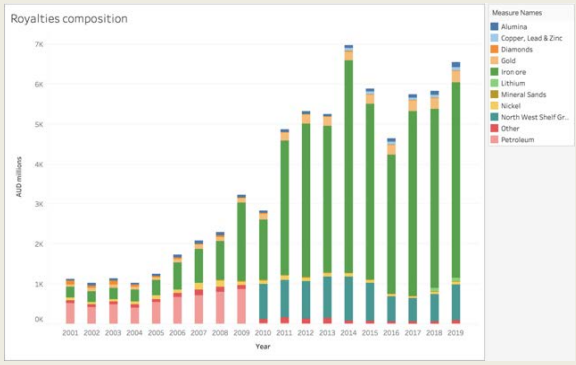
Looking ahead, this evidence strengthens the need for counter-cyclical fiscal planning and focusing on shoring up non-resource sources of revenues to ensure sustainable finances.

Figure A1: Government Revenue Sources



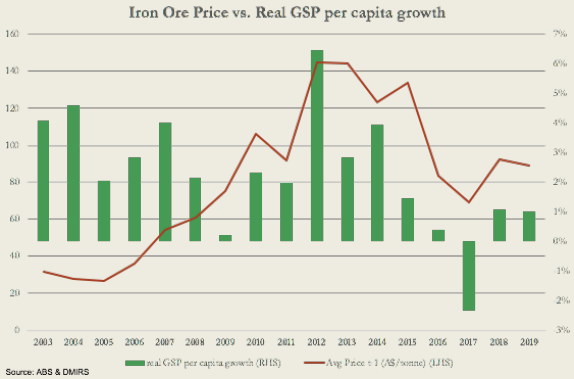
Source: ABS

Figure A2: Mining Royalties Composition



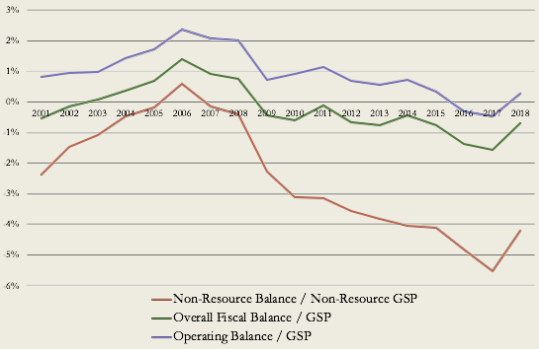
Source: DMIRS

Figure A3: Iron Ore Prices and Real GSP p.c.



Source: AB

Figure A4: Govt Fiscal Balance Measures



Source: ABS

Factors that Influenced the Pro-Cyclicality of Fiscal Policy

The fiscal response was less counter-cyclical than needed due to three factors: (i) a lack of inter-temporal smoothing mechanisms, (ii) resource earmarking, and (iii) concerns about mounting debt.

First, given that the state had incurred substantial expenditures and investments to provide public services to a growing population and public goods to support productive investments, it had not been able to save during the good times. This is a relatively common outcome for regional and national governments that lack an enforcement mechanism to save a share of revenues during boom periods in anticipation of a slowdown. It is common for regions with resource wealth to set up stabilization funds for this purpose, but WA lacked one. It is also common for states to set up intergenerational savings mechanisms including sovereign wealth funds. In this case, WA does have one, but it remains very small. During the slowdown, the Western Australia Future Fund (WAFF) was set up in 2016 for a term of 20 years, but it was too little too late. It was seeded with a nominal starting investment, and since 2016 receives only 1% of royalty inflows as top-up payments. This is far less annual capitalization than required to reach a relevant scale (and far less as a share of mining revenues than most other sovereign wealth or stabilization funds, at a state or national level).

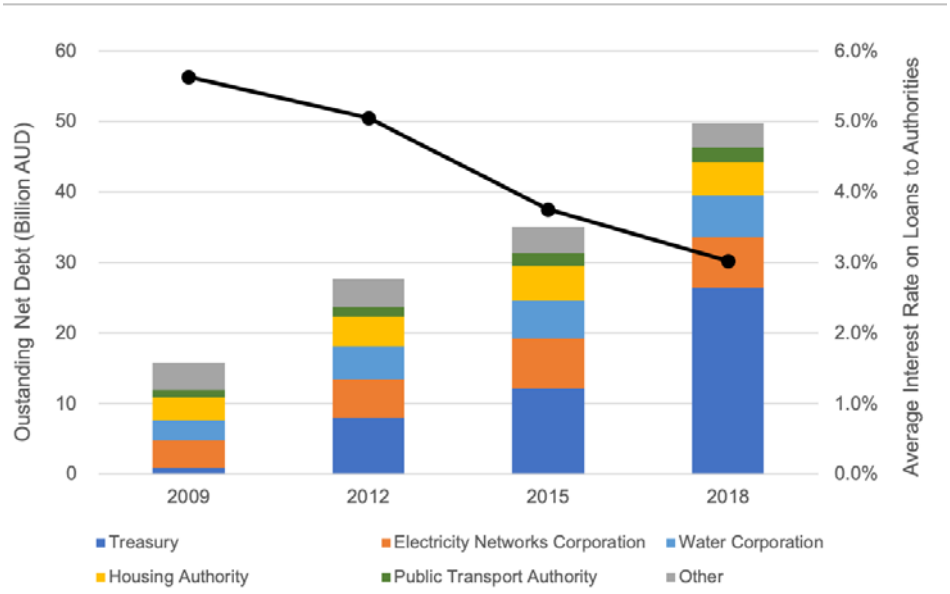
Second, during the peak boom years, along with an absence of fiscal policies to save, resource earmarking was introduced as a significant policy in 2008/09 through the flagship Royalties for Regions (RfR) fund, which was introduced as a vehicle to channel the financial gains from the mining sector directly back to the regions. With an earmark of 25% of royalties being channeled into it, this promising program inherited the volatility of the mining sector. During the boom years, RfR received more funding than could be effectively spent. The vast majority of the program focused on infrastructure projects in the regions, ranging from projects in tourism, to agriculture, to Aboriginal community initiatives. Discussions with Regional Development Corporations revealed mixed outcomes: some stated that it creates a zero-sum environment that fostered competition amongst the region, who all vie for access to much-needed funds, while others claimed that it was only through RfR that they could build the infrastructure they needed to catch up to other parts of the state.

Meanwhile, the seed investment for WAFF was allocated from RfR funds, illustrating the structural mismatch of the optimal allocation of resource revenues between productive spending goals and precautionary savings. The funds are administered by Treasury, and the legislation surrounding it is not specific with respect to how they may be spent. Interviews with relevant stakeholders described the interest being used to pay down the public sector debt, fund healthcare research, and support regional infrastructure. Policymakers in resource-rich countries are constantly faced with the decision of using fiscal resources for investing in projects that have future revenue-generating potential versus investing in financial assets or other savings tools. In WA, in retrospect, the public sector could have diverted more of its efforts to saving through resource stabilization funds. Discussions with academics and public officials point out the broader macroeconomic narrative in Australia during the commodity supercycle that played a role in the spending versus savings dynamics. At the State and National level, macroeconomic forecasting was done in anticipation of an ever-continuing commodity boom, and hence treating the boom as

structural rather than cyclical. When the slowdown inevitably came, there was a lack of sufficient fiscal space.

Lastly, while the state could have not only saved more during the boom years, the state could have also borrowed more during the slowdown. Since WA's borrowing costs remained very low even while state final demand dropped by 13% in real terms and job losses were extensive, it is clear that WA would've likely benefited from a larger fiscal stimulus. By the time growth began to rebound in 2017/18, interest payments on total public sector debt represented only 3.6% of revenues and rates on new debt issued by the Western Australia Treasury Corporation remained low (Figure 38). Debt accumulation during this period was noteworthy for its concentration in borrowing by the treasury and the limited growth of debt for state infrastructure, which was a reversal from the past dynamics of borrowing. This likely contributed to the low cost of new borrowing. Therefore, the state may have had ample space to borrow and spend more to cushion the slowdown and return to growth more quickly. However, during the slowdown, concern about mounting state debt prevented this course of action.

Figure 38: Debt Breakdown and Average Interest Rate on Stock of Debt for Select Years



An agenda to "internalize the externalities" of WA's traditional growth process will require a change in fiscal policy to introduce a shift from a pro-cyclical to a counter-cyclical fiscal approach. Suggested policies that would advance this goal are discussed in the policy recommendations section of this report.

5.3 Infrastructure Policy Misalignment

Public infrastructure plays a significant role both enabling economic activities (for example, through ports, roads, pipelines) and advancing the quality of life of the local population (for example, through schools, telecommunications, mass transport). Hence, misalignments in public infrastructure can translate into barriers for economic diversification, constrain permanent labor supply, and increase pro-cyclical fiscal pressures.

Even without considering the recent dynamics of the commodity supercycle, WA faces several distinct structural challenges in the provision of public goods, including but not limited to: (i) the lack of connectivity to national networks (including electricity, road, rail and air travel); (ii) the very large mismatch between the location of highly productive economic activities (i.e. mining and agriculture) and the places where most of the labor force lives; (iii) natural scarcity of some key resources (especially water); and (iv) other features of its geography and population distribution (i.e. vast swaths of territory with dispersed pockets of population).

Hence, expanding infrastructure access and developing infrastructure in remote areas of the state often entails large up-front investments and sustaining high fixed costs that are often socialized across the state. This means that the state faces difficult choices in how and when to invest in infrastructure, particularly when facing rapid demand surges in remote areas, such as those associated with the recent commodity boom. For instance, when thinking of investments in areas such as education, housing and health, the state faces difficult tradeoffs. Under-investing results in poor living conditions and perpetuates the reliance on FIFO and other labor market imbalances described above, while over-investing may lead to expensive stranded assets when demand subsides. Similarly, WA also faces complex tradeoffs when considering investments in other productive assets such as electricity, railways, and air strips. Some economic activities, such as mining, can and do provide an unusually large share of its own infrastructure, which theoretically could ease the burden on the public sector. However, given that these are not often connected to broader infrastructure networks, they increase regulatory difficulties in maintaining overall network coherence and introduce pricing challenges for public services. In the face of such challenges, significant public investments may still be required. In WA, a large share of economic infrastructure is developed by individual resource companies with limited overarching planning or coordination: this results in areas where multiple rail lines, electricity grids, air strips, etc. run parallel to each other, each servicing the respective company. This is highly inefficient and adds strain on the provision of these goods for non-commercial purposes.

What has resulted is an equilibrium where key infrastructure systems face significant weaknesses in coverage and high market prices. These weaknesses, in turn, may hamper the performance of industries unable to self-provide public goods, further increasing the cost of living, and increasing fiscal pressures. These effects serve to reinforce the growth, labor and fiscal dynamics outlined in previous sections, as they may hinder the diversification of the economy, constrain labor supply,

and enhance pro-cyclical spending patterns. Whereas the reinforcement of externalities regarding labor market imbalances and fiscal policy can be clearly seen in the boom-slowdown cycle of the last two decades, understanding how and why these externalities associated with public infrastructure misalignment persist requires a somewhat longer view. Hence, unlike previous sections in which we describe recent patterns and the factors underpinning the externalities, here we profile factors that lead to a shortfall in the provision of certain public goods — electricity and water — and then offer analytical observations of how these findings may interact with diversification efforts.

Electricity

Western Australia has two separate large electricity grids — one in the southwest serving the bulk of the state's population and another in the north for population centers there — and each of these are disconnected from the major electricity grids serving the rest of the country. The state equalizes the prices charged to end users across the two grids through implicit cross-subsidization between the systems. High and increasing electricity prices have been a problem across Australia over the last two decades, and Western Australia is no exception. As shown in Figure *39*, end user prices are among the highest in the country.

There are at least five factors that can explain why WA has higher electricity costs than the rest of the country. First, WA has an electricity market that is much smaller than the integrated network that serves the eastern half of Australia, meaning that "cost sharing" to build and maintain the infrastructure must be done across a narrower base. Second, distribution costs are high and have continued to increase, because of the challenges of serving remote and thinly populated regions. Third, the state displays a relatively under-diversified electricity generation mix that is heavily concentrated in natural gas (see right side graph of Figure *40*), which exposed the rest of the economy to rapidly increasing electricity costs during the commodity supercycle at the very same time that the state's LNG industry was benefiting from higher global prices In recent years, this has reportedly been tempered by WA's domestic gas policy, which requires LNG producers to reserve gas equivalent to 15% of LNG exports from each project for the domestic market. This may have helped to stabilize domestic gas supply and keep wholesale gas prices lower in WA than in the eastern states.

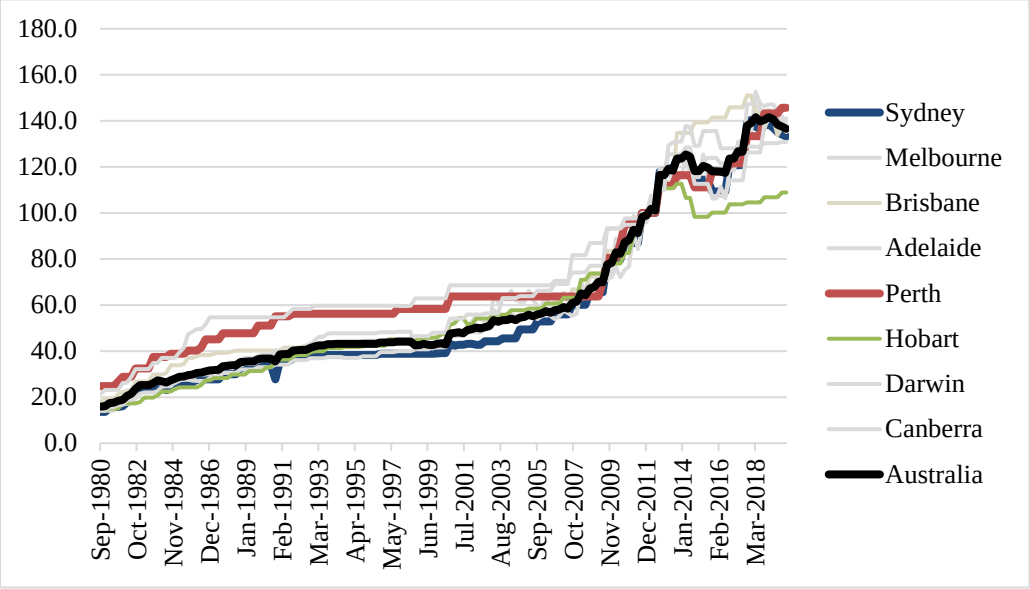
Fourth, WA has seen an increasing prevalence of decentralized energy generation. Part of this relates to the fact that many stakeholders in highly productive industries (i.e. mining) generate their own energy, and part of this relates to enormous growth in decentralized renewable energy. The latter dynamic has been a welcome global phenomenon that has been especially positively received in places like WA where electricity from the existing grid is so expensive. However, this decentralization places substantial added stress on the grid and utilities, which still must provide

baseload and back-up power and provide transmission; meanwhile, the system loses revenues as households and businesses generate more of their own power.

Lastly, WA's economy is much more intensive in its overall energy intensity (left side graph of Figure 40) than its electricity intensity (right side graph of Figure 40). The implication of this is that significant parts of the economy have had limited reliance on affordable electricity and higher reliance on raw fuel inputs. Thus, it is natural that forward-looking system-wide planning that could have kept final prices low in the past may have been less of a priority than in other parts of the world. This dynamic is an example of how the existing economic base of the state may entrench infrastructure systems that undermine diversification, increase fiscal pressures, and adversely impact quality of life.

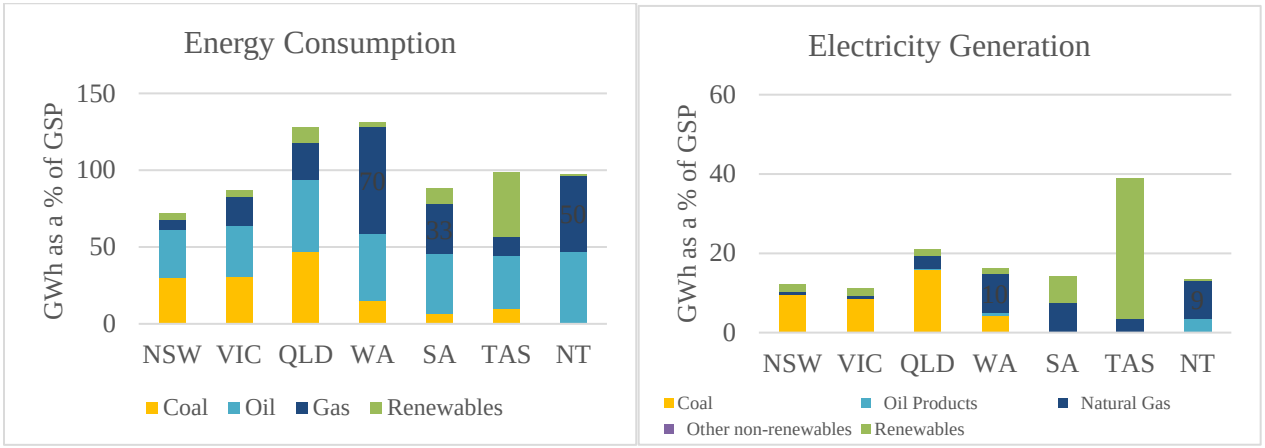
It is clear that WA is now making significant strides toward adapting the electricity system through its Energy Transformation Plan and that the state has widespread opportunities to increase centralized renewable energy sources and storage at much lower overall costs. However, the state is starting this process with an initial hurdle of very high prices inherited in the system, and it may still face the dynamic of sudden increases in demand associated with future mining expansions in remote regions.

Figure 39: Electricity Price Index for Major Cities in Australia (1980-2020)



Source: ABS industry price indexes

Figure 40: Energy Consumption and Electricity Generation Sources by State (2017-18)



Source: Australian Energy Statistics (AES) data

Water

Constraints to water access in WA are driven by a different dynamic, but with similar results as electricity. Water has long been a naturally scarce resource in WA, and its availability has largely determined historical population settlement patterns. In recent decades, water has only become scarcer. This is driven by two main causes: (i) using more water annually than the natural water cycle replenishes; and (ii) less overall rainfall. In essence, parts of Western Australia are running out of natural water supply. These issues are particularly evident in the populated southwest.

Perth is unique in comparison to other major Australian cities in the intensity of this challenge, as it now relies almost exclusively on pumping groundwater and desalination to meet its water needs (Figure 41). Desalination technologies allow for seawater to ultimately provide water supply when natural water supply runs out. However, desalination is far from a costless solution, especially in the context of high electricity costs. This is reflected in the fact that water and sewerage prices for Perth are the highest of all major cities in Australia (Figure 42). Businesses across the state cite water-related prices being a constraint to production. Several noted the lack of enabling infrastructure to connect to an integrated network. Moreover, as water tables continue to fall in many parts of the state that are far from the coastline, water access will include the infrastructure costs to move desalinated water inland.

Figure 41: Water Sources for Capital Cities in Australia (2012-17)

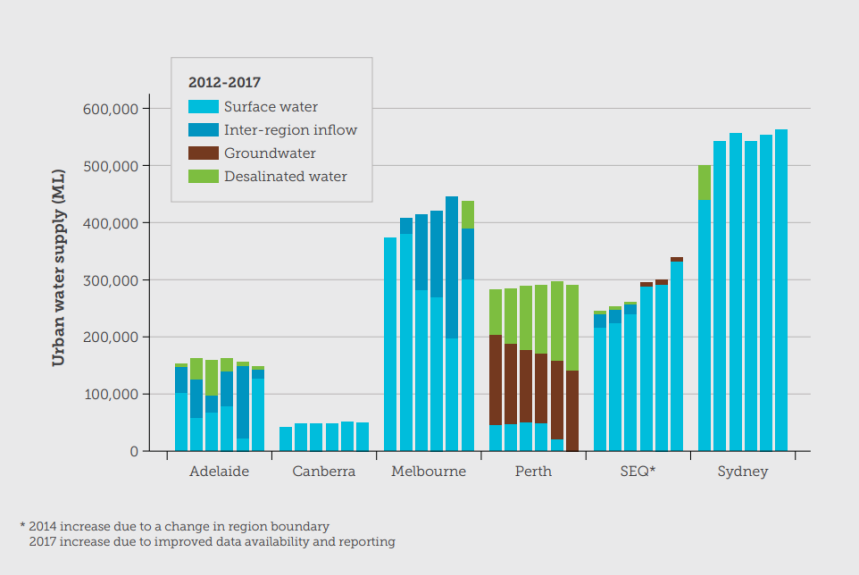
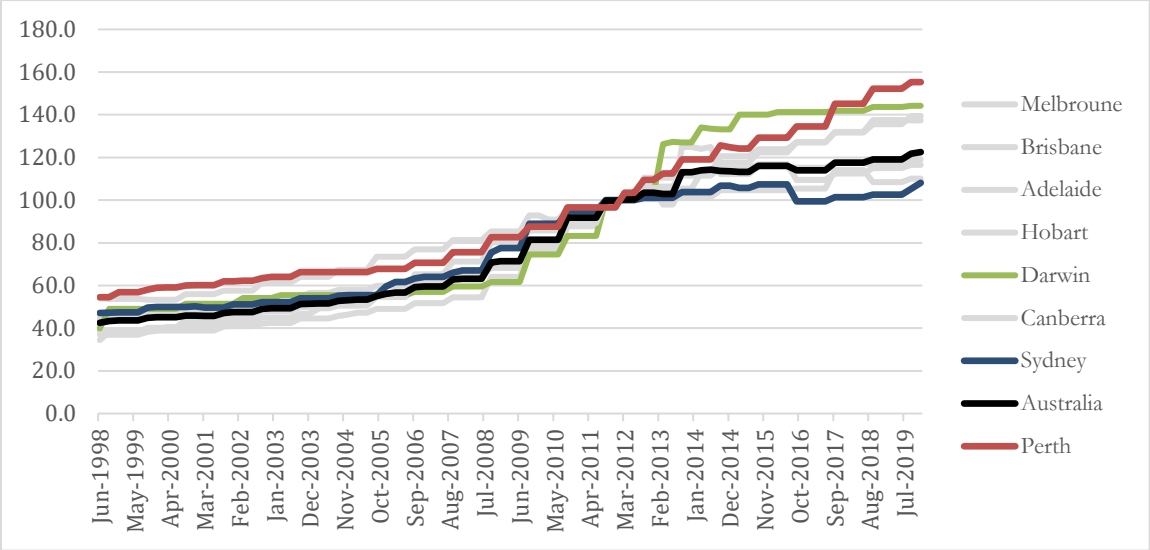


Figure 42: Water and Sewerage Price Index for Capital Cities in Australia (1998-2019)



Source: ABS industry price indexes

Scarce water and high market prices represent a reality that will remain in Western Australia long into the future. As with electricity, this result is partly due to geographical factors, but is also due to the way that the existing economic structure of the state may impact forward-looking system wide planning. WA's pricing of water — already high — is likely unsustainable. In economic policy, the concept of "scarcity rents" applies to non-renewable resources. When the policy aim is for the resource to be used efficiently by society in consideration of future generations, scarcity

rents are charged to users. These rents can be levied in various forms, including through tradable quotas. However, in WA, scarcity rents are not passed on to end users. While this makes water close to free for users that source their own water, water is far from free for society overall. The costs of inefficient water use are ultimately paid for in the costs of desalination, the need for deeper wells, more pumping to reach groundwater over time, and water transport costs. With a paucity of long-term infrastructure to desalinate and distribute water, these transport costs include the need to move water by truck when localities run out of local supply.

Mining and agriculture source their own groundwater and have never paid a unit price for using that water. Around 40% of all water use in the state is currently attributed to mining, while close to 20% of water use is agricultural. These industries' access to this scarce resource does not fully internalize its true cost and thus has increased the cost of water for others over time, which once again undermines diversification, increase fiscal pressures, and adversely impacts the quality of life. Additionally, by having to devote more public resources than what is economically efficient to safeguard water access, it also means that the state has less degrees of freedom to invest in other public goods that may serve to enhance quality of life across the state or enable the development of other economic activities.

Common Themes

Electricity and water are just two cases of misalignment in public infrastructure in WA with the needs of a diversified economy. But there are myriad of examples of significant inefficiencies in WA's public infrastructure systems. For example, road and rail systems have limited connectivity across sparsely populated regions. The same is true for internet access, with the added limitation that where networks do reach more remote areas, costs are very high. Similarly, air travel is very expensive across the state. Finally, the reach of public services including education and healthcare can only extend so far before services become very thin and quality becomes an issue.

While each of these areas of public goods provision exhibits different dynamics, there are commonalities in the overall misalignment of infrastructure policies. First, structural features of the state make provision complex. Second, forward-looking system-wide planning has been informed by the needs of existing drivers of growth and not necessarily by the needs of prospective drivers of growth. Third, the societal costs of direct and indirect access to public infrastructure are not adequately internalized in the cost structure. Fourth, the high costs of providing infrastructure to remote areas have been socialized through pricing policies and subsidies. What has resulted is an equilibrium where key infrastructure systems face significant weaknesses in coverage and prices that further increase the cost of living, negatively affect the performance of industries unable to manage self-provision, and increase fiscal pressures.

Thinking strategically about the challenges existing public infrastructure may pose for diversification efforts is particularly important for WA. Given that labor costs are so high in the state, WA would benefit from all the cost advantages it can get through infrastructure costs to become a competitive location for business activities that would otherwise locate in other parts of the country or other parts of the world. As the cases of electricity and water show, WA starts at a large disadvantage in cost and coverage for several types of public infrastructure tied to its past drivers of growth. If WA is to diversify its drivers of growth for the future and avoid the pitfalls of the past, strategic public infrastructure development will be critical. Necessary steps toward this are discussed in the policy recommendations section of this report.

6. Policy Framework and Concluding Thoughts

Policy design and implementation is an iterative and non-linear process, involving large-scale coordination among multiple stakeholders, representing many agencies and constituencies. At the sub-national level, challenges multiply as layers of different government, with varying mandates, interact and collaborate to design and implement policies. In Western Australia, State, Commonwealth and Regional stakeholders must coordinate and collaborate to structure policies, enforce regulations, and provide public goods. Western Australia has many examples of successful policies and public initiatives, but this report does not focus on those. Growth Lab research as summarized above highlights specific areas where changes in policies and process are needed to overcome critical challenges.

Western Australia requires a systematic approach to address the self-reinforcing channels discussed in the *Growth Perspective Report* and to jumpstart diversification through opportunities discussed in the *Economic Complexity Report.* Since many of the adverse dynamics identified are grounded in deep-rooted factors, policy responses may not be able to fully resolve these issues in the short-term. However, they can work to build a better foundation to address them.

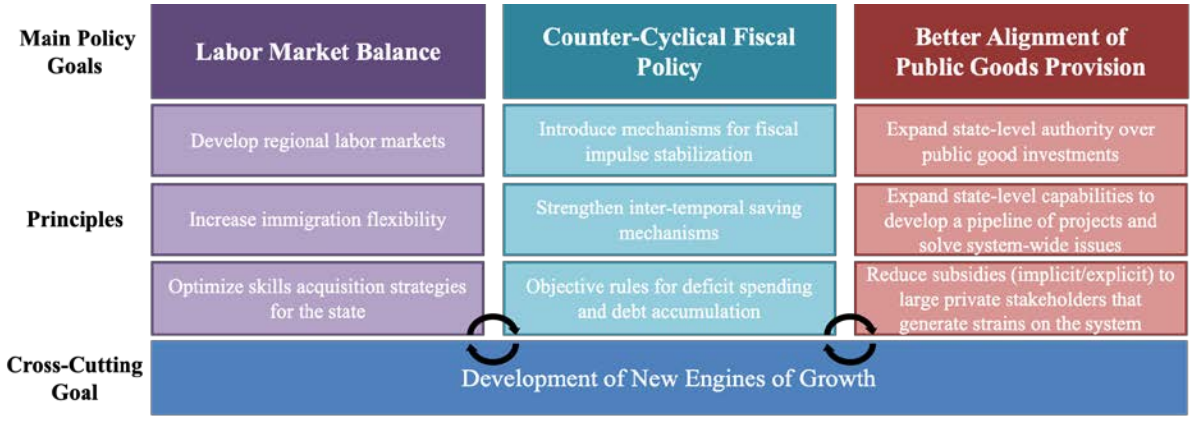
The policy framework, illustrated in Figure 43, is designed toward this end – to serve as an organizing mechanism for policy initiatives, across multiple stakeholders and levels of government. The framework is largely organized around three main policy goals, namely, to achieve: labor market balance, counter-cyclical fiscal policy, and better alignment of goods provision. The framework closely follows the structure of the *Growth Perspective Report*, as each of these policy goals centers on reducing and reversing a self-reinforcing channel and internalizing relevant externalities. For each policy goal, the framework describes a set of policy principles that aim to address the factors that underpin the problem.

We proceed to suggest a brief list of potential policy initiatives that could fall under each policy principle. These policy initiatives are indicative in nature and should be vetted and complemented by relevant local stakeholders, who have a more complete contextual and policy area knowledge to develop concrete policy alternatives. It is worth noting that while some of these initiatives would require explicit coordination with the Commonwealth, whether through legislative changes or otherwise, significant actions can be taken across each of the three policy goals and nearly all principles through the state's existing authorities.

The three main policy goals are complemented by one cross-cutting policy goal – fostering the development of new engines of growth. This goal cuts across the scope of the channels identified in the *Growth Perspective Report* and is important for achieving all of the main policy goals. However, it also benefits from progress made around the main policy goals, which introduces a dynamic of positive self-reinforcement. It should be noted that even though this framework seeks to facilitate conditions for more diversified economic growth to take place and enhance the State's capabilities to identify and address additional constraints to diversification, it is not designed

around industry-specific policies. The framework aims to create a holistic policy response that would resolve fundamental frictions in the growth process and create space for diversification to take place. We would expect the strategic industries identified in the *Economic Complexity Report* to lead diversification as this policy framework is pursued, but other industries may likewise emerge. We also provide several illustrative examples of what active productive development policies could look like to help catalyze diversification opportunities, if they were to be undertaken alongside initiatives across the broader policy framework to address deep structural problems.

Figure 43: Policy Framework



6.1 From Labor Market Imbalances to Labor Market Balance

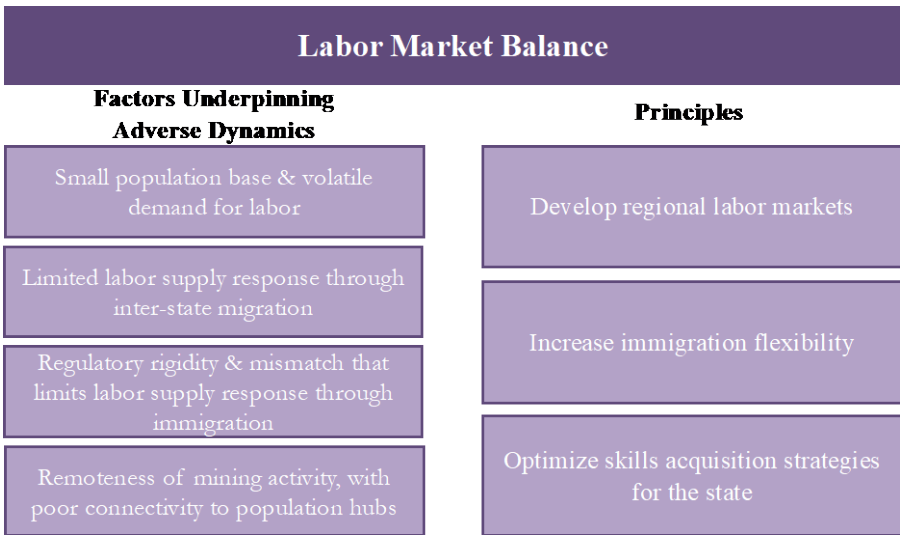
This policy goal is critical for building labor market resilience. A resilient labor market across the state would be able to adequately respond to positive and negative economic shocks, reducing volatility in job losses. During an investment boom, a responsive labor supply is needed to respond to a surge in labor demand in a flexible, timely, and adequate manner, thus reducing outsized upward wage pressures, which would in turn aid the viability of other sectors in the economy. When the local labor market size is insufficient to generate a supply response, it could be complemented through more responsive interstate and international migration, which implies flexible channels and active promotion of immigration. Additionally, deepening labor markets across the regions would support building regional communities, reduce dependence on FIFO workers in the regions, and reduce channels through which shocks radiate across regions. Deeper regional labor markets would also increase the viability of engines of growth in the regions. During slowdowns in the resource-related sectors, laid off workers could benefit from retraining initiatives – as part of a broader skills acquisition strategy – that would allow them to be effectively redeployed to other parts of the economy with relatively high flexibility.

Contrary to this goal, Western Australia's labor market faces recurring imbalances. First, despite the recent slowdown and downward adjustment in real wages, firms in WA must pay significant premiums vis-à-vis the rest of Australia, which reduces competitiveness, especially for nascent industries. Very high wages served as an important barrier for the development of tradable

industries unrelated to mining during the boom, and they likely continue to do so during the slowdown. When the slowdown began, since so much of consumption in the state depended on wealth generated from mining expansion, labor did become available not only in the mining-related economy, but also from non-tradable industries that suddenly faced reduced demand. This was an opportunity for labor to be redeployed to other productive activities, but since nascent industries did not grow during the boom, there were limited engines of growth to expand and absorb this labor. As a result, unemployment and underemployment increased while net interstate migration reversed from an inflow to an outflow.

Factors that led to these adverse dynamics relate to the limited labor market supply response to the high demand during the boom. These factors can be summarized as a volatile demand for labor that cannot be met by a small population base, which is exacerbated by remoteness and lack of connectivity, and an insufficient response of inter-state and international migration. Frictions to inward migration – whether inter-state or international – also create particular shortages in some skills and a mismatch in labor available versus labor demanded. Figure 44 summarizes the factors giving rise to WA's history of labor market imbalances and also outlines principles that can address the mechanisms behind them.

Figure 44: Labor Market Balance Factors and Principles



The principles listed here would together address the constraints that have caused labor market imbalances to persist. First, if volatile demand for labor is taken as a given due to the combination of a large mining sector and global volatility in commodity prices, developing local labor markets is key to reducing the constraint of a small population base. This would not only reduce the likelihood of outsized upward wage pressure and shocks that radiate across the state through FIFO workers – both through the mechanism of drawing labor from other regions and concentrating consumption in Perth – but also create more sustainable and vibrant communities capable of advancing more local economic diversification. Second, increasing immigration flexibility – both

interstate and international – would support supply response to sudden upswings and downturns in labor demand, including for particular skills, and would help to increase local labor supply over time. Finally, optimizing the State's skills acquisition strategy would deepen the skill base of the local labor market, make employment transitions smoother, and further enhance the stock of productive knowhow in the state. The rest of this sub-section discusses each principle in more depth and provide examples of potential policy initiatives that would fall under each principle.

1st Principle: Develop regional labor markets

The phenomenon of the fly-in-fly-out (FIFO) workforce in Western Australia is ultimately a result of insufficiently large local labor markets close to mining operations. This is not surprising given the relatively small population base of the State, even more so in regional WA. To put WA into perspective, the state is 1.35 times the area of Mexico but has only 2% of Mexico's population, and 80% of this population is concentrated in Perth. The challenge with the FIFO model is that it not only adds to the wage pressures as workers need to be compensated for the inconvenience the model entails, but that it also sustains a large geographical mismatch between places where wealth is created and where workers spend their earnings and increase demand for non-tradable services. During a downturn, the effects reverberate across places and economic activities far removed from mining. While difficult given that individual mining operations are not permanent, there can be appropriate ways to deepen local permanent labor markets. The ultimate goal is to disrupt the shock dissemination across the State and enable the creation of alternative engines of growth in each of the regions. Ideally, these would be productive enough to sustain some wage pressures and large enough to absorb excess capacity in downturns.

What follows are two types of policy initiatives that could advance this principle, both relate to shifting some of the payment to workers from wages and incentives for FIFO work to incentives to live in the regions. As noted earlier, these are suggestions based on our evolving but still limited understanding of the policy ecosystem in WA. They are to be appraised and complemented by local stakeholders.

- One type of policy is that which proactively promote and increase the attractiveness of regional WA and increase population retention in regions. Such initiatives could take the form of incentives, largely fiscal but also regulatory, to make settling in the regions more desirable, especially for young families. Fiscal incentives could include optimized tax exemptions while regulatory incentives could relate to optimizing the design of visa streams to increase the attraction and retention of international migrants in the regions, which is discussed further below. These incentives could be complemented by a promotion strategy to proactively market the State as a desirable place to settle in. Ultimately, however, the State will need to invest in improving the livability in the regions through improved amenities, which is discussed further under better alignment of public goods.

- Along with regional settlement promotion initiatives, there could be space for reducing the current incentives for FIFO work in order to encourage more permanent residence. A review by the Productivity Commission on remote area tax concessions,[18] found that the exemption of FIFO workers from the fringe benefits tax (FBT), which are taxes on employer-provided housing, transportation, meals, accommodation, and others, is highly generous.[19] The review estimates the overall effect of the FBT exemption from employer-provided housing for FIFO workers to be between AUD 30 and 50 million annually in the Pilbara. While the forgone revenue may seem modest (and likely to be higher if fringe benefits other than housing is included), removing the exemption could send a powerful signal about the State's commitment to developing the regions. The FBT tax could also be an additional source of revenue for the regions to fund their promotion and attraction strategies. This could be supplemented by initiatives that encourage companies to hire locally to further help build communities.

2nd Principle: Increase immigration flexibility

When demand for labor surges beyond local capacity, it is important for the labor supply response through both international and interstate immigration to be as rapid and complete as possible to prevent labor market imbalances. A flexible migration response would also allow an additional channel of labor supply after the boom period to fit the evolving needs of a diversifying economy – this would be in line with the objectives of the 3rd principle. This flexible response is necessary to alleviate labor demand pressures, while also increasing the long-run population base of the State. This principle can be advanced by initiatives related to increasing the size and flexibility of both interstate and international migration.

- *Interstate Migration*: There is room for WA to grow its appeal to and share of interstate migrants. During the recent investment boom, interstate migration to WA accounted for only 8% of population growth, and the state received a smaller share of interstate migrants than other comparable states such as Queensland. The factors behind this trend are largely due to remoteness and lack of connectivity. Therefore, this initiative can be substantially aided by the incentive suggestions discussed in the previous subsection related to making regional WA more attractive and the initiatives on improving the livability of region discussed under the public goods policy goal. As a more direct initiative to increase the response from interstate migration, developing a proactive interstate migrant attraction strategy to Perth and the regions could be a promising start. These can run the gamut of fiscal to housing incentives for interstate migrants to move to WA.

[18] See: https://www.pc.gov.au/inquiries/completed/remote-tax/report/remote-tax-overview.pdf
[19] It should be noted that the Commonwealth did not accept the Productivity Commission's recommendations (Zone Tax Offset be abolished and FBT exemption be addressed) based on their study.

- *International Migration:* The immigration system has rigidities that limit the adequacy and flexibility of the labor supply response from this channel. Moreover, there is also an inherent mismatch between the needs of the WA economy and the Commonwealth immigration policies (Box B). The latter target predominantly highly skilled immigrants, whereas the WA economy during the boom showed significant demand for relatively low skilled occupations to work in construction and mining capacity expanding activities. This mismatch is concerning for the present and for the future labor market dynamics of the State. While recognizing that these would involve significant coordination with the Commonwealth, the following are examples of initiatives that could be beneficial.

    - First, WA could proactively provide input to the occupation list for the Temporary Skills Shortage visa stream (TSS). This doesn't guarantee that these needs would be reflected timely and adequately in Commonwealth policies, but it's a step in that direction. A concerning trend is that the occupation list has only been getting narrower, shedding 184 occupations between 2010 and 2019 (Box B). There are also seemingly no updates of the remaining occupations based on the evolving needs of each State's unique labor market needs. Without a proactive involvement in the process it is unlikely that WA will achieve a fair representation of its needs in the Commonwealth system.

    - Second, the State can also coordinate with the private sector to reduce confusion related to the work visa application process and eligibility requirements and increase readiness for opening this channel of labor supply. This can also be furthered through building relationships with agencies in other countries to identify and develop a pre-qualified pool of international migrant workers, which can be tapped into when demand goes back up again.

    - Third, in addition to increasing the flexibility of the visa streams, the State can also scale up the use of labor agreements with the Commonwealth, which seem to be better aligned with the unique needs of the WA economy and its labor market conditions. A great example of this is the Kalgoorlie-Boulder designated area migration agreement (DAMA).[20] As the State learns from this experience, it can work to formulate a plan to scale this practice up, while exploring the optimal level of thresholds of concessions for different areas - occupation lists, minimum wage and English language proficiency requirements. Moreover, WA can explore

[20] The DAMA is a five-year labor agreement between the city of Kalgoorlie-Boulder and the Commonwealth, which has its own occupation list and offers room for other concessions – related to English language proficiency requirements and the temporary skilled migration income threshold requirements. An analysis of the skill level of occupations in the DAMA list shows that 44% of the occupations in it are of the highest skill level compared to 65% in the combined TSS lists, and 14% of the occupations are of the lowest skill level, compared to 1% in the combined TSS lists. Despite their increased tailoring to the needs of the local labor markets, there is only one DAMA in WA and only seven in the whole country.

concessions to specific strategic economic activities as it makes its diversification agenda transversal across functions and unifies stakeholders around it.

- Fourth, WA should ensure that there are no binding caps on international migrant inflows into the state. The relevant area to be considered is the regional visa streams, which have a cap of 25,000 for the whole country. Caps to immigration work directly against this policy principle and the above three initiatives.

3rd Principle: Optimization of Skills Acquisition Strategy

This principle concerns optimizing the skills acquisition strategy of the State to ensure smoother transitions between jobs and labor redeployment during downturns, to track skills shortages in existing industries in a timely manner, and to plan for and target the acquisition of skills needed for strategic tradable activities to thrive in WA. Between 2008 and 2018 the unemployment rate in WA more than doubled. A significant part of this may have been due to skill mismatches, both skills required for work during the boom and skills required for limited jobs available after the boom had ended.

- There is room for the State to play a proactive role in the timely tracking of skills required by both existing industries and high-potential diversification opportunities. This function should not be confined only to advanced skills but rather have under its purview all skill levels. During the boom period, certain skills of machinery operators and technicians were in short supply, which are typically viewed as medium or low-skill jobs. It will be important for the State to track the shortage of skills across all levels and ensure their timely reflection in the State and Commonwealth labor market and immigration policies.
- There could be a role for reskilling initiatives that can help laid off workers to be effectively redeployed to other parts of the economy with relatively high flexibility. The Department of Training and Workforce Development has initiatives related to vocational training programs. Qualitative interviews with small and medium-sized firms in some regions pointed to areas of improvement for the TAFE colleges (vocational training schools) related to the acquisition of advanced manufacturing technical skills. It will be important for the Department to evaluate the effectiveness of its programs related to flexible and successful re-skilling of workers in Perth and in the regions, especially with a focus on skills required by strategic tradable activities.
- Lastly, the State can also incorporate in its skills acquisition strategy forward-planning for skills necessary for the take-off of strategic sectors that WA does not have a comparative advantage in yet. This process can be guided through close coordination with private sector representatives, the education system and Commonwealth immigration policymakers. This information can be utilized in building programs in both vocational schools and higher education institutions.

Box B: WA is differentially impacted by the Commonwealth immigration policies

The underlying problem that prevents a flexible labor market response from international migrants appears to be a mismatch between the needs of the Western Australian economy and the design of the Australian immigration system. The Australian immigration system for work visas is designed to attract highly skilled international migrants and/or those that have specialized types of knowhow, for which there is a shortage in the country. This design has served the country well, increasing its skilled workforce and making Australia one of the countries with the highest level of immigration among OECD countries. However, there is a pronounced mismatch between the less skilled and temporary workers WA needs during booms and the highly skilled occupations that the visa system allows. For instance, during resource investment boom periods, WA increasingly required temporary and lower skilled workers in construction and other mining capacity expanding activities. Namely, the occupations that saw the highest premia in wages during the boom were laborers and machinery operators and drivers, which are not well represented in the main visa channels.

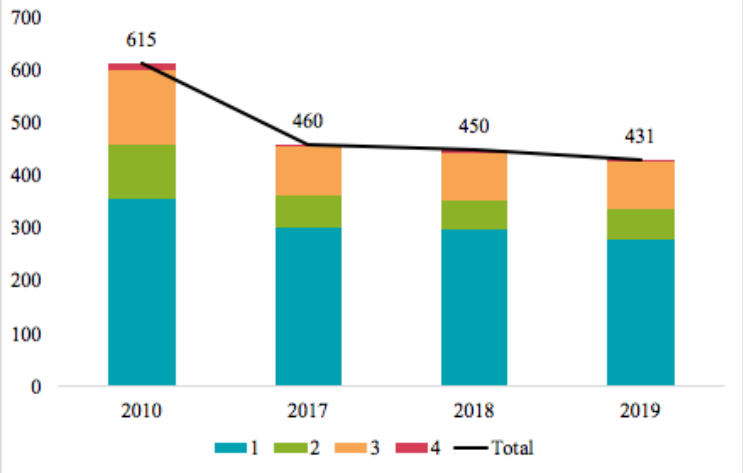
The most widely used visa type for temporary work in Australia is the temporary skill shortage visa (TSS, subclass 482), which accounted for 38% of all immigrant workers to WA during the boom. One of the main eligibility requirements of the visa is for the position to be listed in an occupation list, which gets updated annually to reflect the short-term and medium and long-term skills shortages in the country. This process is designed to be a collaborative of the Commonwealth gathering input from each state. An analysis of the occupations in the list finds that the TSS is geared towards mainly high and medium-skilled occupations. Of the occupations in the list, 65% are the highest skilled occupations (managers, professionals and technicians), while only 1% are skill level 4 (penultimate lowest skill level, representing laborers and other lower skilled workers). Therefore, while the occupational list signals a goal to attract predominantly high-skill workers, WA experienced significant temporary shortages in lower-skilled occupations, as can be seen by overheating in wages in these occupations. Moreover, the list has been shortening over time with no relevant inclusion of new occupations. This suggests that the revision of the list is not likely to consider the changing needs of the WA economy as it goes through different economic cycles.

Apart from the TSS, there are other temporary work visa streams, such as the working holiday maker visa, which accounted for 36% of immigrant workers to WA during the boom. Even though it does not have any restrictions on occupations, this visa stream is also ill-adapted to meet WA's labor demand. First, it is only open to citizens of certain countries between the ages of 18 and 35. Second, it has work duration requirements that limits the tenure with one employer to 6 months with an aggregate duration of the visa of 12 months, making it most suitable for the agricultural sector. Another visa stream is the seasonal visa, targeted mostly to citizens of Pacific Island nations and the program itself is more of a foreign assistance program rather than a way to address labor supply shortages. Moreover, the take-up of the program so far has been quite low (6,166 workers in 2016-

2017)[21] and it is mostly concentrated in Eastern states, which are closer in proximity. Finally, the program is open to a restricted set of sectors – mostly to agriculture and accommodation in selected locations.[22]

In short, the visa streams in the Commonwealth immigration system do not adequately suit WA's labor market needs well. But there are arrangements that do, such as labor agreements with the Commonwealth. One such example is the Kalgoorlie-Boulder designated area migration agreement (DAMA). The DAMA is a five-year labor agreement between the city of Kalgoorlie-Boulder and the Commonwealth, which has its own occupation list and offers room for other concessions – related to English language proficiency requirements and the temporary skilled migration income threshold requirements. An analysis of the skill level of occupations in the DAMA list shows that 44% of the occupations in it are of the highest skill level compared to 65% in the combined TSS lists, and 14% of the occupations are of the lowest skill level, compared to 1% in the combined TSS lists (**Figure B1**). There is also a level 5 (lowest skill level) occupation in it – driller's assistant. To put in perspective – there are no skill level 5 occupations in the TSS occupations list and very few skill level 4 ones. Despite their increased tailoring to the needs of the local labor markets, there is only one DAMA in WA and only seven in the whole country. As the State learns from this experience, it can work to formulate a plan to scale this practice up, while exploring the optimal level of thresholds of concessions for different areas - occupation lists, minimum wage and English language proficiency requirements.

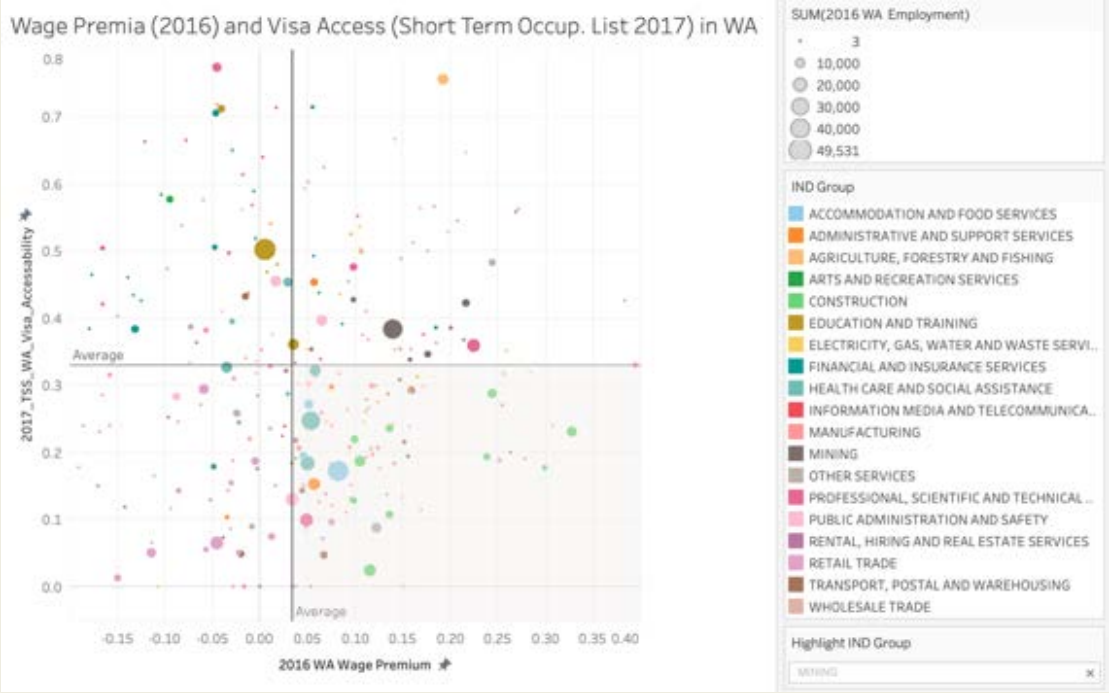
Figure B1: Number of occupations in combined TSS lists (Subclass 482) by skill level (2010-19)



Note: 1 Denotes highest skill level, 5 - lowest skill level, as classified by ANZSCO
Source: Department of Home Affairs, ABS

[21] https://www.sbs.com.au/news/who-are-australia-s-seasonal-workers
[22] https://www.employment.gov.au/frequently-asked-questions-about-seasonal-worker-programme

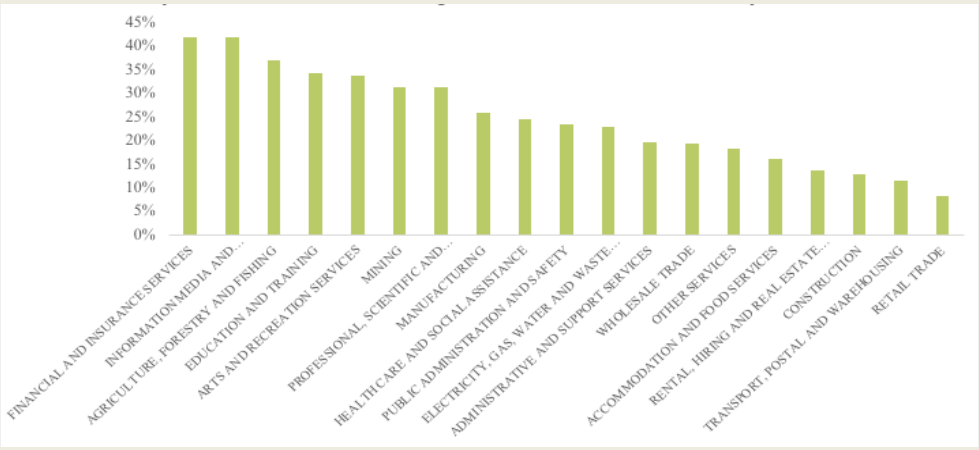
Figure B2: Wage Premia (2016) and Visa Access (2017)



Note: Wage premia (uncontrolled) is the difference in average wages at the 4-digit ANZSIC level in WA relative to the rest of the country. Additionally, it should be noted that the share of visa access represented here is likely overestimated due lack of consistency in the level of aggregation of the publicly available data. Occupation lists are available at the 6-digit ANZSCO level while the industry occupation composition is available at the 4-digit level. Current approach extends availability at a given 6-digit occupation to all other occupations within the same 4-digit category. Thus, ascribing eligibility to a significantly larger number of occupations.

Source: Department of Home Affairs, ABS Census 2016

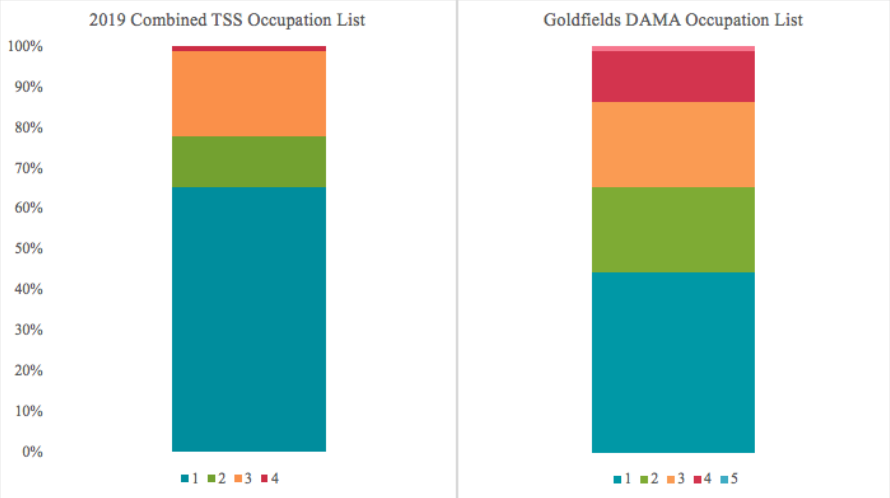
Figure B3: Share of Jobs Eligible for International Migrants via 482 Short-Term Skilled Visa in 2019



Source: Department of Home Affairs, ABS

Note: It should be noted that the share of visa access represented here is likely overestimated due lack of consistency in the level of aggregation of the publicly available data. Occupation lists are available at the 6-digit ANZSCO level while the industry occupation composition is available at the 4-digit level. Current approach extends availability at a given 6-digit occupation to all other occupations within the same 4-digit category. Thus, ascribing eligibility to a significantly larger number of occupations.

Figure B4: Skill Levels of Occupations in the TSS Combined Lists and the Goldfields (Kalgoorlie-Boulder) DAMA Occupation List



Note: 1 Denotes highest skill level, 5 - lowest skill level, as classified by ANZSCO
Source: Department of Home Affairs, Kalgoorlie-Boulder DAMA

6.2 From Pro-Cyclical to Counter-Cyclical Fiscal Policy

This policy goal is essential to allow that fiscal resources be utilized to buffer, rather than exacerbate, the natural swings of commodity cycles and related investments. Not only is this a necessary tool for reducing painful job losses and the breakdown of some markets, such as local housing markets, it is also a means through which WA can capitalize on times of low commodity prices to invest in public goods and strategic initiatives that could catalyze diversification. It should be noted that the technical term "counter-cyclical fiscal policy" does not entail austerity. In fact, it means the opposite. Counter-cyclical fiscal policy is the practice of saving resources during the good times, when the private sector is generating rapid growth, such that those resources can be spent during downturns at precisely the time when society needs them the most. Since the State is able to borrow from the market at generally low interest rates, the goal of counter-cyclical fiscal policy can be pursued not only be forward-thinking saving and spending decisions but also by sound debt management, which may borrow in bad times in order to spend more provided that the State maintains a sustainable debt trajectory.

Western Australia has largely practiced pro-cyclical fiscal policy as the macroeconomic dynamics of the state have been closely related to the resource boom and bust cycles. Over the duration of the boom, and especially from 2008-14, the State spent all the resources it gained in revenues and more. Spending levels in 2014 were 2.5 times those of 2002. This meant that the state saved little and even incurred substantial fiscal deficits during the mining investment boom. There were legitimate reasons why spending increased as demand for public goods and services expanded, and there were particular challenges that the State faced as a result of Federal-State fiscal

relationships, but the result in which the State spent more than one-for-one what it gained in revenues as the economy grew has served the State poorly. When the slowdown started and iron ore prices fell, WA faced a predictably sharp loss of revenues made worse by a backward-looking inter-state fiscal equalization process.[23] This was paired with an inertia in planned expenditures, no savings to tap into to cushion the impacts of the economic slowdown, and an orientation against additional debt accumulation which may not have been consistent with the costs and benefits of borrowing. Pro-cyclical fiscal policy thus describes how, in hindsight, the State overspent during the boom and underspent during the slowdown, and thus was not able to provide some headwind against the downturn or use it as an opportunity.

Figure 45: Counter-Cyclical Fiscal Policy Factors and Principles

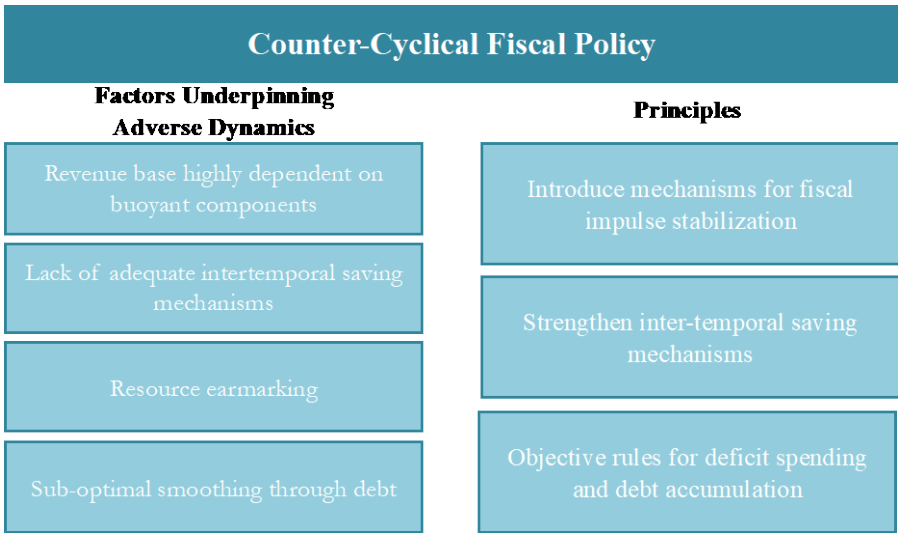


Figure *45* lists the factors that underpin the pro-cyclical nature of fiscal policy and policy principles that could be followed to address these in order to transition to a counter-cyclical fiscal stance. The issues to address include: a high dependency on buoyant revenue components (largely royalties); a lack of inter-temporal saving mechanisms; resource earmarking; and sub-optimal smoothing through debt. The principles to address these include: introducing mechanisms for fiscal impulse stabilization; strengthening inter-temporal saving mechanisms; and setting objective rules for deficit spending and debt accumulation. These principles aim to make it easier to leverage fiscal space during downturns. While this cannot fundamentally offset the swings of commodity cycles in the short-term, this is a foundational component for economic diversification. In the longer-term and in the context of a more diversified economy, counter-cyclical fiscal policy alongside the

[23] It is important to also note the implications of fiscal federalism on the State's ability to adopt a counter-cyclical fiscal approach. For instance, the majority of grants from the Commonwealth are tied to specific purposes, limiting the degrees of freedom in determining how they are spent. Furthermore, the tax and transfer base of the state is relatively narrow compared to that at the federal level.

dynamics prevalent in large complementary engines of growth, might be able to more fully offset the economic swings associated with commodity cycles and its related investments.

1st Principle: Introduce mechanisms for fiscal impulse stabilization

When revenues spike during the boom and collapse during the bust, this naturally creates conditions for overspending during the boom and a painful sudden stop to spending during the bust. Therefore, a portfolio of revenue sources with more balanced elasticity – that is, considers a larger share of revenue components that are independent from commodity cycles – will leave WA better poised to manage the volatility of the cyclical components. Note that the next policy principle relates to savings mechanisms, which is better aligned with negating the need for balancing the flow of revenues inter-temporally, but this principle is likely to be useful given constraints on state-level saving abilities. The focus here is on creating revenue sources that are either less volatile or inversely related to boom-bust cycles. Initiatives that support this principle relate to policy instruments that can restructure existing revenues that are highly elastic to GSP and considering new revenue structures. As before, while recognizing that these would involve significant coordination with the Commonwealth, the following are examples of initiatives that could be beneficial.

- Royalty rates and formulas may be revised to be less vulnerable to commodity price swings, thereby transferring the volatility from government revenues to company profits. Legislation on this in WA dates back to almost four decades, and requires coordination with the national government and consultation with relevant stakeholders; however, efforts can be focused on finding ways to raise the effective royalty rate on mineral output. It is important to note that this requires considering not only the relevant stakeholders that shall be part of the negotiations, but also the relative degrees of freedom the state has in determining the effective royalty rates.

- Another initiative to balance the elasticity of revenues may be to consider ideas for smoothing revenue collection from large construction projects. Given the nature of the previous growth slowdown, where construction slowed, it could be helpful for taxes on construction activity and real estate transactions to be balanced such that revenues are largest at the late stages, when the activity is close to finished and the demand on the rest of the economy from the project is set to end.

- Other taxes levied on items that themselves are not highly elastic and on capital and wealth rather than income and sales, can also be a stabilizing force. WA has a successful track record of leveraging excise duties such as the stamp tax and taxes on gambling. Further study of the tax system would be needed to identify changes in tax structures that may be helpful and to consider the additional benefits and costs of any changes.

- A final suggestion for initiatives on this front is to structure the release of Commonwealth transfers (including earmarked funds) to be higher during downturns and lower during booms. This would function essentially as a pre-transfer saving mechanism. This may be politically challenging to navigate and may also face difficulty in administrative legislation on the same. However, it is worth exploring options to intertemporally smooth earmarked funds so that the state can more efficiently direct the use of its resource revenues.

2nd Principle: Strengthen inter-temporal savings mechanisms (stabilization and intergenerational)

Fiscal policy in resource-rich economies should be geared towards smoothing the shocks from the volatility driven by commodity shocks. However, it is difficult to forecast and accurately predict the exact nature and timeline of booms and slowdowns. Therefore, it is important to institute fiscal rules for saving and utilizing either stabilization and inter-generational funds, or both, depending on the expected duration of commodity-related revenues and the relative importance of stabilization during commodity price downturns versus generating long-term returns to compensate future generations for the use of a limited resource today. There is a wide range of literature that shows the benefits of institutions that ensure that excess revenues from natural resources are saved during the boom with clear rules that govern the share of resource-related revenues that are saved. These rules are necessary because it is easy to assume that commodity booms will be permanent when you are in the middle of them.

- The first need in establishing strong inter-temporal savings mechanisms is establishing a strong fiscal rule (or set of fiscal rules for saving). It is important to "tie your hands" through a rule because otherwise there are very strong pressures to spend during the boom that are hard to avoid. There are, in fact, good things to spend on during the boom, but doing so means that you cannot leverage at least part of those resources to achieve a higher social return later. Targets to consider setting include, but are not limited to: setting a budget surplus target, but allowing larger deficits to be run under conditions of negative commodity shocks below a threshold or when output falls short of potential; allocating a fixed- and variable-component of royalty revenues to a savings fund with independent management based on export performance that fiscal year. The idea would be to formalize the details of the procedure into law and give the members a management panel legal independence.

- Alongside the fiscal rule, there is the need to set up a formal stabilization fund that holds a share of the savings with clear rules for how it manages the fund to accumulate interest, when its funds become available for use, and how these funds can be spent.[24] To the extent

[24] One issue to consider in designing a stabilization mechanism and saving from resource rents for a later date is any spillover effects this may have on other components of the fiscal balance. In Australia, the national horizontal fiscal equalization process is geared at a national-level equalization of standards of living for every Australian citizen. While this has been seen as a deterrent towards savings stabilization funds, the relative size of GST transfers in

that WA has relatively more autonomy in allocating funds from its resource revenues for certain purposes, it can set up multiple funds for specific later-use purposes. For example, a rainy-day fund for targeted healthcare research, or a fund for fiscal stimulus in the case of sweeping labor market shocks during steep downturns. Importantly, it is hard to know *ex ante* what to spend these savings on, which may inadvertently lead to temporary surges on current expenditures, which may be suboptimal in their own right. Therefore, it is worth establishing a pre-approval process or committee-level decision-making body that can pursue appropriate channels to use the funds when needed as efficiently as possible.

- In many instances, a complementary goal of inter-temporal savings mechanisms focuses investing savings for future welfare of the population, often in global portfolios. The oldest and most established examples to look to are in the Middle East, those of Kuwait and the UAE. However, more relevant case studies to look at are from comparable subnational entities such as the Alberta (Canada) fund and Alaska (USA). WA has such an intergenerational mechanism in the WA Future Fund; however, its inflows have remained extremely small since its creation, such that interest generated by the fund remains small. In order for the fund to play a relevant role in "future proofing", the fund would need receive more savings inflows, interest would need to be allowed to accumulate, and spending from the fund would need to be guided by long-term goals. Admittedly there may be a short-term tradeoff between saving for stabilization purposes and saving for "future proofing" purposes. However, in the mid-term as sufficient funds are accrued for stabilization purposes this tension would likely be reduced.

Box C: Characteristics of Selected Sovereign Wealth Funds

Several governments use natural resource royalties to finance an array of funds that can help smooth the impacts of cyclical economic shocks, advance structural development goals or facilitate inter-generational savings. These funds vary substantially in scale, design and objectives. The table below shows some properties of funds in Alaska, Alberta, Norway, and Western Australia.

Table C1: Features of Stabilization Funds in Alaska, Alberta, Norway, Western Australia

Economy	% Royalties Deposited	Size of Fund	Oversight
Norway	100%	$1 trillion USD	Central Bank
Alaska	25%	$65 billion USD	State-Owned Corporation

comparison to WA's overall revenue base has not been large enough to negate the potential benefits of a state stabilization fund. Moreover, the recent GST reform of 2019-2020 sets a minimum floor transfer for each state. Without the concern for a lagged shrinking of GST transfers, the state can move forward with savings fund and not face as high a negative shock to these grant transfers.

Alberta	0% - 30%*	$17 billion USD	State-Owned Corporation
WA	1%	$1 billion USD	State Treasury

Note: 1 Has varied over time
Source: see References section

The Norwegian and Alaskan funds are the largest in part because they follow strict rules to maintain financial health. In particular, these governments have continuously devoted large shares of resource royalties to their funds and have primarily spent their funds' investment income rather than principal. There are key limitations on how this financing can be altered. For instance, the principal of Alaska's fund is protected by the state constitution, and the Norwegian government can withdraw at most 3% of its fund's value annually. These funds have been managed relatively apolitically, through institutions that are deliberately independent from the regular political process.

In contrast, the Albertan fund was managed directly by the Albertan Ministry of Finance until 2008 and has been subject to considerable adjustment. It initially received 30% of resource royalties after its creation in 1976, but these contributions were halted outright in 1987 to repay provincial debt instead. In addition, the fund's principal has been drawn down to finance a series of loss-making economic diversification projects, including a cell phone manufacturer, a pulp mill, and a canola oil plant.

The revenue directed towards these funds of course depends not only on the share of royalties taken, but also the total royalties that are leveraged. Alaska and Norway had Marginal Effective Tax & Royalty Rates on oil of 32.9% and 32.4% respectively in 2019, versus 23% in Alberta. This indicates that Alberta may have some room to increase its oil royalty rates, keeping in mind possible differences in profitability of its oil sector. For comparison, WA's Marginal Effective Tax & Royalty Rate on iron ore in 2016 was estimated as 37.1%, a rate similar to that found in Minnesota (35%) and South Africa (38.4%).

While Norway, Alberta and Alaska use fund revenues to support their general budgets, the latter additionally earmarks a share of its investment income to provide an annual payout of approximately $1,600 USD to all its residents. Although this provides a form of Universal Basic Income (UBI) for Alaskans, it also reduces the flexibility of fund expenditure. The share of investment income directed towards these individual payments versus the state budget can be adjusted by elected officials, which has resulted in some political controversy in recent years.

Whereas the other governments in the example table above began spending returns from fund investment soon after their creations, the WA Future Fund stipulates that all investment income must be reinvested in the fund until 2032. This may be because WA devotes a comparatively smaller share of resource royalties to the fund; a 20-year protection period gives it some runway

to grow in scale before expenditure begins. Ultimately, this cross-comparison is a starting point for policy discussions on establishing stronger complementary inter-temporal stabilization funds to channel returns from the mining sector into future resources for various purposes.

3rd Principle: Set objective rules for deficit spending/debt accumulation

Counter-cyclical fiscal policy requires not only saving during good times but limiting the adverse effects of contraction during adverse times. Policy initiatives need to be planned in advance to mobilize relief and stimulus spending so that it takes place quickly and efficiently. Likewise, deficit spending and debt management must be guided by an intertemporal framework that provides objective information for political decisions on debt accumulation. Strengthening objective rules, approved under wide-ranging societal consensus and enforced by independent civil servants, is necessary to effectively counteract pressures during political cycles.

- In line with the discussion in the previous section, WA can create a rule for when exactly stabilization funds can be drawn on. This can be based on signals such as: labor market signals of a downturn, target gaps in the output gap, shocks to real household disposable income. Transparent and professional managed commodity funds are versatile and can be adapted to suit the State's needs. Automatic stabilizers such as savings funds are strengthened not only by how much and the frequency of savings, but also the agenda that determines how they are spent and managed.

- Even with savings funds for stabilization and intergenerational uses, debt accumulation can be used at times to optimize counter-cyclical fiscal policy. In particular, borrowing during downturns to amplify an appropriate fiscal response can be fully appropriate if the costs of borrowing are manageable within a clear debt management framework that accounts for long-term risks. A debt management strategy must see the debt-to-GSP ratio fall during most years, such that it can rise during clear times of need. An objective strategy with rules for accountability is needed in WA since the past boom included persistent deficit spending and the subsequent slowdown utilized relatively little debt accumulation compared standard ratios for government debt management.

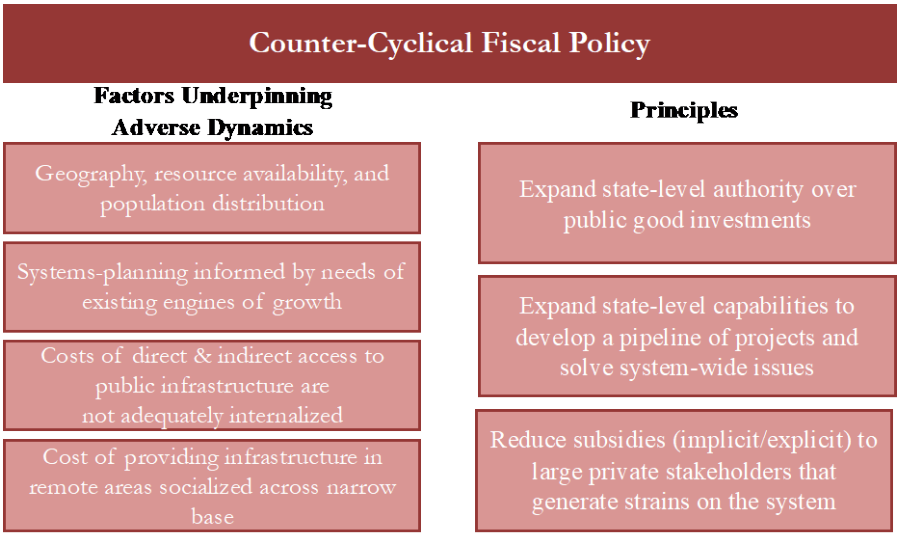
6.3 From Misalignment to Better Alignment of Public Goods Provision

This policy goal is the most wide-ranging and least amenable to a concrete policy roadmap, but equally critical. A more diversified WA economy, with adequate labor supply availability across regions, will require different public goods and different systems than the concentrated economy of the past. But knowing which infrastructure and public services will be needed by industries that are not yet present is far from straightforward. Likewise, creating better living conditions in places that do not yet have a critical mass of population is very challenging. This section focuses more

on policymaking processes more than policies or specific initiatives, because rising to these challenges ultimately requires increasing institutional capabilities to discover and deliver valuable public inputs for the whole of society. This goes hand-in-hand with reducing the overall orientation of public goods to serve the needs of large existing industries without necessarily serving the needs of others.

Figure 46 again summarizes factors that have led to misalignment of public goods and policy principles that can guide a transition to better provision of public goods. The sheer size of the state, the mismatch in location of highly productive sectors and population centers, and the natural scarcity of key natural resources make public goods provision highly challenging. Added to that is a legacy of the systems-planning that was naturally tied to existing engines of growth and the existing population base, which has also led to widespread ways in which access to key resources are paid for by all of society for use by established industries. To address these challenges, it will be crucial for decision-makers and organizations who design, plan, and approve public investments to be integrated and aligned with the broader diversification goals of the State and thus have a forward-looking process for prioritizing public good spending and resolving systemic constraints in public infrastructure. This will likely require some re-designing or re-negotiating long-standing arrangements with the Commonwealth government, which will allow the State to design and carry out its own strategic infrastructure provision plans. But even before gaining new authorities, steps are needed to build the capabilities of state institutions to better deliver on its responsibilities. This is essential for delivering new types of public investment that can jumpstart diversification and support long-term population growth. Finally, access to many public goods and services are not priced at their true cost to society, including future generations. The last policy principle entails leveling the playing field in access to scarce resources across the state, which may require different actions for regulating existing companies and charging new entrants varying fees and taxes for use of scarce resources and strains that they introduce on public systems.

Figure 46: Better Aligned Provision of Public Goods Factors and Principles



1st Principle: Expand state-level authority over public good investments

Authorities note that much public good spending and investment is federally controlled which constrains the resource base that may be available to address the substantial challenges around public goods provision. This system also limits the abilities of the State to set holistic priorities for infrastructure development since many funds are effectively earmarked by decisions that take place far from the state and its unique issues. Through more state autonomy with systematic input from regional and local authorities, infrastructure expansion could better match needs of a diversifying economy and healthy population growth.

- Acting on this principle requires a careful review of all Commonwealth transfer mechanisms to identify those where more autonomy of the State would be most effective. This was beyond the scope of this research, but it is likely that many Commonwealth goals could be better achieved by State-level decision-making guided by clear frameworks.

- Within WA, the same optimization between centralized and de-centralized decision-making is needed. In the case of the State, there appears to be significant room for improving state-local information sharing and coordination mechanisms such that local needs and priorities are fully incorporated into State planning. Several tools toward this are embedded in the principle below.

2nd Principle: Expand state-level capabilities to develop a pipeline of projects and solve system-wide issues

Even before gaining any expanded autonomy for public goods planning, the State would benefit from strengthening processes and institutions to deliver on its existing responsibilities for developing, prioritizing, and delivering public goods. Two current areas of weakness stand out. The first is an uneven infrastructure development across the state and potentially suboptimal project prioritization. The second area of weakness is the prevalence systemic issues in infrastructure networks and pricing policies that have undermined the effectiveness of infrastructure systems to deliver high-quality services with broad access at an accessible price. Some such issues have been discussed in this report for electricity and water, but others were not fully explored in air travel, rail, telecommunications and housing. Each of these weaknesses – in prioritizing infrastructure for the future and addressing current systemic issues – could be resolved through targeted institutional development and new processes.

- WA could expand capabilities through a dedicated institution for developing and delivering a pipeline of public investment projects – particularly in regional WA – based on rigorous feasibility studies and economic transformation potential. The idea here is that this role of the state cannot be effectively served through the budget process itself or public spending alone, but rather there needs to be a unit of government with this sole mandate that works continuously throughout the year and has both the staff to handle a variety of technical

tasks that require specialized skills and an institutional set-up that leverages many stakeholder interests.

- This unit could have staff spread across the state, rather than concentrated in Perth, to ensure close coordination with local authorities and to recognize emerging needs in different areas. There could also be targets for maintaining and delivering a project pipeline that is equitable across regions and a process for addressing when imbalances emerge.

- In terms of the public investment projects that are in the pipeline, it is essential that these not only be traditional public goods but also have a focus on two key needs: (1) developing coordinated public goods related to industry clusters that create conditions for diversification opportunities particular to locations; and (2) developing innovative projects to increase the livability of regions.

    - One potential example of industry cluster planning would be to develop public research areas, industrial parks, housing, and community infrastructure in areas where innovative private-sector renewable energy projects are set to launch. Such cluster planning requires careful design considerations and managing risks, but the potential upside would be in developing an ecosystem for innovation that catalyzes wide-ranging private sector opportunities and a starting point for population growth. Additionally, it could more adequately consider how to effectively co-deliver missing inputs associated with the development of prospective industries with high-potential

    - Other strategic public investments continue to be necessary to increase the attractiveness of living in regions and spur local population growth. Chief among the needs is for innovations in housing systems that can scale up rapidly in places where local labor demand grows and at costs low enough that housing prices are not as volatile as in the past. These housing systems must also be built in such a way that allows local communities to develop to include broader amenities such as consumer and leisure goods and service, enhancements to the physical and aesthetic appearance of the place, other goods and services that directly raise quality of life (i.e.: schools, hospitals, and public safety agencies). Perth has made significant advances in providing these groups of amenities. There are many examples of public investments in healthcare, education, culture, arts and leisure to support this. While some of them may not have been executed in the most efficient way possible, they have, undoubtedly, contributed to making Perth the 14th most livable city in the world (Economist Intelligence Unit, Global Livability Report, 2019). However, there is still a lot of space to increase amenities in

the regions and facilitate long-run population growth in regional WA. This will require a concerted effort among State and regional officials and will have interactions and overlaps with many of the initiatives outlined in earlier sections.

- This unit would need dedicated staff with experience in project finance, which might require recruiting staff from the private sector, in order to structure a wide variety of project modalities (fully public, public-private, concessions, etc.) based on the best opportunities.
- This unit could have structured linkages with utilities in order to coordinate with their own planning processes, including Western Power, Horizon Power, the Water Corporation, and others.
- The existing Royalties for Regions Program may provide an adequate financial basis on which to develop these pipeline planning capabilities.

- While the research underlying this report has not included a review of all existing strategies for system-wide planning to increase supply, reduce costs, and improve quality of public services, the following general observations are relevant for the challenge of addressing systemic issues that have grown over time.
  - The existing Energy Transformation Strategy is holistic and well matched to resolve the interacting issues in the system that have resulted in undersupply and very high electricity prices. As the implementation of this strategy is now delivering clear results, there may be opportunities to use this experience as a model for other transformation strategies (housing, internet/telecommunications, rural education, rural healthcare, etc.).
  - Recognizing the power of crowdsourcing design ideas, WA could use more of the power of state procurement as an incentive to catalyze innovative solutions to public goods challenges using both private sector innovation (such as in prefabricated housing). This is especially important when transformation strategies identify areas where policies need to be paired with new technologies, which the public sector will not be able to develop on its own.

3rd Principle: Reduce subsidies (implicit/explicit) to large private stakeholders that generate strains on the system

Throughout WA's history, many traditional public goods have been developed privately by large companies operating in remote regions. This may have been necessary, but the accumulated result has been problematic in that private infrastructure has crowded out the State's ability to develop systems that serve society as a whole and private infrastructure has entailed public costs. In many

cases, private infrastructure even creates a new strain on the public sector. For example, a private rail line forces the public transportation network to pay for added costs to cross it. In other cases, the implications are less obvious but still costly. For example, private air travel still requires public safety measures and air traffic controls. In still other cases, the private use of a scarce resource, like water, at little or no cost implies very high costs borne by society as a whole, including future generations. In many ways, direct and indirect, society at large subsidizes large private stakeholders through these channels while receiving relatively limited social return. Reducing both implicit and explicit subsidies to large mining firms in particular – and other large private stakeholders in general – would shift more of the tax burden from the rest of society to the mining sector and would make the State responsible for delivering public goods that serve broader public interests rather than settle for private infrastructure that serves narrow interests. Additionally, explicit subsidies should be targeted to nascent industries in a time-bound way that would help to support the emergence of new engines of growth.

As with the second policy principle, this one requires different actions to reduce existing implicit subsidies to a more limited degree and policy changes to reduce future subsidies to a larger degree.

- For existing large private operations:
    - WA can and should review regulations and regulatory enforcement. Where regulations are weakly enforced, it should be made a priority to fully enforce them.
    - Meanwhile, overly generous subsidies may be revisited if the public benefit of changes is very large.
- Looking forward, policy changes can set the stage for much less implicit and explicit subsidization of large companies in the future.
    - Explicit subsidies to established industries should be rationalized moving forward. To the extent subsidies are used, they should be focused on nascent industries and should be time-bound so as not become permanent when nascent industries grow into established industries.
    - Meanwhile, WA should consider options for increasing effective royalty rates on future mining operations and/or charging fees for any private sector activities that create strains on public infrastructure provision.
    - Where the social costs of using finite resources (such as surface and groundwater) at the expense of future generations are not internalized, WA consider mechanisms to charge for their use (which could be through tradable quotas or taxes).
    - WA could review regulatory institutions with an aim toward providing state and local authorities much stronger authority over upfront approvals of private

infrastructure development and oversight of infrastructure use, in both cases to ensure broad public benefits and limit social costs.

6.4 Fostering the Development of New Engines of Growth

This cross-cutting policy goal is complementary to the three policy pillars outlined above. If progress were to be made across all three pillars, we would expect a range of new economic activities to begin to emerge, likely starting with many that were identified in the *Economic Complexity Report*, but many other industries may likewise benefit. A flexible labor supply would reduce outsized wage pressures that may crowd many nascent and potential industries. More flexible channels of immigration and an optimized strategy for skills acquisition would also complement the existing knowhow base of the state to enable the development of new diversification opportunities. Meanwhile, counter-cyclical fiscal policy would be able to leverage part of the revenues generated by mining booms to facilitate entrepreneurship, self-discovery and overcome coordination failures. With improved processes for planning public goods provision and improved public-private coordination, more of the necessary inputs for competitiveness would be in place to benefit society at large.

At the same time, as new engines of growth emerge, this would make the principles of the three policy pillars easier to achieve. A more diverse WA, with robust complementary engines of growth to the mining sector, would be less vulnerable to adverse shocks to global commodity demand and would support a more sustainable and equitable growth process. WA's complementary engines of growth could expand concurrently with mining during commodity booms and absorb excess labor capacity during downturns in commodity demand, reducing the risk of major labor dislocations. Alternative engines of growth could also provide new channels of investment that – in the long term – could reduce the volatility introduced by mining investment cycles as well as introduce more stable sources of revenue. Both elements would serve as additional economic stabilizers to substantially complement efforts of counter-cyclical fiscal policy. A more diverse WA would contribute to generating additional economic agglomerations, particularly in regions, which could facilitate planning for the long-term demand of public goods and favor the fiscal sustainability of these efforts.

Like the previous section, here we focus more on policymaking processes rather than policies or specific initiatives. This is necessary because productive development policies must be highly context-specific and engage committed private sector stakeholders in order to be well-designed and adapted over time as appropriate. However, we can draw upon several examples of promising industries identified in the *Economic Complexity Report* to outline how the active fostering of new engines of growth could look in practice. It is important to note that it would be misguided to treat this cross-cutting area in isolation of the actions to sustainably address the deep structural issues of the three pillars, because without addressing those foundational problems, actions described here would be likely to run into fundamental problems that would undermine success.

Self-Discovery Promotion

In part, the process of diversification happens through businesses exploring how they can expand on products that they make and services that they provide in a place and, often, through businesses in one place determining that they can do what they currently do in a new place. In both cases, the process involves businesses and entrepreneurs discovering opportunities and taking risks, and in the process figuring out what works, what doesn't work and what may work if certain constraints are lifted.

The State may play a role in supporting discovery by lowering risks engaged by entrepreneurs. This support does not have to be limited to financial support through targeted credit or tax incentives, which may not be viable or sustainable. Support can also take the form of addressing information asymmetries; connecting high-potential projects local projects with local, national and international networks that support high-impact entrepreneurship (incubators, accelerators, venture capital); facilitating partnerships through research institutions (national and global) that can inform businesses processes and innovation; public programs to subsidize missing inputs (ranging from office space to consulting services in key areas); and other initiatives that can minimize the risk of active self-discovery.

For example**,** consider the opportunities identified in the *Economic Complexity Report* grouped under Professional Services. WA appears to have a latent comparative advantage for wide-ranging professional services, including in information technology, engineering, legal services, design services, research and consulting. At present, many individuals working in such jobs are focused on providing services to existing industries, with the exception of a non-trivial number of immigrants who have moved to WA to work remotely for companies in other countries. Potentially, there is room to expand the scope and scale of this type of work by leveraging WA-specific structural advantages.

It is now clear that COVID-19 has caused a rapid acceleration in the global economy's capacity for remote work, which opens wide-ranging opportunities for self-discovery in WA, given the very high quality of life that the state offers. As stated before, public policies can support this self-discovery through many means. Some actions may include targeted marketing initiatives key markets that either share a time-zone, language or broader work culture. Such initiatives would clearly need to be complemented by appropriate immigration policies. They may also be complemented by such public-private developments as shared offices (with COVID-19 measures) with robust "plug-and-play" telecommunications infrastructure and targeted communities for housing rentals with attractive leasing programs. Most of all, such programs could target WA-based companies that are providing professional services abroad through targeted public inputs, regulatory measures, and potentially fiscal incentives in the form of wage subsidies, payroll tax benefits or otherwise. Since this group of stakeholders already exists in the country, measures could be developed in consultation with the private sector (see comments below on public-private dialogue for guidance on how to do this).

Identifying and Addressing Industry-Specific Binding Constraints

Through a mix of quantitative analysis and careful use of qualitative evidence, it is often possible to identify critical constraints holding back the expansion of certain industries and the emergence of related industries. When this is possible, the obvious question for government is whether the State can fix that problem at a reasonable cost or rather if it can be addressed thought effective coordination with private sector stakeholders. Box D provides some examples of quantitative analysis of electricity and water constraints that could be expanded to understand these constraints. Similarly, the *Economic Complexity Report* includes other examples when considering complementary feasibility measures for potential diversification opportunities. However, this identification of constraints is often most feasible for industries in particular locations. Here we provide two brief illustrative examples based on the *Economic Complexity Report*.

First, consider the potential development of the Intermediate Inputs and Materials Manufacturing grouping in the Pilbara. Since many large mining and LNG operations are located in the region it can be a uniquely attractive diversification opportunities in "upstream" industries that provide physical inputs to these operations. This includes a variety of chemicals, metal products, plastics, and construction materials. The physical advantage of being close to these operations creates immense demand. However, the region appears to lack several critical inputs to scaling and diversifying production of these products. This includes very high cost electricity, very minimal water and wastewater treatment infrastructure, and highly limited port access resulting in high transportation costs. The region also suffers from a shortage of reliable housing for permanent workers, but this is gradually being improved. As discussed in the *Growth Perspective Report*, these infrastructure shortages are partially the result of infrastructure being provided by large companies to serve their own purposes. This collection of constraints suggests that opportunities may emerge quickly if the region were to be served by a broad-use port and the development of modern industrial parks to provide high-quality electricity service, water, waste management infrastructure. Set-ups of this nature allow firms to partially benefit from agglomeration – even in otherwise remote settings. Agglomeration makes a set of indirect benefits possible, noteworthy among which are savings in transportation costs, general availability of qualified workers, and enhanced access to key public goods and logistical infrastructure. Additionally, these types of economic areas may be leveraged to introduce geographically bounded stable regulatory frameworks that may allow firms to circumvent certain key restrictions (i.e.: immigration exceptions). Lastly, as these areas may be targeted for specific types of activities it also facilitates the process of identifying and addressing additional specific industry-place bindings restrictions that may emerge over time.

Second, consider Technology and Advanced Manufacturing opportunities around sites of renewable energy development. WA has several opportunities to be on the forefront of renewable energy development, including around very large scale solar and wind, hydrogen as a "green" fuel source, and even wave power. Like mining industries of the present and past, natural resource availability (sun, wind, waves) will ultimately determine where renewable energy generation takes

place. But public policy will determine the extent to which positive economic spillovers occur around these developments. If it aims to seize this opportunity, it's important for the State to develop plans for the development of coordinated public goods in areas where private development is likely to take place in order that innovation ecosystems develop alongside the generation projects themselves. Moderate public investment toward research clusters in collaboration with top research universities and the private sector may create the space for technological innovations and intellectual property to be developed in WA. Research locations in close proximity to the generation projects themselves may be uniquely positioned to research, develop and patent the many supporting technologies that renewable energy production will need. But in the absence of public goods to create the space for an ecosystem to emerge, these technologies may end up being developed elsewhere or within a few multi-national companies with limited spillover for the state's economic ecosystem. These clusters will need basic research infrastructure and housing development at minimum. Such clusters may prove to be opportunities for of innovative housing development as discussed elsewhere in this report in order to quickly provide housing in remote areas and minimize the risks to the financial sector that can undermine housing development.

Note that actual constraints may not be well-captured in these illustrative examples. It is critical that diagnoses of constraints be verified through robust and consistent evidence prior to launching potentially expensive public actions as illustrated here.

Systems for Public-Private Strategic Dialogue

Independent analysis can only infer potential constraints from publicly available information. Moreover, this information may be relevant for the median firm in a median location, but it may not be pertinent for a specific relevant stakeholder in the context of WA. In this sense, existing spaces for dialog between the private and public sector, may serve as a mechanism for collecting some of this information. However, these spaces have two limitations. The first one is that the quality of information gathered in repeated interactions may be constrained by the ability to effectively act on that information to address constraints to productivity, either directly or in collaboration with the private stakeholders. The second limitation is that these mechanisms are skewed in favor of the stakeholders already in WA, so that may be less informative with regards to the missing inputs that have prevented the appearance of new industries. Hence, existing spaces of dialogue could be complemented with proactive information gathering via a revamped investment promotion unit that actively seeks out and documents unobservable aspects that discourage prospective investors in high potential industries.

With regards to the first limitation some relevant experiences refer to productivity councils or sector specific roundtables. These are temporary public-private working groups that are not focused on ways to directly increase firm profitability, but rather on tackling factors inhibiting productivity such as: market failures, misalignments in the availability of public goods and services with productive needs, outdated regulatory frameworks and poor service delivery due to limited public-public coordination.

These initiatives tend to include three groups. First, representatives of the private sector autonomously organized around a sector or cross-cutting issue. These representatives should be fully aware of the challenges faced by firms on a day-to-day basis, have a broad view of ways to address these issues, and be able to make concrete commitments to address these issues. Second, broad representation of the public sector. These representatives should have a real ability to execute initiatives and a concrete mandate to do so. Usually, these public sector representatives tend to be at the secretary or director level. Lastly, the mechanism requires a full-time coordinating group, responsible for guaranteeing the fluidity and continuity of interactions and facilitating the monitoring of progress of both concrete initiatives and projects. The coordination group can also facilitate access to independent technical advisory assistance in order to inform decision making on matters outside the parties' areas of expertise. (Crespi & Stein, 2014; Guezzi, 2016). These groups tend to meet to meet frequently to quickly move from deliberation to execution. The initiatives agreed upon tend to be concrete, specific and achievable in the short-term. These initiatives are closely monitored to detect implementation problems as they arise and to validate the commitment of all relevant stakeholders. In terms of the initiative's scale, these tend to start modestly (one or two roundtables), to allow stakeholders to learn from the experience, and adjust the design before extending the initiative to a larger number of sectors.

Lastly, with regards to investment promotion agencies, many institutions can expand their information gathering capabilities by considering a few guiding principles. First off, they can focus their information gathering mechanism on a reduced set of economic sectors, for instance those identified in the *Economic Complexity Report* or other relevant industries. Second, they can advance industry specific analysis to identify key observable requirements for the development of the industry. These analyses can be similar to the one described in Box D or the ones leveraged to construct the complementary feasibility measures of the *Economic Complexity Report*. Third, the agency can document qualitative and quantitative evidence of the location's ability to satisfy these key observable requirements. Where observable gaps exist, the agency can work with the relevant public sector stakeholders to identify prospective policy solutions to these issues or document previous experiences overcoming similar gaps. Fourth, the agency can coordinate with rest of the public sector in order to identify and help troubleshoot common issues generally associated with setting up new firms in the place, through a standardized and simplified policy process. Fifth, the agency can contrast both the availability of observable requirements and policy offerings of the location vis-à-vis other relevant destinations.

All this information can be consolidated in industry specific pitch-books, which essentially serve as a mechanism to jump-start conversations with key industry players either in a bilateral fashion or in the context of targeted participation of conventions, fairs, roadshows and other diffusion mechanisms. Initial interactions of this nature will rarely lead directly to investment commitments. However, these interactions will serve as a mechanism to identify previously unobserved additional constraints which may in-turn inform policy offerings and improve the likelihood of success in future interactions.

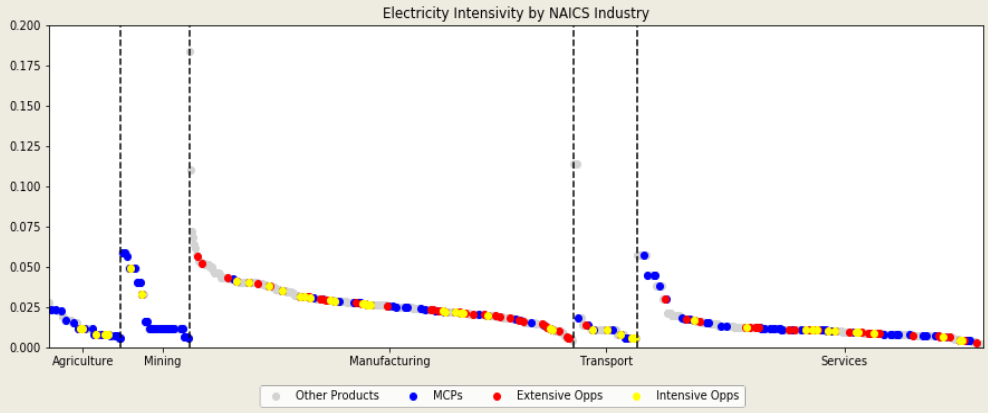
Box D: Public Infrastructure as an Input for Diversification Strategies

While it is clear that infrastructure provision in WA has gaps that may undermine the competitiveness of non-mining and non-agriculture activities, it is not necessarily the case that addressing all of these issues across the state is a necessary precondition for diversification. Business activities that are very intensive in electricity will certainly find WA to be a very expensive place to do business until the state can sustainably lower the price of electricity. Water-intensive industries will be limited to locations where they can be sure that they will have adequate supply. Similarly, industries that require good physical connectivity to other economic hubs will also have limited options for where they can locate. However, not all economic activities are intensive on all public infrastructure.

Building on the *Economic Complexity Report for Western Australia*, we can begin to quantify how common these constraints are likely to be among promising diversification opportunities. **Figure D1** shows the electricity intensity of all industries, with industries in which WA already has shown a revealed comparative advantage (i.e. MCPs) colored blue and promising diversification opportunities colored yellow and red, depending on whether they would be new industries (extensive opportunities in yellow) or expansions of existing industries (intensive opportunities in red). **Figure D2** shows the same graph based on water intensity of production. When yellow dots fall below blue and red dots, it means that prospective industries are less intensive in the use of the factor than industries that have already been developed in the state. Hence, the factor is less likely to be an active constraint to diversification and vice versa.

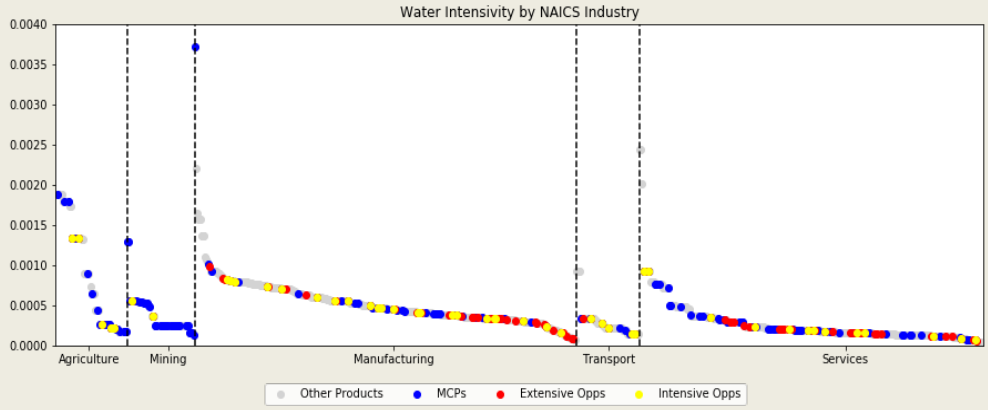
For both electricity and water, potential new industries in manufacturing tend to be significantly more intensive than the current ones, which are located at the low-intensity end of the spectrum. This might mean that promising manufacturing industries find themselves constrained in reality. For example, rolled steel manufacturing is an identified opportunity on the intensive margin that is intensive in electricity use. Our own qualitative interviews revealed an interest in producing steel products in the Pilbara to serve final demand from mining companies, but a planned galvanizing plant would face prohibitively high electricity costs if it purchased electricity from the grid. Hence, if the project is going to go ahead, it will need to provide its own renewable generation capacity.

Figure D1: Electricity Intensity of Current Industries and Key Diversification Opportunities



Source: BEA Input Output tables

Figure D2: Water Intensity of Current Industries and Key Diversification Opportunities



Source: BEA Input Output tables

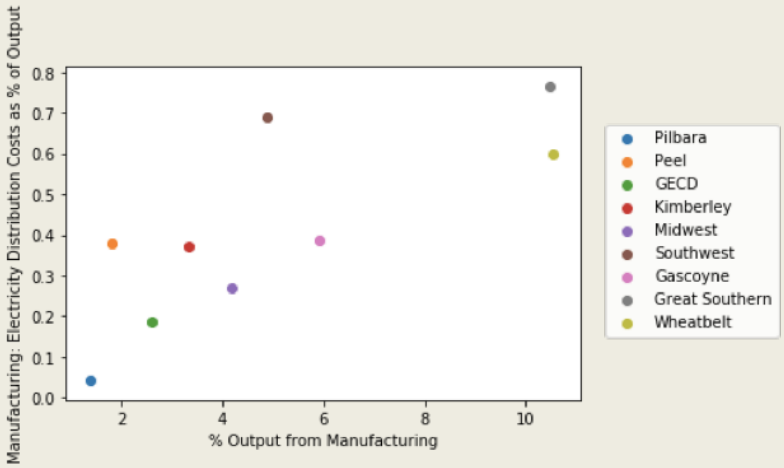
Meanwhile, the majority of prospective industries in non-manufacturing sectors tend to be as intensive in the use of these factors as existing industries, which signals that these factors may not pose a critical constraint to their development. However, they might be facing other sector specific constraints and thus require additional analysis and active engagement with sectoral stakeholders.

Even this preliminary analysis can be helpful in enhancing diversification strategies. For one, it can serve to prioritize efforts around industries that are less-intensive in the use of scarce public goods. Additionally, it can guide productive dialogue with private stakeholders towards addressing constraints to productivity (i.e. access to cheaper renewable energy in the Pilbara) rather than just fiscal benefits. It also provides a framework to advance diversification initiatives in parallel to

medium- and long-term reforms of public infrastructure provision. Lastly, given that different regions have different levels of public infrastructure quality, it can help to fine-tune the roles different regions may play in a state-wide diversification strategy.

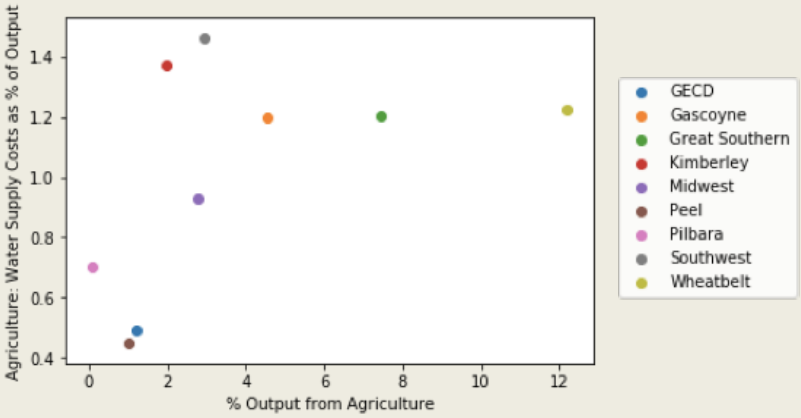
For instance, there is compelling circumstantial evidence that regions with infrastructure constraints may specialize away from those constraints in response. In particular, regions with lower shares of output from agriculture tend to engage in sub-industries within agriculture that are less water-intensive, and vice versa. Similarly, regions with lower shares of output from manufacturing tend to engage in sub-industries within manufacturing less electricity-intensive manufacturing and vice versa (**Figures D3 and D4**). This type of information is useful in teasing out locations in the state that may be best suited to support the development of prospective industries intensive in the use of a given public infrastructure.

Figure D3: Electricity Intensiveness of Manufacturing Output by Region



Source: Remplan

Figure D4: Water Intensiveness of Agriculture Output by Region



Source: Remplan

6.5 Concluding Thoughts

Western Australia benefited significantly from the global commodity supercycle experienced between 2002 and 2014. During this period, WA attracted hundreds of billions of dollars in new mining investments, which served as the main driver for rapid economic growth. However, as global demand growth for key commodities slowed, the flow of investment toward expanding mining capacity came to a halt. The impact of this sudden stop reverberated throughout the economy and across the state. As demand for labor fell, the state lacked supplementary engines of growth that would have been able to absorb workers, which resulted in a sharp increase in both unemployment and underemployment.

Therefore, even though WA's growth trajectory over the last two decades significantly outperformed other states of Australia and regional peer economies worldwide, the growth process built up economic pressures that led to sharp corrective forces. Growth hinged on a single factor heavily influenced by exogenous variables – investments geared at expanding the capacity of the mining sector - and WA was unable to promote the necessary economic resiliency to manage significant external shocks. The *Growth Perspective Report* detailed three self-reinforcing channels that together contributed to the sharpness of the economic downturn: labor market imbalances, pro-cyclicality of fiscal policy, and a misalignment of public goods. The report proceeded to discuss factors that underpin each of these challenges. Addressing these factors and reducing the self-reinforcing adverse dynamics associated with these channels will be critical for WA to overcome repeated boom-slowdown dynamics.

Additionally, the state would benefit from the introduction of new complementary engines of growth. These engines of growth would help to advance the intermediate goals of addressing the self-reinforcing adverse dynamics and also the broader goal of a more sustainable and inclusive growth path. The *Economic Complexity Report* outlines some key challenges around a diversification agenda, namely the how the knowhow embedded in industries that are present in WA do not stimulate diversification as easily as other similar states, both in Australia and globally. This reflects a pattern where employment and exports are concentrated in low-complexity sectors overall and in low-complexity activities across all sectors. This – alongside the channels identified in the *Growth Perspective Report* - helps to explain why diversification of WA's exports has been very limited over the last decade in particular and underscores the need for the state to take a strategic approach to catalyzing economic diversification if the future is to look different.

Despite being at a disadvantage for diversification versus other states, applying a tailored process to identify the most promising industries for diversification still yielded a wealth of opportunities. Looking across these opportunities, there is a clear potential for the state to build on its "upstream" capabilities to serve the demand of its very productive industries (i.e.: mining, agriculture, healthcare, education, etc.) and innovate to serve the future needs of the rest of the world. WA's economy need not be exclusively tied to its long history as a primary resource-driven economy.

Rather, through forward-thinking uses of its natural resource wealth and continued policy innovation, WA's economy can diversify to develop supplementary engines of growth that can expand concurrently with mining during commodity booms and absorb excess labor capacity during global downturns in commodity demand. More so, it can eventually position itself on the innovation frontier of the global economy.

In order to advance these dual goals of addressing adverse growth dynamics and catalyzing diversification, this report has introduced a coherent policy framework that seeks to serve as an organizing mechanism for policy initiatives across multiple stakeholders and levels of government. It considers three main policy goals – labor market balance, counter-cyclical fiscal policy and, better alignment of goods provision – to address each of the main channels identified in the *Growth Perspective Report*. For each policy goal, the framework lays out a mission statement, which introduces the overarching objective of diminishing and reversing the adverse dynamics that affect the channel. It then considers a set of principles that aim to address the underlying factors and brief list of potential policy initiatives that would fall under each principle. The three main policy goals are complemented by one cross-cutting policy goal – fostering the development of new engines of growth. Progress in each of the policy goals, favors (directly or indirectly) progress in the other policy goals, which introduces positive self-reinforcement dynamic.

The process and results from this analysis are intended to serve as a starting point for further work, study and collaboration. Opportunities abound for the state and its regions but capitalizing on these opportunities will require new forms of collaboration across public sector institutions, between the public sector and private sector, and between Perth and the regions. Hopefully, through further iterations, these findings and the policy responses that emanate from them will improve and lay the foundation for institutional innovations and a broad-based long-run economic development strategy.

7. References

Australian Bureau of Statistics. Various tables and years of publication. Distributed by the Commonwealth of Australia. https://www.abs.gov.au/

Australian Energy Statistics. 2019. Distributed by the Department of Environment and Energy. https://www.energy.gov.au/publications/australian-energy-update-2019

Annual Reports. Western Australia Treasury Corporation, 2019

Bond-Smith, Steven, M. Dockery, A. Duncan, D. Kiely, S. Salazar. *Future-Proofing the WA Economy: A roadmap to industrial diversification and regional growth*. Bankwest Curtin Economic Center, 2019.

Census of Australia. 2006, 2011, 2016. Distributed by the Commonwealth of Australia, Australian Bureau of Statistics. https://www.abs.gov.au/census

Consumer Price Index database. 2020. Distributed by the Commonwealth of Australia, Bureau of Australian Statistics. https://www.abs.gov.au/ausstats/abs@.nsf/mf/6401.0

Crespi G., Fernández-Arias E., Stein E. (2014). "A Conceptual Framework for Productive Development Policies." En: Crespi G., Fernández-Arias E., Stein E. (eds.), *Rethinking Productive Development*. Palgrave Macmillan, New York.

Diodato, Dario. *A network-based method to harmonize data classifications*. No. 1843. Utrecht University, Department of Human Geography and Spatial Planning, Group Economic Geography, 2018.

Designated Area Migration Agreement. City of Kalgoorlie-Boulder, 2019

Dun & Bradstreet Dataset. 2019. Distributed by Dun & Bradstreet. Private access dataset.

fDi Markets Dataset. 2019. Distributed by the Financial Times. Private access dataset.

Future Fund Investment Holdings Reports. Department of Treasury of the Government of Western Australia, 2017-2020.

Gillies, Stewart, H. Wei Wu, G.D. Just. *The success of fly-in-fly-out Australian Mining Operations.* Proceedings, Second Gold Forum on Technology and Practice, The AusIMM, Melbourne, 1991, pp. 391-397.

Glaeser, Edward, Kolko, J., and Saiz, A. *Consumer city*. Journal of Economic Geography, 1 (1), 27–50, 2001

Global Livability Report. The Economist Intelligence Unit, 2019

Ghezzi, P. (2016). "*Mesas ejecutivas: A new tool for productive diversification*". Ministerio de la Producción del Perú.

Hausmann, Ricardo, and B. Klinger. *Structural Transformation and Patterns of Comparative Advantage in the Product Space*. KSG Working Paper No. RWP06-041; CID Working Paper No. 128, 2006

Hausmann, Ricardo, Hidalgo, C., Bustos, S., Coscia, M., Chung, S., Jimenez, J., Simoes, A. and Yildirim, M. *The Atlas of Economic Complexity*. Puritan Press. Cambridge MA, 2011

Hausmann, Ricardo, et al. *The atlas of economic complexity: Mapping paths to prosperity*. MIT Press, 2014.

Hausmann, Ricardo, et al. *Jordan: The elements of a growth strategy*. Working Paper No. 346. Center for International Development at Harvard University, 2019.

Hausmann, Ricardo, and C. Hidalgo. *The Network Structure of Economic Output.* Journal of Economic Growth, 2011

Hausmann, Ricardo, Morales Arilla, J.R. and Santos, M.A. *Panama beyond the Canal: Using Technological Proximities to Identify Opportunities for Productive Diversification*. Working Paper No. 324. Center for International Development at Harvard University, 2016.

Input-Output Accounts Data. 2012. Distributed by the Bureau of Economic Analysis of the US. https://www.bea.gov/industry/input-output-accounts-data

Labor Force Survey. 2020. Distributed by the Commonwealth of Australia, Australia Bureau of Statistics. https://www.abs.gov/AUSSTATS/r

McKenzie, Fiona Haslam. *Chapter 15: Fly-in fly-out: the challenges of transient populations in rural landscapes*. Curtin University of Technology, 2010.

Mulligan, Gordon and Carruthers, J. *Amenities, Quality of Life, and Regional Development.* In Investigating Quality Urban Life, Theory Methods and Empirical Research, Marans, R., Stimson, R., (eds), Springer, Dordrecht, The Netherlands; 107–134, 2011

Occupational Employment Statistics Dataset. 2018. Distributed by the U.S. Bureau of Labor Statistics. https://www.bls.gov/oes/home.htm

OECD Regional Statistics. 2019. Distributed by the Organization of Economic Co-operation and Development. https://www.oecd-library.org/

Paredes, Dusan, J.D. Soto Díaz, D.A. Fleming-Muñoz. *Wage compensation for fly-in/fly-out and drive-in/drive-out commuters.* Papers in Regional Science, No. 97, pp. 1337-1357, 2017

Remote Area Tax Concessions. Productivity Commission Study Report Overview. 2020. https://www.pc.gov.au/inquiries/completed/remote-tax/report/remote-tax-overview.pdf

Remote Area Tax Concessions and Payments: Productivity Commission Study Report. Australian Government Productivity Commission, 2020

Remplan Dataset. 2020. Distributed by REMPLAN. https://remplan.com.au

Resource Data Files. 2019. Distributed by the Department of Mines, Industry Regulation and Safety, of the Government of Western Australia. https://dmp.wa.gov.au/

Snooks, G.D. "Development in Adversity, 1913-1946". a chapter in C.T. Stannage (Ed.), *A New History of Western Australia.* University of Western Australia Press, Nedlands, pp.239-226, 1981

UN Comtrade Dataset. 2019. Distributed by the United Nations. https://comtrade.un.org/data/

WA Domestic Gas Policy. Department of Jobs, Tourism, Science and Innovation. https://www.jtsi.wa.gov.au/economic-development/economy/domestic-gas-policy

Wilson, Elspeth, B. Layman & D. Christmas. *An Economic History of Western Australia since Colonial Settlement*. Department of Treasury and Finance, Government of Western Australia, 2004

References for Box C: Characteristics of Selected Sovereign Wealth Funds

2018-2019 Annual Report. *Alberta Heritage Savings Trust Fund*. https://open.alberta.ca/dataset/3675e470-646e-4f8a-86a7-c36c6f45471a/resource/8ff03852-3df5-478c-9a48-5cb5e90bdec5/download/2018-19-heritage-fund-annual-report.pdf

APFC Mission. *An Alaskan's Guide to the Permanent Fund*. https://3zi9ys20feru1cmlnv3u4tep-wpengine.netdna-ssl.com/wp-content/uploads/2017/11/APFC-An-Alaskans-Guide-to-the-Permanent-Fund.pdf

Bazel, P. & Mintz, J. *Effective Tax and Royalty Rates on New Investment in Oil and Gas after Canadian and American Tax Reform*. 2019. https://www.fraserinstitute.org/sites/default/files/effective-tax-and-royalty-rates-on-new-investment-in-oil-and-gas.pdf

Chen, D & Mintz, J. *A 2016 Update of Effective Tax Rates on Australia Mining and an Evaluation of Proposed Increases in Taxation of Iron Ore*. 2016. https://cmewa.com.au/wp-content/uploads/2019/09/Mintz-report.pdf?path=mintz-report.pdf