

# Regional economies

Shape, performance and drivers

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## Authorship

Each year NZIER devotes resources to undertake and make freely available economic research and thinking aimed at promoting a better understanding of New Zealand's important economic challenges. This paper was funded as part of this public good research programme.

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# Key points

## Divergence and the search for a solution

Economic performance is uneven across New Zealand's regions. For example, there are differences across household incomes, unemployment and population growth in the latest Census.

Regions are closely connected on some measures, in others they are divergent or in competition. Economic outcomes – whether in terms of level, growth or resilience – differ. These differences lead to calls for a solution. Lawrence Yule, President of Local Government New Zealand, illustrates the thinking: *“Local and central government need to work together to reduce these regional inequalities”*.<sup>1</sup>

## Understanding before solutions

With much of the political and policy attention focused on Auckland – New Zealand's economic powerhouse, on at least some measures – putting a spotlight on the performance of the regions is welcome.

But there is a risk of moving too quickly from a perceived need to an action plan. We need to understand what causes the differences in regional economies, and then we can focus on if, when, where, and how policy can help.

## Regional narrative is complex

The regional economic narrative is complex. Regional economies share many common traits, but also many differences. The common threads suggest a common, co-ordinated approach to policy is a good starting position.

But significant and competing differences under the surface mean that an approach that works in one place may make no sense in another, or could even pull the regions further apart. We need to understand the causes of economic differences before wasting precious resources on policies that will not 'solve' true issues.

## ...similar and different

This paper highlights the similarities and differences in regional economies, the drivers of past performance, and how that performance is shared in the community (GDP versus household income, for example).

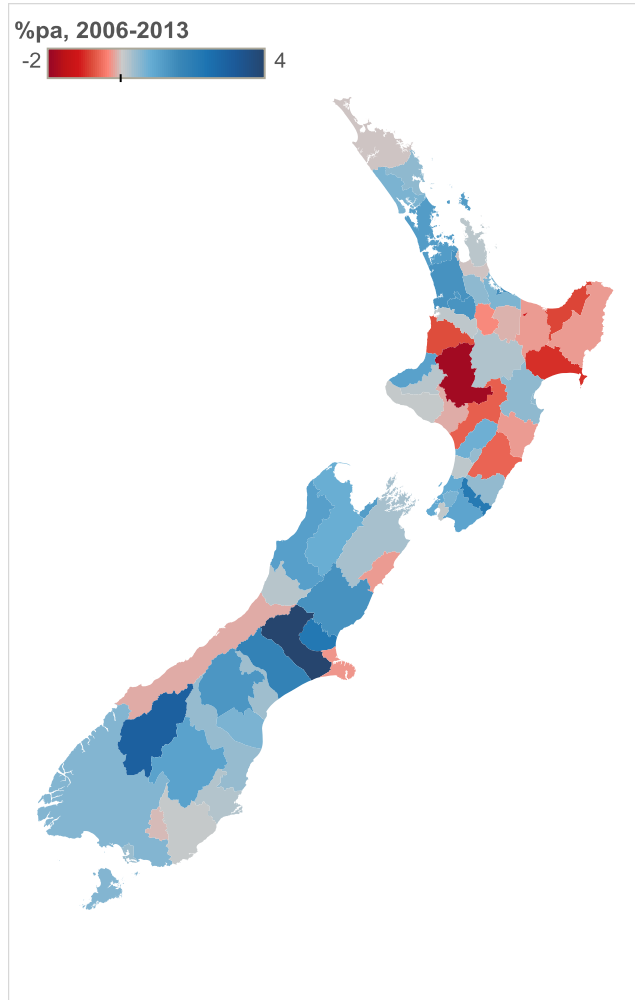
Regional economies are affected by common national trends. But there are also clearly distinctive economies, with their own drivers of success: the urban centres of Auckland and Wellington, the resource-driven economies (mining and agriculture), and the other provinces. Some tend to rank worryingly low on many metrics, like Northland, Gisborne-Hawke's Bay and Manawatu-Wanganui.

While there are differences, there are also dense economic connections between regions. Because regions can have complementary and competing specialisations, what happens in one region can affect another. For example, growth in Auckland may spur growth in complementary industries in Waikato. But growth in Wellington may drain jobs from competing industries in neighbouring locations.

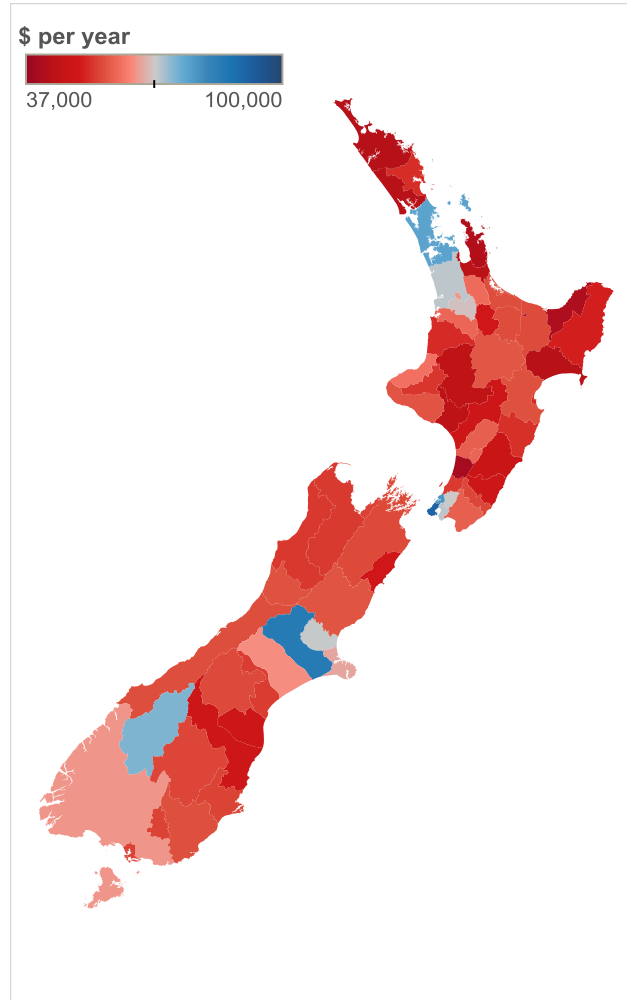
These complexities required careful diagnosis and deep understanding of what makes regions tick; this paper is our contribution to developing that understanding.

**Figure 1 Selected economic indicators by territorial authority**

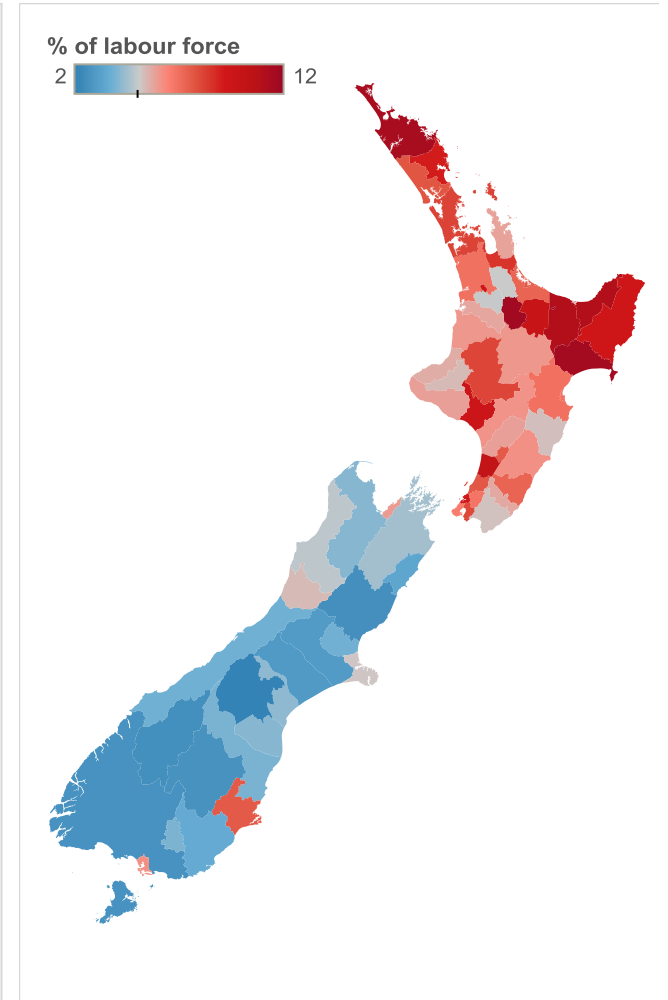
Population growth  
(2006-2013, %pa)



Median household annual income  
(2013)



Unemployment rate  
(2013)



Source: Statistics New Zealand

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# 1. Describing performance

*We can describe regional economies using different dimensions. Each dimension tells a different story. This means regions need to be considered across a range of measures.*

Economic performance can be measured across different dimensions. We look at three areas: the level of GDP per capita (economic prosperity), GDP growth (economic progress), and volatility (economic resilience).

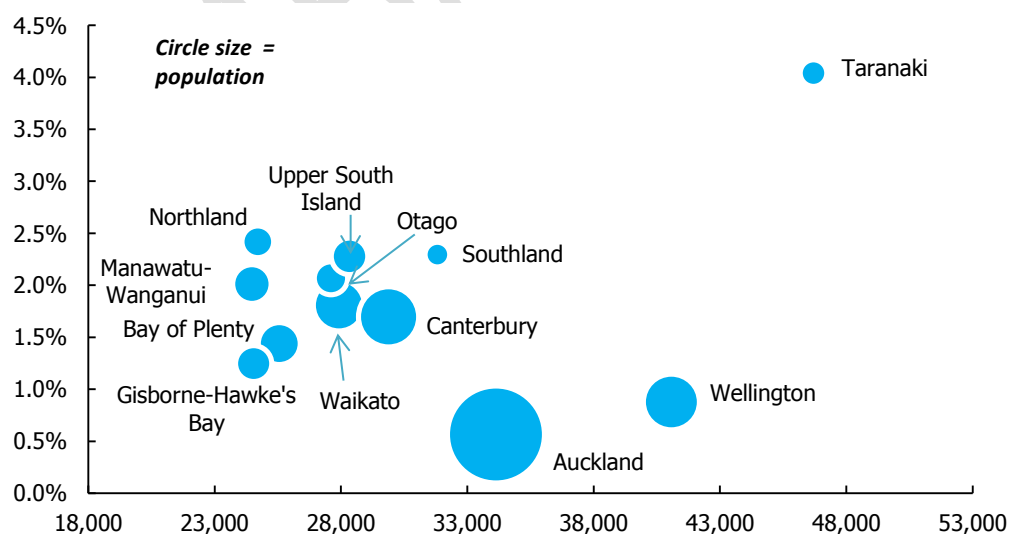
The level of GDP per capita tells us how well off a region is. The rate of GDP growth tells us when the economy is growing, consistent with creating more jobs and boosting incomes. Volatility tells us how resilient the economy is to shocks, and whether the growth is sustainable.

We can rank regional economic performance on each of these measures in the 2000s. But the measures do not always back the same conclusion about performance. For example, Auckland is New Zealand's largest economy, has a high level of GDP, but moderate growth, and low volatility. Northland is a small economy, but has grown at a faster pace, although with more volatility.

This is illustrated by Figure 1 above, and the figures below and overpage. The data below draw on Statistics New Zealand's official regional GDP estimates published in June 2013, covering 2007-2010,<sup>2</sup> and our own historical estimates back to 2000 using Linked Employer Employee (LEED) income data by sector and by region, and Household Labour Force Survey (HLFS) employment data when the LEED data is not available. We have not used the more recently published regional GDP estimates, as they do not yet have the necessary industry detail to allow full analysis.

**Figure 2 Regional economic performance in the 2000s**

Real GDP per capita 2010, horizontal scale; Compound annual growth rate, vertical scale



Source: NZIER estimates, Statistics New Zealand data

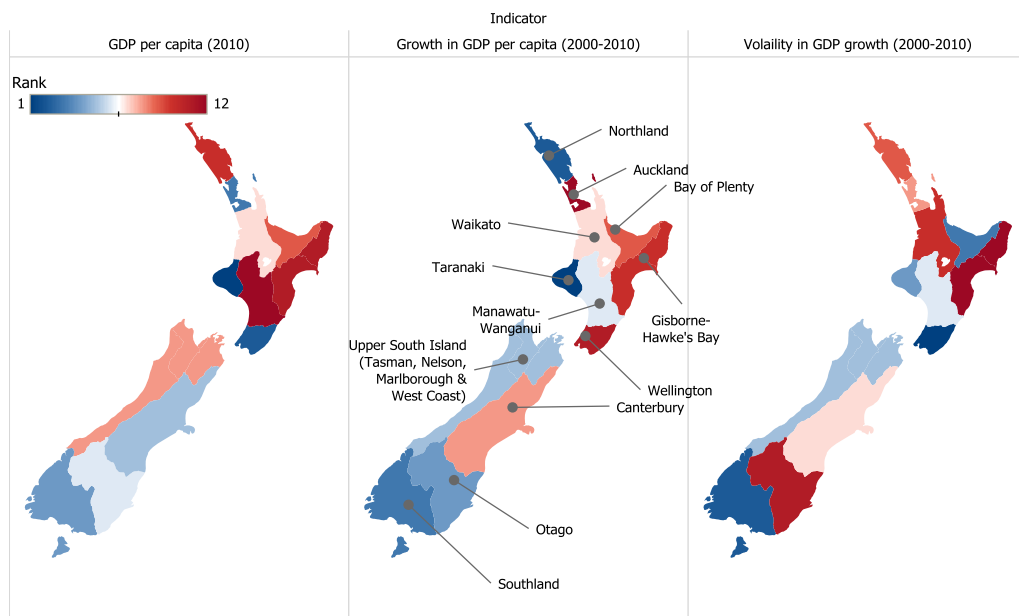


**Table 1 Regional rankings across three metrics**

	GDP per capita (2010)	GDP per capita growth (2000-2010)	Volatility (2000-2010)
	1= highest GDP per capita	1=fastest growth	1=least volatile
Northland	10	2	9
Auckland	3	12	8
Waikato	7	7	10
Bay of Plenty	9	9	3
Gisborne-Hawke's Bay	11	10	12
Taranaki	1	1	4
Manawatu-Wanganui	12	6	6
Wellington	2	11	1
Upper South Island (Tasman, Nelson, Marlborough & West Coast)	8	5	5
Canterbury	5	8	7
Otago	6	4	11
Southland	4	3	2

Source: NZIER estimates, Statistics New Zealand data

**Figure 3 Maps of regional rankings**



Source: NZIER estimates, Statistics New Zealand data

## Box 1: Economic versus administrative regions

Regional data and analysis are based on administrative boundaries. But these are not necessarily economic boundaries or the correct regional 'unit' of comparison. Administrative regions vary by size of economy, land area and landscape. Many economic activities cut across regional boundaries.

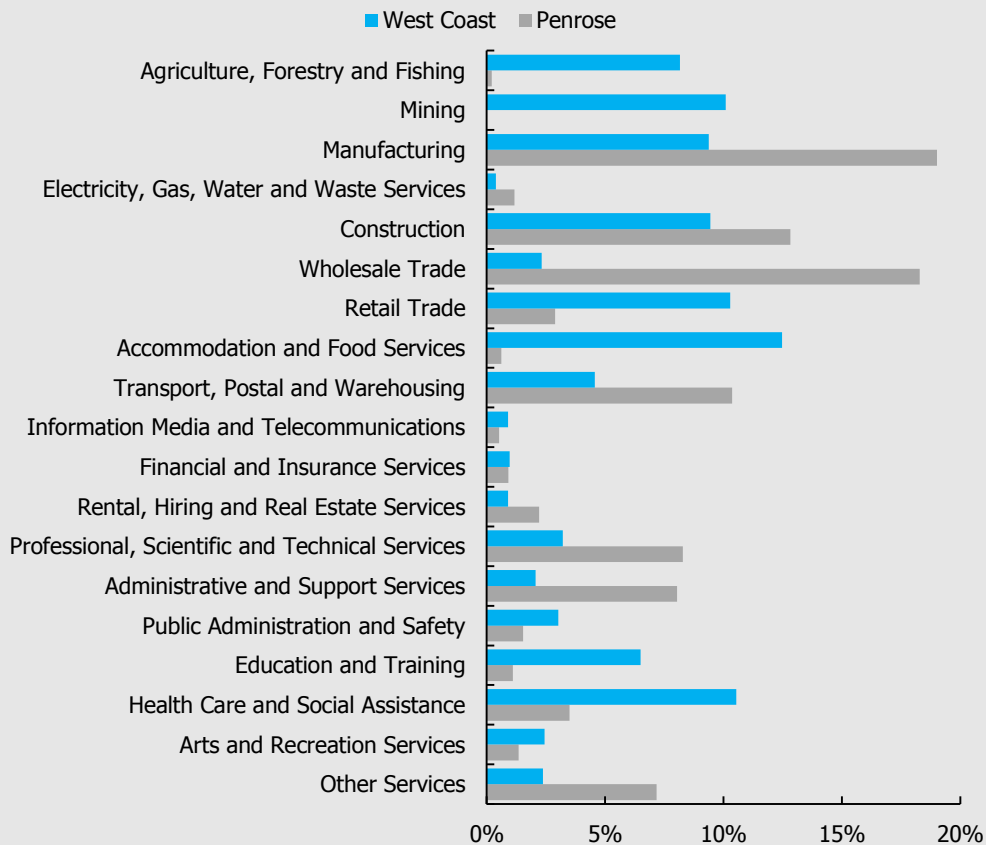
For example, on some levels it makes more sense to compare the economic activity of the West Coast region with activity in the Auckland suburb of Penrose. They employ a similar number of people and share a similar diversity of industries (except for primary).<sup>3,4</sup> On other dimensions, such a comparison is equally unhelpful: West Coast has district governance and land masses that are hugely different (Penrose is around 4 km<sup>2</sup> and West Coast is around 23,000 km<sup>2</sup>).

Size matters. Small regions tend to be influenced by national economic trends but are more vulnerable to shocks to their specialisations. This mirrors New Zealand's performance within the context of global economic growth. Larger regions tend to be more stable and capable of generating growth from within.

Administrative boundaries can be different from economic regions and encompass many other variations. Hence, analysis based on administrative data needs to be treated with care.

### Figure 4 Comparing regions to pockets of activity can be helpful

Employee count by Industry shares of employment, Penrose vs West Coast



Source: Statistics New Zealand, NZIER

### 1.1.1. Levels versus growth

As we saw, levels of GDP per capita and economic growth do not always point in the same direction.

Regional economic prosperity measured by the level of GDP per capita was varied during the 2000's. Levels of economic activity were generally highest in the urban and more densely populated regions. But growth was not as high in these regions. Growth rates were higher in the smaller and more rural regions.

Taranaki, Auckland, and Wellington rank highly in terms of output per person. Taranaki is supported by a large mining sector, while Auckland and Wellington benefit from being urban centres of highly productive business and political capital centres of New Zealand.

High GDP per capita does not guarantee fast growth. Northland, Taranaki, Southland, and Otago grew more than four times faster than Auckland, New Zealand's largest region, and around two-thirds faster than the national average.

Taranaki stands out as both the fastest growing region and the largest in terms of output per person.

### 1.1.2. Resilience to shocks

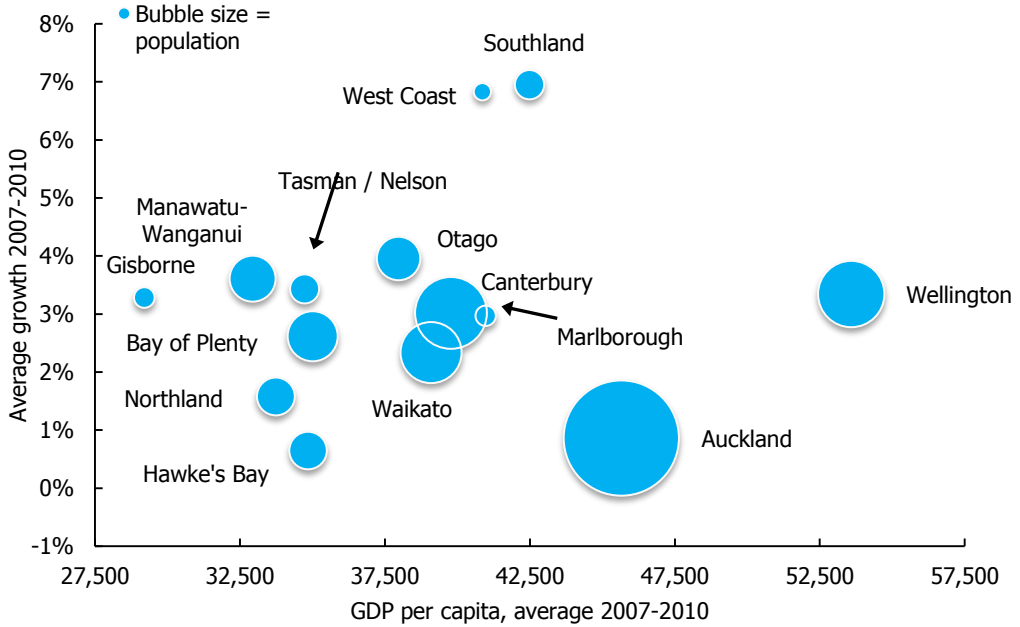
Regions are varied in terms of their economic volatility. Some of this volatility can be explained by how they performed during the recession. But this does not explain all the variation; some of the volatility was due to other factors.

Most fast growing regions were resilient during the economic slow-down of the late 2000s. As shown in Figure 5, Taranaki, Southland and the West Coast all exhibited reasonably strong growth between 2007 and 2010. Output in Taranaki grew at double digit rates over that period, expanding by an average of 13% per annum. Northland, however, was more negatively affected by the slow-down than most other regions.

While most regions performed well between 2007 and 2010, Hawke's Bay grew below the average rate for regional economies in the OECD (0.7% against a 1.1% OECD average- measured on the left axis in Figure 6). The strength of growth across the regions is consistent with New Zealand's relatively shallow recession compared to global peers (Figure 7).<sup>5</sup>

**Figure 5 GDP per capita and growth during the recession 2007-2010**

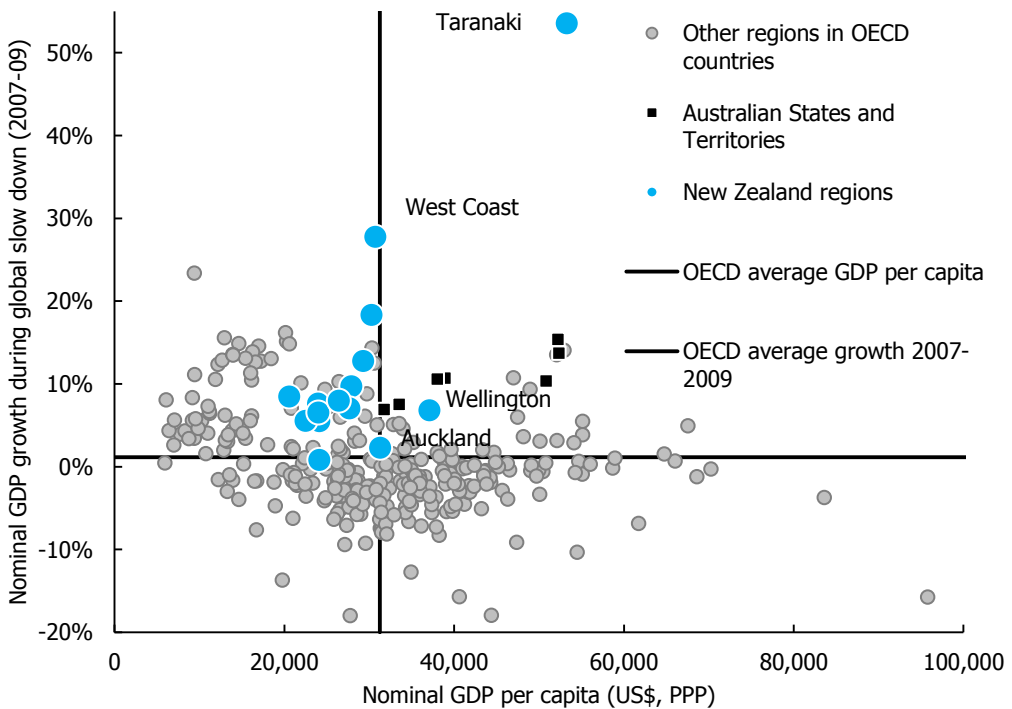
Nominal GDP, inset chart shows Taranaki, an outlier, alongside other regions



Source: Statistics New Zealand

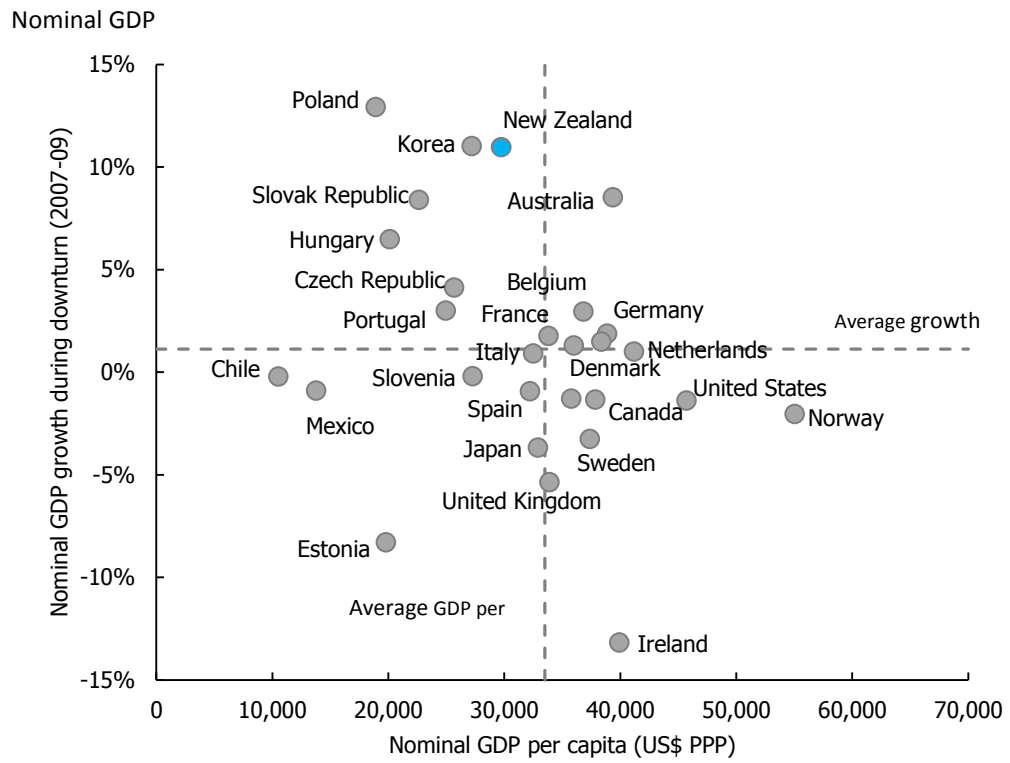
**Figure 6 Regional resilience during the downturn**

Nominal GDP



Source: Statistics New Zealand, OECD

**Figure 7 New Zealand's growth beat many countries through the crisis**



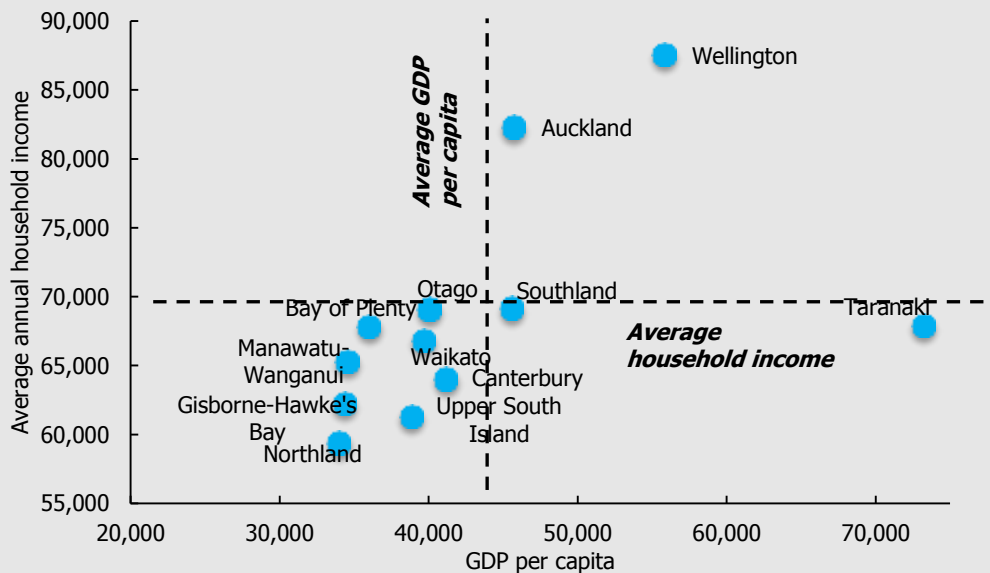
Source: Statistics New Zealand, OECD

## Box 2: GDP is not everything

While GDP is a useful measure of economic activity, it is not the only measure of economic outcomes. There can be wide divergences between GDP and more personal economic outcomes like household income (Figure 8). For example, Taranaki has very high GDP per capita, but household incomes are about the national average. This means that the high GDP per capita in Taranaki has not lifted the economic performance for everyone in Taranaki.

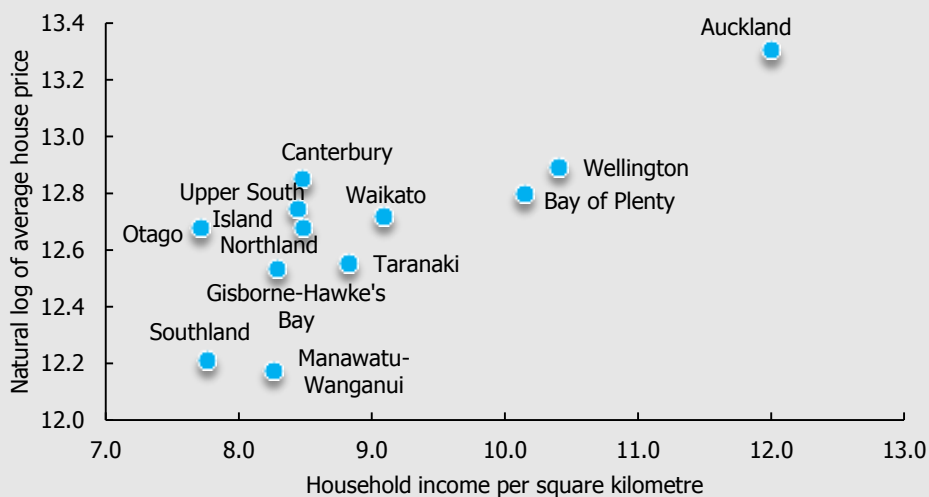
Auckland and Wellington, on the other hand, have high GDP per capita and high average household incomes, which are 20% higher than the national average. Of course, these higher incomes should be viewed in the context of local living costs, particularly for housing and transport (Figure 9).

**Figure 8 Relationship between GDP and household income, 2010**



Source: NZIER, Statistics New Zealand

**Figure 9 Higher incomes and higher house prices**



Source: NZIER, Statistics New Zealand, QV

## 2. Explaining performance

The reasons for different economic performance across the regions are varied, and include differences in people (education and age for example), industrial structure, complexity of their economies and connections or spill overs from other economies (complementary and competing).

### 2.1. Sources of growth

Not only is the economic performance different depending on measure use, the drivers of performance also varies. As an illustration, we decompose the growth in GDP per capita into scale effects (growth in population), economic participation (employment) and performance (productivity or output per worker).<sup>6</sup>

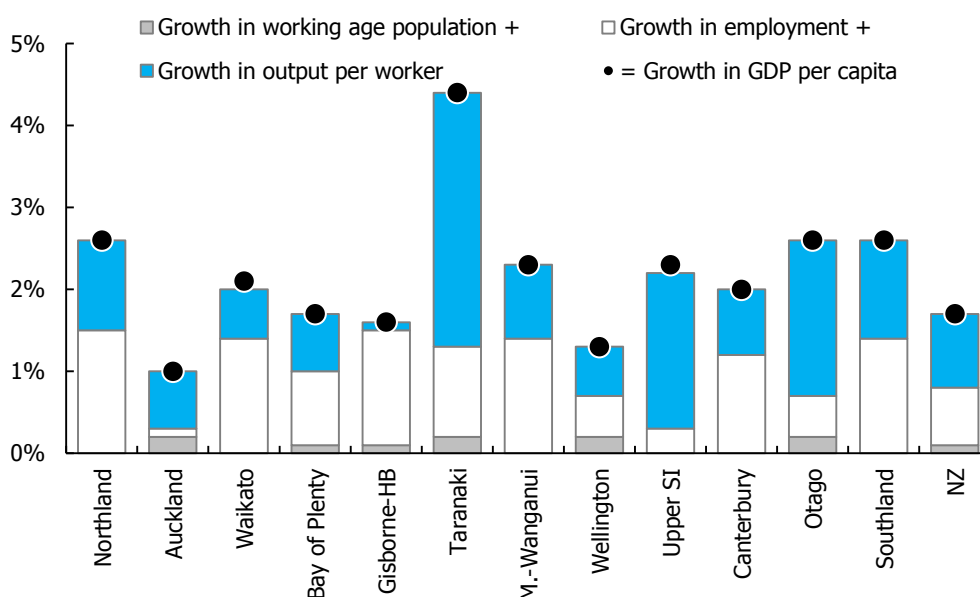
Figure 10 shows the decomposition by region. These factors help to explain why GDP growth per capita has changed. There is considerable variation in the drivers of growth among regions. Economic growth comes mainly from employment and productivity growth, but the mix varies depending on the region.

Even in similarly performing regions the drivers may be different. For example, Otago and Southland have grown at a similar pace between 2000 and 2010. But Otago has had much more of the economic gains from productivity, while Southland has had relatively more impact from employment and population gains. One form of growth may stimulate employment and population growth and another may not.

The sources of growth vary depending on the industrial makeup of the region and the skills of its population. Not all industries are growing strongly and each requires different skill sets.

**Figure 10 Fast growing regions exhibit output growth per worker**

Sources of economic growth, average annual percent change, 2000-2010

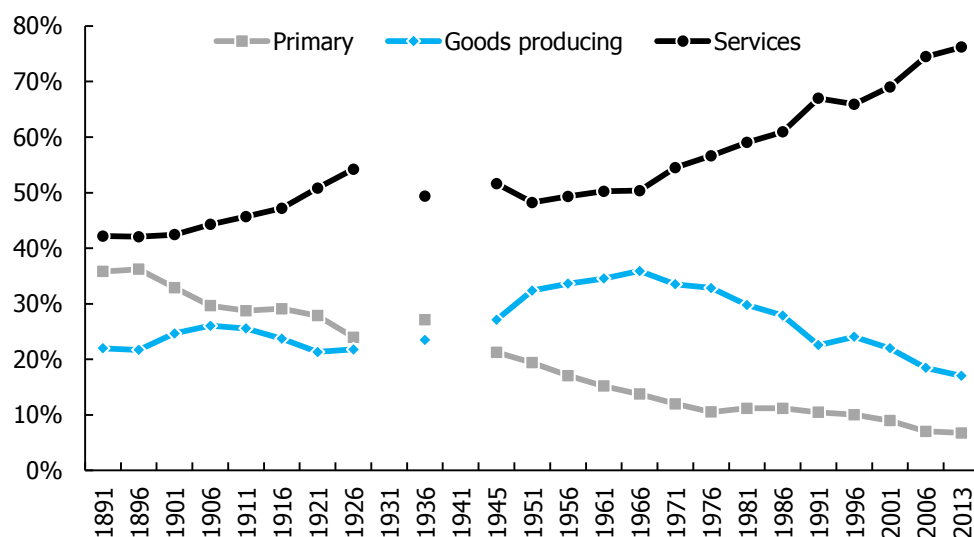


Source: NZIER estimates, Statistics New Zealand data

These differences are in part related to different prospects for industries and regions. Primary and manufacturing sectors are becoming a smaller share of the economy, while services are rising (Figure 11). Not only have the industries changed, but so have the composition within them (occupation) and the skills required (Figure 12). So, the industrial make up and skill level of the population matters for regional economic performance. These are long standing ‘secular’ trends, which will accelerate and intensify in the future. We summarise the key drivers, technological change, urbanisation, globalisation and ageing in Appendix A.

**Figure 11 Employment share by industry, 1891-2013**

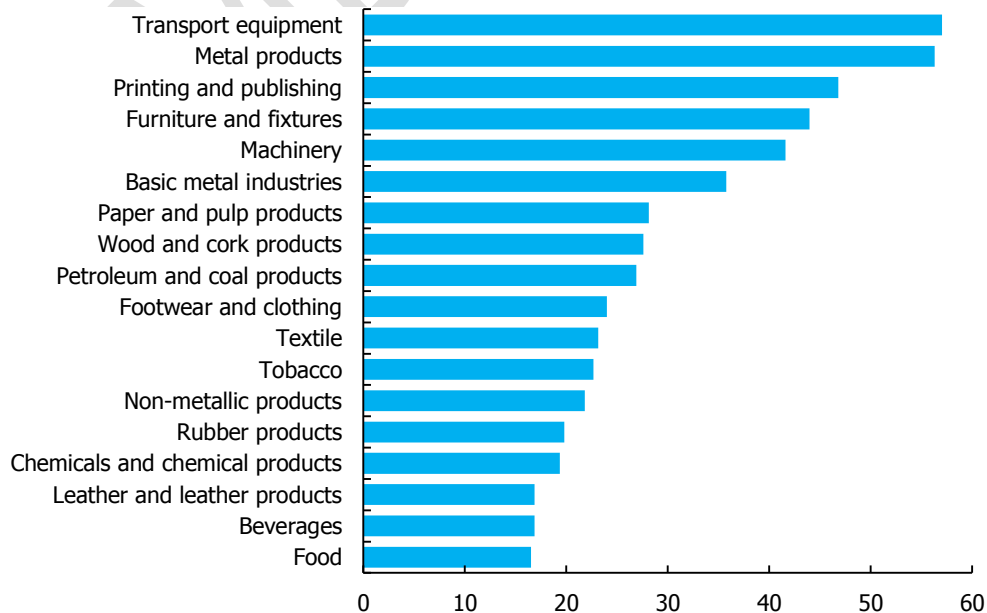
Share of employment by broad industry sector, census years, 1891-2013



Source: Statistics New Zealand, NZIER

**Figure 12 Increase in professionals in manufacturing, 2013 vs 1967**

Change in % share of employment in professionals, 1967 to 2013



Source: Statistics New Zealand, NZIER



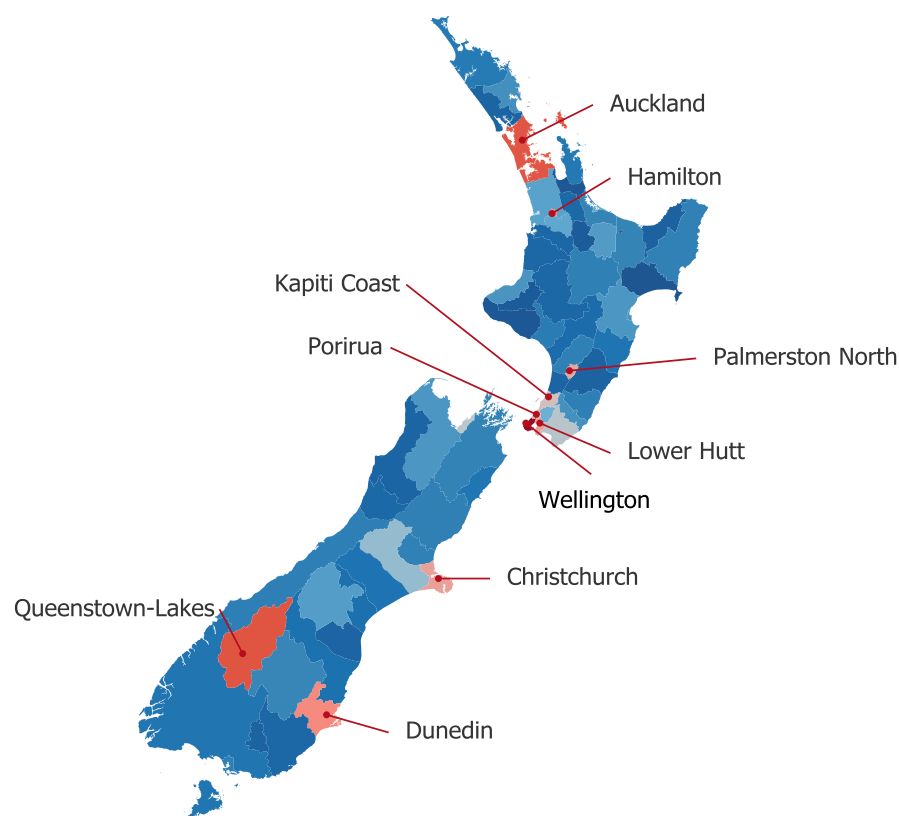
## 2.2. People and their skills

Regions have different collections of people (qualification, age, etc.) and employment opportunities. They may be suited to different types of economic activities across industries and occupations. One example is a concentration of tertiary educated in only a few locations (Figure 13).

Education outcomes are very different across New Zealand. For example, only 69% of eighteen year olds in Northland leave college with NCEA Level 2 or higher, compared with 78% in Auckland. Tertiary-educated people make up 41% of the Wellington population, but only 13% in Marlborough. We summarise these differences using a measure of lifetime income or human capital.

**Figure 13 Tertiary educated by territorial authority, 2013**

Share of population with tertiary qualifications, (dark blue low, red high)



**Source:** Statistics New Zealand, NZIER

Human capital is the value from a worker's skills and abilities over their lifetime. We measure this value as the expected future earnings of people living in each region – a market-based measure of human capital. Differences in human capital reflect differences in education or skill levels.

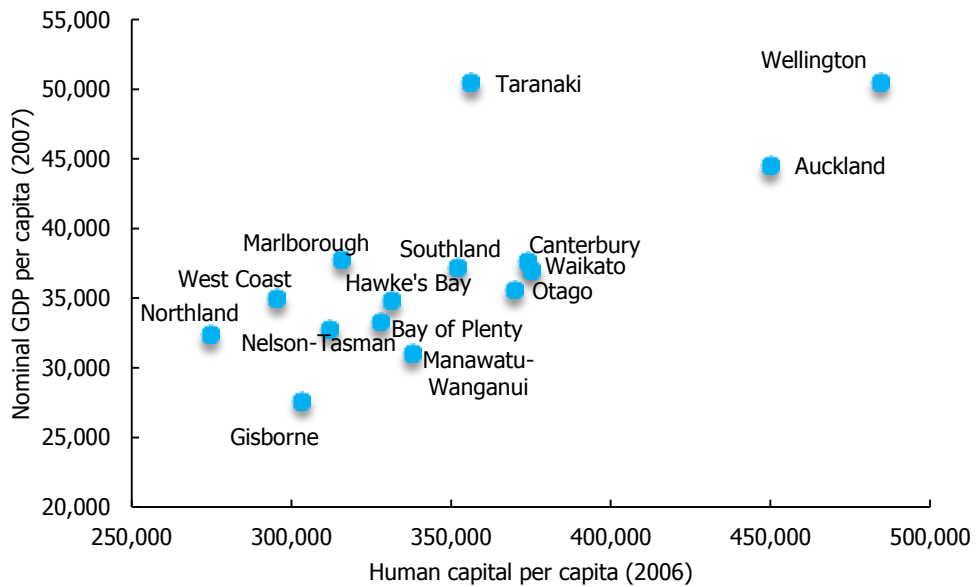
Figure 14 shows that Auckland and Wellington have the highest human capital – mainly due to concentrations of highly educated workers (tertiary and postgraduate) working in well-paying sectors. Northland has the lowest human capital, with a

population that is relatively less skilled and has lower levels of education than Auckland and Wellington.

Workers' income depends on their profession, skills, training and industry of work. These factors all matter. But so does where you live. Figure 15 shows that if you work in finance or retail, you will earn more in Auckland compared to neighbouring Waikato.

### Figure 14 Auckland and Wellington stand out – high level of human capital

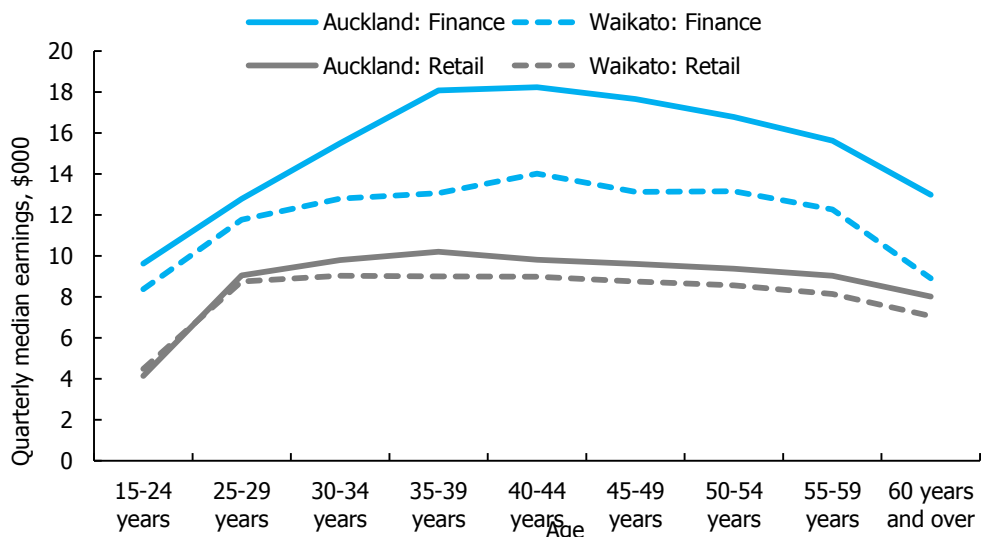
Human capital (2006) vs GDP per capita (2007)



Source: NZIER, Statistics New Zealand

### Figure 15 Location matters for how much you earn

Income by selected industry, region and age, median quarterly earnings, June 2012



Source: Statistics New Zealand, NZIER

The premium between regions for a given industry can also differ across age groups, or lifetime earning potential. So, choosing to live in a particular region has significant economic implications. This analysis does not adjust for regional differences in living costs, which tend to be most acute for housing and transport.

There is evidence that success breeds success. Regions with high concentrations of skilled and high paying jobs attract more new jobs and businesses to locate there. Thickness of labour markets means more workers move there and so the virtuous cycle reinforces itself. Auckland and Wellington fit this bill. There may be a skilled engineering position in Napier, but it can be difficult to fill because there are few engineers who live there and few other engineering outfits (that is, the market is thin for both employers and employees).

Increasingly, successful regions have a core of innovative and highly skilled industries. They may not be the largest sectors, but they require a large number of services, an ecosystem. Because a skilled job is more than just a job, it also creates unskilled jobs and lifts their incomes. The race has changed. While the economic imperative of the 20<sup>th</sup> century was physical capital, we are now increasingly after human capital.

## 2.3. Complexity boosts incomes

*New Zealand's regional economies are constructed differently. Some are large and diverse, while some are specialised and small, with many flavours in between. Complexity matters because it boosts incomes. Complexity describes the breadth and uniqueness or specialisation of an economy. An economy is complex if it produces a range of products and services that no other economy produces.*

Auckland and Wellington have sophisticated economies, which are specialised in many different sectors. They also create high economic value for each employee. In contrast, Northland is a relatively simple economy, with concentrated specialisations and lower incomes (Figure 16).

To take account of both specialisation and diversity (or good at many things) at the same time we use the 'method of reflections' used by Hidalgo and Hausman (2009). See Appendix C for further details.

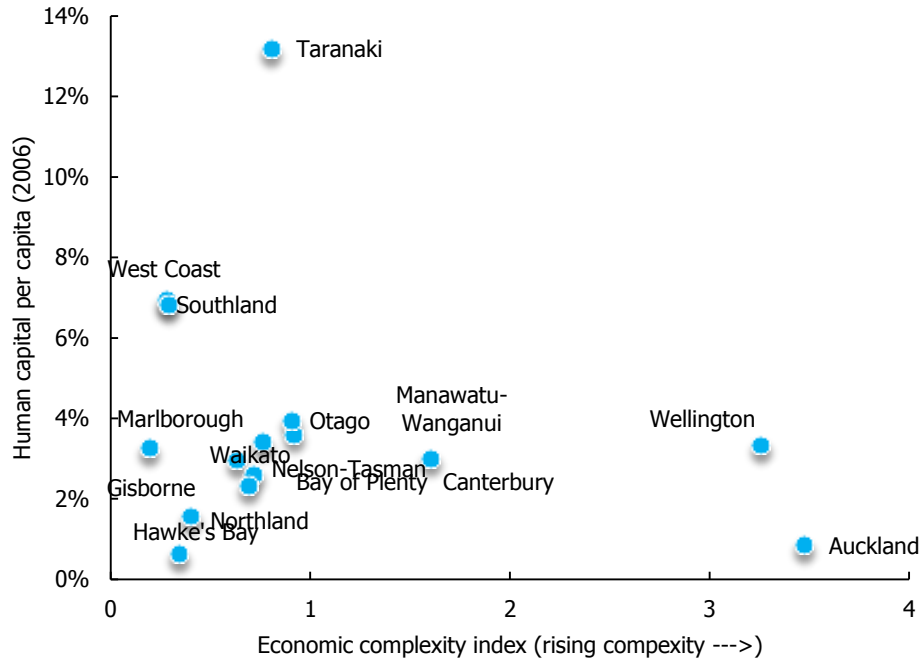
Complex economies tend to have a higher concentration of skilled people. They earn more income per person because specialisation matters. When an economy is specialised in an industry, it creates productivity gains. The more specialised knowledge there is in an economy, the greater the productive potential.

Complex economies also have an ecosystem where industries can benefit from the diversity of knowledge of industries around them. Firms can benefit from having more accounting firms, marketing, and finance firms around them to give them advice.

Small economies can find it difficult to build capabilities around them, unless deep connections can be developed with people and knowledge elsewhere. Where these limits lie and how they might be overcome is unclear. But a small economy does not necessarily mean it is not complex. Some small economies in developing countries like Singapore are also complex.

While economic complexity can explain the level of income differences between regions, it is not a good predictor of growth. Auckland and Wellington are complex but have not experienced higher growth.

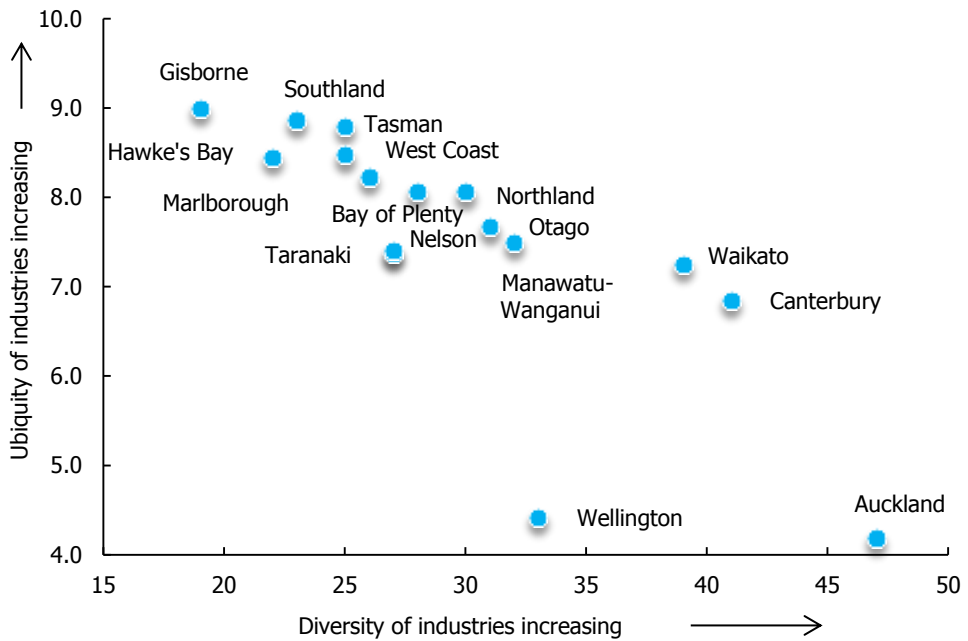
**Figure 16 Economic complexity and human capital**



Source: NZIER

**Figure 17 Economic complexity of New Zealand regions**

Based on industry employee counts



Source: NZIER

## 2.4. Industrial make up matters

*One of the drivers of complexity is specialisation. What a region specialises in can influence how it performs, but how a local industry performs is also important. Specialisations can be complementary or compete with other regions.*

Lifetime incomes of people in a region depend not only on what education and skills they have, but on also what occupations and industries they work in. Each region has a portfolio of industries. Some regions show strong specialisations, while others are generic but large. Specialisation can drive strong economic growth, but lack of diversity can reduce resilience against shocks. Specialisations help to explain economic performance, but local factors also play a part.

Table 2 summarises the broad industrial make up of regional economies by the number of jobs in each industry. Most provincial regions have a lot of exposure to agriculture, while Taranaki and West Coast stand out for their exposure to mining. Otago stands out for tourism related activity, and Wellington stands out for financial and government services.

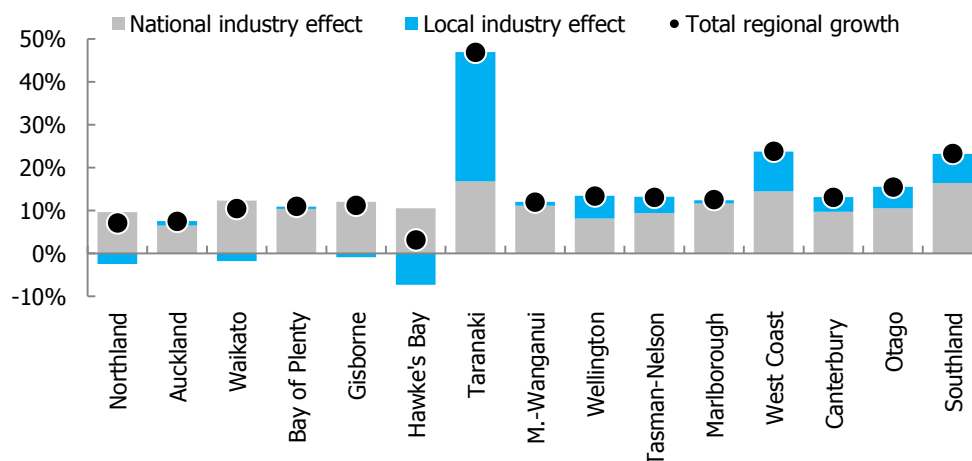
Specialisation explains some of the regional growth variations, but not all. Variations in regional economic growth can be because of industries they specialise in, the general performance of that industry, as well as local conditions for that sector.

Figure 18 breaks down each region's performance into the national industry effect and the local industry effect. The national industry effect shows how much the region would have grown if the performance for each of its industries was the same as the national average. The local industry effect shows the difference of performance within each industry between regions.

Average growth rates can mask underlying differences. For example, Northland and Auckland had similar average growth rates over 2007-10, but the drivers were different. Auckland won twice, from being in the industries that are growing (national industry effect) and outperforming other regions in those industries (local industry effect). In contrast, Northland's local industry effect was negative.

**Figure 18 Regional growth due to industrial mix effects, 2007-2010**

Variation in growth due to industry composition, 2007 to 2010 % growth, nominal GDP



Source: NZIER

## Specialisations can help or hinder

Regions have specialisations in various industries, some are complementary and others are competing (Table 2). Some specialisations are in industries that are growing, others in decline.

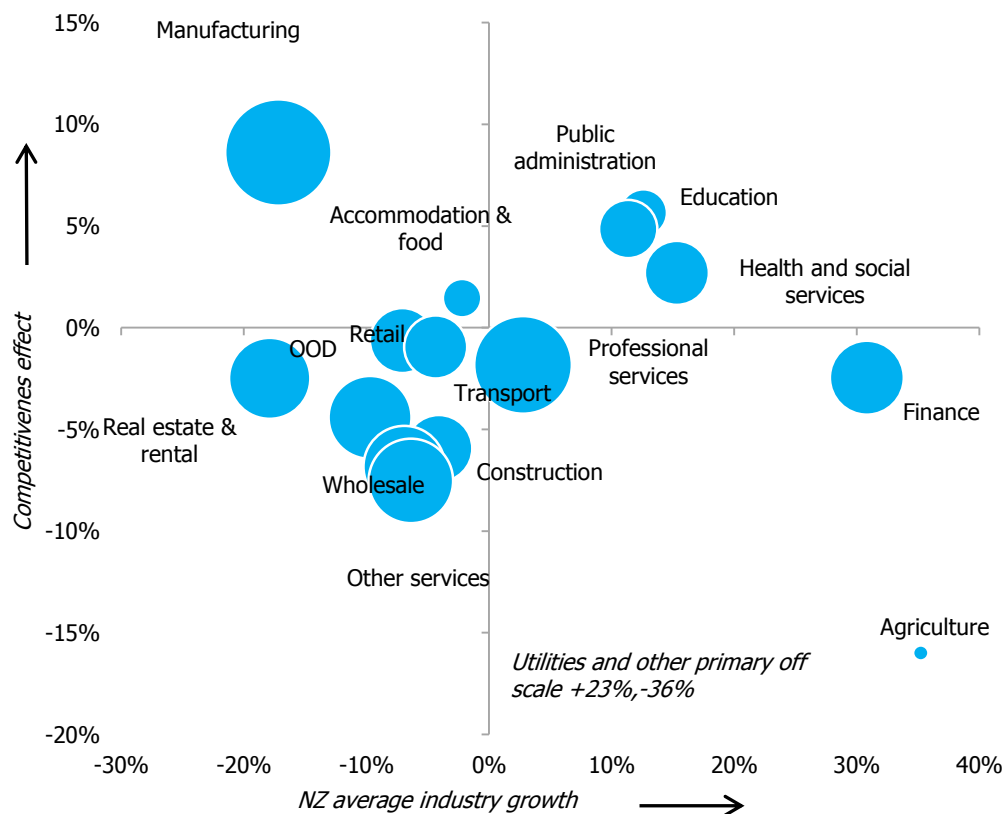
The top contributors to national growth between 2007 and 2010 were the finance and insurance industries, and the natural resource industries. Even though some regions may specialise in finance, insurance and natural resources, they may not necessarily grow the fastest. This is because local conditions also matter.

For regions with natural resources, performance was uneven. Taranaki grew at four times the national rate, West Coast at double the rate, but Waikato underperformed.

For regions with finance and insurance, the story repeats. Auckland and Wellington are both specialised in finance and insurance. Wellington has performed above average but Auckland has not, despite having a strong specialisation in this industry. The finance sector performed worse than the national average due to local factors. This can be seen in Figure 19 where finance is to the far right of the chart because it grew rapidly but is located below the horizontal axis because Auckland has lost market share in the sector, interpreted here as a loss of competitiveness.

**Figure 19 Auckland region growth decomposed by industry**

2007-2010. Bubble size indicates share of regional economy.



Source: NZIER

**Table 2 Regional specialisations**

Share of industry in region relative to share of industry in NZ, values above 1 indicate comparative specialisation

	Agriculture	Forestry, fishing, mining, electricity, gas, water, and waste services	Manufacturing	Construction	Wholesale trade	Retail trade	Accommodation and food services	Transport, postal, and warehousing	Financial and insurance services	Rental, hiring, and real estate services	Owner-occupied property operation	Professional, scientific, technical, administrative, and support services	Public administration, defence, and safety	Education and training	Health care and social assistance	Other services
Northland	1.7	0.8	1.7	1.1	0.5	1.1	1.0	0.9	0.5	1.1	1.1	0.6	0.7	1.0	1.2	0.6
Auckland	0.1	0.3	1.1	0.9	1.6	1.0	0.9	1.1	1.4	1.1	1.1	1.3	0.7	1.0	0.9	1.2
Waikato	2.4	1.4	1.0	1.2	0.7	1.0	0.9	0.7	0.5	1.0	1.1	0.7	0.8	1.1	1.0	0.7
Bay of Plenty	1.4	1.3	0.9	1.2	0.8	1.1	1.1	1.2	0.5	1.0	1.2	1.0	0.7	1.0	1.3	0.6
Gisborne	2.0	1.3	0.8	1.3	0.4	1.1	0.9	1.4	0.3	0.9	1.2	0.7	1.0	1.2	1.3	0.5
Hawke's Bay	1.8	0.9	1.3	1.1	0.6	1.1	0.9	1.0	0.6	1.1	1.0	0.8	0.9	0.9	1.3	0.5
Taranaki	1.9	6.1	0.9	0.7	0.3	0.6	0.5	0.6	0.3	0.5	0.5	0.5	0.3	0.5	0.6	0.3
Manawatu-Wanganui	1.9	1.0	0.9	1.2	0.8	1.3	1.0	0.8	0.5	0.9	1.0	0.6	1.9	1.5	1.2	0.7
Wellington	0.2	0.9	0.6	0.8	0.7	0.7	0.9	0.9	1.7	0.7	0.9	1.3	2.5	0.9	0.9	1.7
Tasman / Nelson	1.2	0.9	1.2	1.3	0.6	1.3	1.3	1.4	0.4	1.2	1.1	0.9	0.5	0.9	1.3	0.6
Marlborough	2.1	1.5	1.3	1.3	0.4	1.1	1.4	1.1	0.6	1.2	1.0	0.4	0.9	0.6	0.9	0.5
West Coast	3.0	2.1	0.9	1.6	0.3	1.0	2.1	0.9	0.5	0.8	0.8	0.4	0.5	0.7	1.1	0.5
Canterbury	1.5	0.7	1.2	1.1	1.0	1.0	1.1	1.1	0.7	1.1	0.9	0.9	0.8	1.0	1.1	0.8
Otago	1.3	1.3	0.7	1.4	0.5	1.2	2.0	1.0	0.5	1.0	1.0	0.7	0.6	1.5	1.2	1.1
Southland	4.6	1.0	1.2	1.1	0.5	1.0	1.0	1.2	0.5	0.7	0.5	0.4	0.6	0.7	0.9	0.7

Legend:   Highly specialised   Moderately specialised   Similar   Lacks specialisation

Source: Statistics NZ, NZIER

## 2.5. Growth can spill-over

Regional economic growth patterns tend to move together, but there are some one-off drivers. We find regional growth is closely connected and almost 90% of the variation in regional growth can be described by three common factors:

- a common national factor
- an urban factor
- a resource factor.

This is summarised in Table 3 which shows the common factors in growth across regions.<sup>7,8</sup> This describes how much regional economies move together and if there are special drivers of divergence, like being an urban or resource centre.

National economic performance is important for all regions. For Auckland and Wellington, specific urban and scale factors support large portions of economic growth. Resources shocks (dairying and mining) in recent years also explain strong economic growth in Taranaki, the Upper South Island and Southland. But these fortunes are not shared equally: Waikato did not surge despite specialising in natural resources.

**Table 3 Common growth factors**

Principal components analysis

	National	Urban	Resource
Northland	↑ 0.35	↘ -0.22	↘ 0.02
Auckland	↘ 0.25	↑ 0.40	↘ 0.09
Waikato	↘ 0.29	↓ -0.37	↘ 0.14
Bay of Plenty	↑ 0.36	↘ 0.19	↘ -0.09
Gisborne-Hawke's Bay	↘ 0.30	↓ -0.29	↓ -0.35
Taranaki	↓ -0.01	↘ 0.21	↑ 0.71
Manawatu Wanganui	↑ 0.32	↘ 0.27	↓ -0.29
Wellington	↘ 0.09	↑ 0.49	↘ 0.07
Upper South Island	↑ 0.36	↘ -0.08	↘ 0.31
Canterbury	↑ 0.40	↘ 0.11	↘ 0.05
Otago	↘ 0.31	↘ 0.03	↘ -0.05
Southland	↘ 0.12	↓ -0.40	↘ 0.38

Source: NZIER

### The three main factors of regional growth

The first factor is a **common national growth** factor, which tends to affect all regions of New Zealand. These influences may be exchange rates, interest rates and global economic conditions. All regions except Taranaki are strongly influenced by the first factor, which is strongly influenced by its natural resources exposure. This pervasive national growth effect is strongest outside of the major urban centres (which tend to have their own internal momentum) and specialised natural resource centres (which tend to be affected by local production and global price effects). Wellington is less influenced by this factor, reflecting a large central government bureaucracy, which is not as affected by the economic cycle.



The common national growth factor is consistent with deep inter-regional economic connections. They are tightly interconnected through common business ownership structures and connections between firms. These relationships are summarised in the web of connections shown in Table 4. This table maps the number of employees in a region which also has connections to an enterprise in another region. The network of links is extremely dense.

The second factor is an **urban** factor. This reflects the nature of urban centres, which tend to specialise in highly skilled jobs. Auckland and Wellington are most influenced by this characteristic. Canterbury is not as prominent because it is a more diverse than other major urban centres. The Manawatu-Wanganui region is also affected by this factor, reflecting the importance of central government operational spending and professional services in its economy.

The third factor is a **natural resource** sector factor. This reflects growth driven by commodities, mainly mineral extraction, oil and gas and agriculture. Taranaki, Upper South Island and Southland benefit the most from mining and agriculture sector exposures.

### Deep connections also mean competition

New Zealand's regional economies are deeply interconnected. Despite strong connections and correlations of economic growth, the levels of GDP per capita can diverge across regions. After accounting for economic connections (using the strength of enterprise connections summarised in Table 4), we find that GDP per capita is influenced by economic complexity, scale (size of the working age population) and economic participation (unemployment rates). The model suggests that:

- a 10% increase in complexity lifts GDP per capita by 1%
- a 10% increase in the share of the population aged between 15 and 64 raises GDP per capita by 6.9%
- a 10% increase in the unemployment rate is associated with a 2% reduction in GDP per capita
- a 10% increase in GDP per capita in one region is associated with a combined 8.0% reduction in GDP per capita in the regions with which it competes (or shares strong enterprise connections).

Because regions share similarities, they are in effect in competition with each other. Regions that perform well draw resources from regions, which they are closely connected to, although this effect is not one-for-one. The competition between regions is natural. Good economic performance attracts investment and workers from other regions.

This result does not mean that if one region grows another will shrink. It does mean that the economic prospects in a region are limited by the extent to which there are better prospects elsewhere. This raises the stakes in regional economic development strategies. It suggests that the impacts of good strategies can be limited by better strategies. In other words, regions are in competition with each other. Understanding the industrial make up of each region, their complementarity or competition of other regions and the strategies of other regions can influence economic performance.

**Table 4 Strength of interregional enterprise connections**

Relative strength of connections based on enterprises employing people in multiple regions. Rows add to 100. The strength of Wellington's connection to Manawatu-Wanganui, for example, is twice that of Wellington's connections to the Upper South Island (Nelson, Tasman, Marlborough and West Coast).

**Also have a presence in...**

<b>Enterprises in...</b>	Northland	Auckland	Waikato	Bay of Plenty	Gisborne-Hawke's Bay	Taranaki	Manawatu-Wanganui	Wellington	Upper South Island	Canterbury	Otago	Southland
Northland		33	9	6	4	3	6	17	3	12	4	2
Auckland	4		12	7	5	4	9	28	4	19	6	2
Waikato	3	38		6	4	3	7	18	3	13	4	2
Bay of Plenty	3	36	10		4	3	6	17	3	13	4	2
Gisborne-Hawke's Bay	3	33	9	6		2	7	19	3	13	4	2
Taranaki	3	32	9	5	4		7	18	3	14	4	2
Manawatu-Wanganui	3	33	11	5	4	3		18	3	13	4	3
Wellington	3	44	9	5	4	3	8		3	15	5	2
Upper South Island	3	31	8	5	3	2	6	18		15	5	3
Canterbury	2	40	8	5	3	3	6	19	4		6	3
Otago	2	33	8	5	3	2	6	18	3	15		4
Southland	3	29	8	5	3	2	6	17	4	14	8	

Source: NZIER, Statistics New Zealand

## 3. Conclusion

This paper is a contribution to describing and understanding regional economies. It is not an attempt to provide solutions, but offers a stock-take to assist with diagnosis and testing of ideas.

### Strength depends on perspective

We find that how we understand performance of regional economies depends on how we measure performance. Level of GDP per capita (income), GDP growth (progress) and volatility of growth (resilience) rank each region differently – there is no consistent winner.

It is also clear that measures like GDP do not capture the whole story. For example, Taranaki has very high level of GDP per capita (much higher than national average), but this does not fully flow through to household incomes (about the same as the national average).

In addition, administrative regions are an imperfect measure of economic regions. This means that regional analysis needs to be done with care, taking into account the spill-overs across administrative boundaries.

### Different economies...

Our analysis shows there are three broad types of regional economies:

- two distinctively urban economies: Auckland and Wellington. They have complex economies and very high human capital
- three distinctively resource-based economies: Taranaki, Upper South Island and Southland, with concentrated exposures to natural commodities and international commodity prices
- remaining regions that are driven by common national factors.

### ...but closely connected

Another finding from our analysis of regional data is how closely interconnected regions are. This means that growth in one region can spill over to others. A neighbouring region may benefit from such growth if it has complementary specialisations, but lose out if it has the same specialisations.

### Regional economic strategy: opportunity and caution

New Zealand, and every one of its regions, is facing the forces of broad secular trends. These affect where people live and work, businesses make investments, and central and local authorities deliver the supporting infrastructure (from roads to schools). And the forces tend to favour the urban centres to the detriment of regional communities.

The focus on regional performance will thus be under an increasingly strong spotlight. But there is no single recipe for success. The similarities between regions, and the issues they face, mean that we need to think about the country as a whole. But there are enough differences to require a closer look to understand the causes of these differences, and find place-specific strategies.

# Appendix A Secular forces for change

The analysis above does not provide us with a full understanding of the future. Though we should expect many of the past dynamics to persist, there are persistent and new forces that will create new or more pronounced opportunities and challenges for regional economic development.

Change is inevitable and speeding up. Over the last hundred years, urbanisation, technology and globalisation have been the most prominent forces. Ageing will be the next big force. These deep-seated or secular forces will redistribute economic activity, incomes, jobs and people across regions. While these secular forces have been at play since the dawn of time, many of these trends are speeding up – increasing the potential for divergent regional economic outcomes.

In a rapidly changing economy, the secret of success is adaptation. This adaptation does not lend itself to easy policy formulations. The nimbleness and agility needs to be across mobility of people, jobs and businesses. It also needs openness to changing industrial structures and policy settings (including incentives, land use policies, training and education). But there is no one perfect policy recipe.

## Urbanisation

The population drift from rural to urban areas has been apparent since the early 1900s. A northward shift in the population, mainly to Auckland, has also been in force for a similar time frame.

The historical changes in industries have been tectonic. Structural change has been wrought by many forces over time. The gold rush of the 1800s led to gold rush towns and inflow of many migrants to New Zealand. Many of these cities have withered, while others have reinvented themselves. Those who came to New Zealand for gold have gone on to do other things. For example, many Chinese gold miners went on to set up market garden operations around New Zealand.

## Technological change

Technological change has been a perennial force reshaping economies globally.

Refrigerated shipping changed the composition of the New Zealand economy too. It led to an explosion of meat and dairy production and exports. These remain a mainstay of New Zealand exports to this day.

But change keeps happening. The internet and reduced communication costs means that we may be on the cusp of another technology revolution that may bring New Zealand economically closer to the world, as refrigerated shipping did.

In many rural areas job opportunities shrunk in the agriculture sector as farms become more productive. But urban jobs become more plentiful as the services sector grows into a larger share of the economy.

Different sectors have different requirements. Service jobs tend to require concentrations of skilled people and are better suited to cities. These skilled workers

in turn demand many services, which can be less skilled, such as haircuts and restaurants. These have reinforced the urbanisation trend.

## Globalisation

The world continues to globalise. Supply chains are continuously evolving. Production of physical goods is moving towards low cost locations, particularly in Asia.

Young and large populations in Asia are becoming better educated, their economies are industrialising and urbanising. Rapid economic growth in emerging markets will see the centre of the global economy moving from the west to the east, towards Asia. There will be a swelling middle class that will drive Asian economic prosperity over the next few decades.

Globalisation and rapid growth in emerging markets is driving the demand for food products, which has been a boon for New Zealand's rural exports. The same forces are hollowing out manufacturing jobs in New Zealand, which are increasingly located in places with the lowest labour costs and proximity of supply chains and ecosystems.

More of New Zealand's trade with the world has happened with our neighbours. The physical and economic distance to the world is reducing. But our export partners will be different, demanding a different set of products, services and ways of doing business. Regions across New Zealand have different comparative advantages, meaning the impact of globalisation will also be different.

## Ageing

Rapidly ageing populations is a local and global phenomenon. Most rich countries, including New Zealand, will be ageing rapidly over coming decades. This will have a number of impacts, ranging from increasing competition for talent and workers, to changing demand for goods and services.

An ageing population will change the demand for products and services. There will be greater demand for demand for services like healthcare and aged care that need to be provided locally. There will be subtle changes too. The type of retail and hospitality demanded will be different, as each generation tends to want different things. The economic potential of regions will also change, because the supply of labour will shift. And historically, entrepreneurship and risk taking has been associated with younger people.

Young populations are shrinking in many of New Zealand regions already. Ageing in rich economies will be crying out for labour, both skilled and unskilled. Young New Zealanders will consider job opportunities not just in New Zealand, but also in for example Australia, Singapore, London and San Francisco. New Zealand will be competing for migrants, to meet the demand for workers. For example, Southland, which is ageing the fastest in New Zealand, is dealing with this by being more open to migrant workers from the Philippines.

Ageing will have profoundly varied impacts across regions. For example, movement of older people has been towards Northland, Bay of Plenty, Waikato and Marlborough. Few older people move to Auckland, Wellington or Otago. But those looking for work do.

# Appendix B Spatial econometric model

Our analysis included an econometric model used to examine drivers of regional economic growth and income levels. The results of the analysis show that there is no simple way to characterise differences amongst the regions.

## B.1 Model

The general form of the model is a spatial panel with fixed effects by region and time:

$$y = X_{r,t}\beta + s_r + p_t + u_{r,t}$$
$$u_{r,t} = \rho W u_{r,t} + \epsilon_{r,t}$$

Where  $s$  are fixed effects by region and the  $p$  terms are fixed effects by time. The model is used to explain (y) GDP per capita and growth in GDP per capita. The full model consists of annual data by region for 2000 to 2012 and the following candidate explanatory factors, in matrix  $X$ :

- Economic Complexity Index by region and over time
- Proportion of each region's population which is of working age
- Labour force in each region
- Labour force participation rates
- Unemployment rates
- Lagged values of GDP per capita or growth in GDP per capita.

The weights matrix,  $W$ , defines the spatial relationships between regions. The general form of the matrix, shown for three regions ( $i, j, k$ ) for simplicity, is:

$$W = \begin{bmatrix} 0 & w_{i,j} & w_{i,k} \\ w_{j,i} & 0 & w_{k,j} \\ w_{k,i} & w_{k,j} & 0 \end{bmatrix}$$

Three weights matrices are considered in the model:

- A spatial contiguity matrix, where  $w_{i,j} = 1$  if regions share a boundary.
- A distance matrix, where  $w_{i,j}$  is the distance between the geographic centre of region  $i$  and region  $j$ .
- A matrix of industry connectedness, where  $w_{i,j}$  is the ratio of the number employees in region  $j$  over the number of employees which share a common enterprise in region  $i$ .

The regional enterprise connections matrix captures both distance and scale effects and helps top control for the arbitrary distinctions between administrative regions.

All weights matrices are normalised so that row sums equal 1.

The model is estimated in full with statistically insignificant variables removed in successive estimations until only significant variables are present. The model is also tested for combinations of the labour force variables. This is done because the labour

force participation and unemployment rate and working age ratio and labour force variables tend to be correlated. Correlation of explanatory variables causes high estimated standard errors and poor estimates of the marginal effects of explanatory variables.

Two additional variables are used:

- A 'Taranaki region' variable (value = 1 if the region is Taranaki, 0 otherwise), considered only when region fixed effects are not used.
- A recession variable (value = 1 if the year is larger than 2008, 0 otherwise), considered only when a time period fixed effect is not used.

The regions in the model are:

- Northland
- Auckland
- Waikato
- Bay of Plenty
- Gisborne and Hawke's Bay combined as a single region
- Taranaki
- Manawatu-Wanganui
- Wellington
- Tasman, Marlborough, Nelson and West Coast combined as a single 'Upper South Island' region
- Canterbury
- Otago
- Southland.

## B.2 Results

A statistical model of regional variations in GDP per capita shows that, over the long term:

- a 10% increase in complexity is associated with a 1% increase in GDP per capita
- a 10% increase in the share of the population aged between 15 and 64 raises GDP per capita by 6.9%
- a 10% increase in the unemployment rate is associated with a 2% reduction in GDP per capita
- a 10% increase in GDP per capita in one region is associated with a combined 8.0% reduction in GDP per capita in the regions with which it shares strong enterprise connections.

Decomposition of these effects show local conditions is more important for local economic performance (GDP per capita) than the performance of other regions. Regions which perform well will have a negative effect on the prospects of those regions which it is closely connected to, although this effect is limited (and is not one-for-one).

## Table 5 High-level model results

Explaining log(GDP per capita)

Variable	Coefficient	t-stat
log(complexity)	0.10	6.17
log(share of population 15-64)	0.69	1.60
log(Unemployment rate)	-0.20	4.99
Taranaki effect	0.37	12.60
W = enterprise connections	-0.80	6.04
R-squared	0.805	

Source: NZIER

The table below decomposes effects on GDP per capita into direct local effects and impacts from changes in other regions – so-called indirect effects or spatial spill-overs. It shows that direct effects dominate indirect effects.

## Table 6 Estimates of spatial spill-overs

Coefficients and t-statistics (underneath and in brackets) of estimation of spatial spill-overs

Coefficients	Direct	Indirect	Total
log(complexity)	0.1069	-0.0500	0.0569
	(6.3976)	(5.1255)	(5.7387)
log(share of population 15-64)	0.7146	-0.3324	0.3823
	(1.6285)	(1.6084)	(1.5910)
log(Unemployment rate)	-0.2072	0.0969	-0.1103
	(5.0352)	(4.3090)	(4.7199)
LM test of 'no spatial lag', probability		0.005	

Source: NZIER



## Appendix C Human capital

We estimated the stock of human capital by region using the lifetime income approach used by the OECD.<sup>9</sup>

The data is from the 2006 New Zealand Census of population and dwellings. For each category, data is collected on:

- number of people in each category
- number of people employed
- total income
- number in study.

The data is broken down by gender, highest qualification, and year of age from 15 through to 65 and over.

The model is composed of three stylised life-cycle stages:

- those in both study and work between ages 15-30 (inclusive)
- those in work between ages 31 and 64 (inclusive)
- those 65 and over who are considered outside the workforce.

The first two of these categories differ from the categories used in the OECD human capital project in so far the first category is considered by us to end at 30 rather than 40 as used in the OECD project.

Lifetime labour income for people 65 and over is assumed to be zero. Lifetime income for the other two categories is calculated as:

$$\begin{aligned}
 LIN_{age}^{edu} &= EMP_{age}^{edu} \cdot AIN_{age}^{edu} + \left\{ 1 - \sum_{edu} ENR_{age}^{edu-edu^*} \right\} \cdot SUR_{t+1} \cdot LIN_{age\ t+1}^{edu} \left\{ \frac{1+r}{1+\delta} \right\} + \\
 &\sum_{edu} ENR_{age}^{edu-edu^*} \left\{ \frac{\sum_{t=1}^{t_{edu-edu^*}} SUR_{age+t} \cdot LIN_{age+t}^{edu^*} \left\{ \frac{1+r}{1+\delta} \right\}^t}{t_{edu-edu^*}} \right\} \quad \text{for ages 15-30, and} \\
 LIN_{age}^{edu} &= EMP_{age}^{edu} \cdot AIN_{age}^{edu} + SUR_{t+1} \cdot LIN_{age\ t+1}^{edu} \left\{ \frac{1+r}{1+\delta} \right\} \quad \text{for ages 31-64.}
 \end{aligned}$$

Where  $LIN$  is lifetime income, by age and education and gender,  $EMP$  is employment rate,  $AIN$  is current annual income,  $ENR$  is rate of enrolment in study and  $t_{edu}$  is the time taken for an individual in study to transition from their current level of educational attainment  $edu$  to the next level of attainment  $edu^*$ ,  $SUR$  is the probability of surviving one more year.

# Appendix D Economic complexity

## D.1 Conceptual basis

Economic complexity indices combine information about scope (diversity) and uniqueness (ubiquity) of economic activity to try and get at the underlying capability or potential of an economy.

The idea is that economic output is like Scrabble.<sup>10</sup> An economy can only make things if it has the necessary letters – or capabilities. Like making words, capabilities can't just come together in any old way and you can't make some words without the right letters. Economies can thus be defined by the kinds of letters they have, the number of letters they have, and the number of words that can be made. Gauging the growth potential of an economy requires checking the extent to which an economy has a lot of letters, or capabilities, and whether or not these are ones which others don't have access to.

Rather than decide which capabilities are important or not, complexity measures use observational data to gauge complexity, rather than fully define complexity at the outset. Network and complexity theory provide the conceptual basis for the complexity measures.

Methods for measuring and analysing economic complexity were pioneered by Hidalgo and Hausmann (2009)<sup>11</sup> and were based on data on product level trade data.

## D.2 Method

Our complexity measure follows the methods of Hidalgo and Hausmann but our data is industry level employee counts by 16 regions for 483 industries for 2000 to 2013 from Statistics New Zealand's business demography database.<sup>12</sup>

Statistics on employee counts ( $e$ ) are converted into measures of regional industrial specialisation ( $S$ ). These show whether an industry ( $i$ ) in a region ( $r$ ) has a greater share of the region's employment than that industry has in national employment:

$$S_{r,i} = \frac{\frac{e_{r,i}}{\sum_i e_{r,i}}}{\frac{\sum_r e_{r,i}}{\sum_{r,i} e_{r,i}}}$$

Results are converted into a binary specialisation matrix ( $SP$ ), industry by region, with a 1 where local industry share greater than national industry share (specialisation is equal to or larger than 1) and 0 otherwise.

Diversity of production of a region is measured as the sum of industries in which the region exhibits specialisation:

$$d_r = \sum_i s_{r,i}$$

Ubiquity measures are based on the sum of regions exhibiting a specialisation in an industry:

$$u_i = \sum_r s_{r,i}$$

An example of the two components is provided in Table 7 for the year 2012.

**Table 7 Economic complexity components, 2012**

	Diversity		Ubiquity	
Northland	209		5.8	
Auckland	261		3.8	
Waikato	120		7.2	
Bay of Plenty	163		6.9	
Gisborne	127		6.9	
Hawke's Bay	150		6.8	
Taranaki	144		6.7	
Manawatu-Wanganui	143		7.3	
Wellington	148		4.5	
Tasman	128		7.5	
Nelson	182		6.5	
Marlborough	144		6.8	
West Coast	94		7.6	
Canterbury	104		7.5	
Otago	110		7.2	
Southland	139		6.6	

Source: NZIER

Analysing the relationship between diversity and ubiquity then requires going beyond the relative position of a region versus all regions (and an industry versus all industries) to compare similar and dissimilar regions. This means jointly analysing the relative position of particular regions and particular industries. We do this to capture information on attributes such as the average diversity of regions with industry mix similar to a given region.

The relationship between diversity and ubiquity is analysed by successive iterations (k) evaluating the average ubiquity of industries in a region:

$$d_{r,k} = (u_{k-1,i} \cdot SP'_r) \frac{1}{d_{r,k=0}}$$

The average diversity of regions (r) specialising in industry (i) is:

$$u_{k,i} = (SP'_i \cdot d_{r,k-1}) \frac{1}{u_{k=0,i}}$$

These evaluations are conducted for every industry and every region, so that we have new vectors of diversity and ubiquity at each iteration ( $ds$  and  $us$ ).

For each iteration the diversity and ubiquity measures change interpretation (they are no longer simply diversity and ubiquity measures) and they gradually converge so that the differences between ubiquity and diversity gradually disappear. The variation which is left is taken to reflect economic complexity.

The final measure we use for economic complexity for each region ( $E_r$ ) is the number of standard deviations from the mean on the 16<sup>th</sup> iteration of the diversity index:

$$E_r = 1 + \frac{\left( d_{r,k=16} - \frac{\sum_r d_{r,k=16}}{R} \right)}{\sqrt{\frac{\sum_r \left( d_{r,k=16} - \frac{\sum_r d_{r,k=16}}{R} \right)^2}{R}}}$$

### D.3 Results

The complexity indices show a persistent pattern of higher complexity in Auckland and Wellington. However, over time Wellington's complexity has been declining while complexity has stayed relatively constant in Auckland it has fallen significantly in Gisborne, and increased most strongly in the Waikato and Taranaki (Table 8).

**Table 8 Economic complexity over time**

Region	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2003-2013 % change
Northland	0.50	0.43	0.50	0.44	0.35	0.33	0.31	0.37	0.37	0.33	0.41	0.36	0.29	0.40	-8%
Auckland	3.17	3.00	3.23	3.18	3.44	3.24	3.27	3.32	3.35	3.51	3.52	3.59	3.48	3.47	9%
Waikato	0.62	0.49	0.50	0.52	0.70	0.63	0.62	0.63	0.60	0.72	0.70	0.64	0.63	0.69	33%
Bay of Plenty	0.85	0.95	0.96	0.85	0.96	0.74	0.73	0.81	0.73	0.65	0.62	0.62	0.74	0.72	-15%
Gisborne	0.37	0.39	0.30	0.44	0.37	0.31	0.21	0.21	0.29	0.29	0.34	0.23	0.23	0.19	-56%
Hawke's Bay	0.59	0.42	0.48	0.43	0.29	0.50	0.45	0.48	0.37	0.41	0.54	0.46	0.44	0.34	-21%
Taranaki	0.44	0.59	0.67	0.60	0.65	0.67	0.87	0.79	0.97	0.92	0.95	0.89	0.86	0.80	33%
Manawatu-Wanganui	0.71	0.82	0.89	0.80	0.71	0.71	0.68	0.72	0.82	0.94	0.75	0.86	0.79	0.92	15%
Wellington	3.61	3.73	3.54	3.60	3.28	3.45	3.53	3.47	3.36	3.26	3.24	3.06	3.29	3.25	-10%
Nelson	0.11	0.24	0.24	0.27	0.18	0.25	0.27	0.25	0.15	0.35	0.33	0.31	0.28	0.27	0%
Tasman	1.16	1.08	1.01	1.21	1.24	1.24	1.08	1.26	1.25	1.12	1.32	1.45	1.29	1.25	3%
Marlborough	0.60	0.59	0.53	0.62	0.54	0.64	0.77	0.60	0.64	0.53	0.65	0.69	0.70	0.63	2%
West Coast	0.44	0.42	0.36	0.29	0.32	0.23	0.35	0.44	0.24	0.26	0.12	0.22	0.30	0.29	1%
Canterbury	1.55	1.62	1.62	1.57	1.58	1.70	1.53	1.45	1.58	1.57	1.47	1.60	1.46	1.60	2%
Otago	0.98	1.01	0.95	0.91	1.08	1.11	0.98	0.98	1.03	0.91	0.85	0.84	0.93	0.90	0%
Southland	0.29	0.24	0.22	0.29	0.31	0.26	0.34	0.21	0.25	0.23	0.19	0.18	0.28	0.28	-5%

Source: NZIER

# Appendix E Supporting tables

**Table 9 Growth decomposition**

Average annual percent change, 2000-2010

	Growth in GDP per capita =	Growth in working age population +	Growth in employment +	Growth in output per worker
Northland	2.6%	0.0%	1.5%	1.1%
Auckland	1.0%	0.2%	0.1%	0.7%
Waikato	2.1%	0.0%	1.4%	0.6%
Bay of Plenty	1.7%	0.1%	0.9%	0.7%
Gisborne-Hawke's Bay	1.6%	0.1%	1.4%	0.1%
Taranaki	4.4%	0.2%	1.1%	3.1%
Manawatu-Wanganui	2.3%	0.0%	1.4%	0.9%
Wellington	1.3%	0.2%	0.5%	0.6%
Upper South Island	2.3%	0.0%	0.3%	1.9%
Canterbury	2.0%	0.0%	1.2%	0.8%
Otago	2.6%	0.2%	0.5%	1.9%
Southland	2.6%	0.0%	1.4%	1.2%
NZ	1.7%	0.1%	0.7%	0.9%

Source: NZIER estimates, Statistics New Zealand data

**Table 10 Variation in growth due to industry composition**

2007 to 2010, nominal GDP

	Regional growth	National industry effect	Local industry effect
Northland	7.1%	9.6%	-2.5%
Auckland	7.5%	6.5%	1.0%
Waikato	10.5%	12.3%	-1.8%
Bay of Plenty	11.0%	10.4%	0.5%
Gisborne	11.2%	12.0%	-0.9%
Hawke's Bay	3.2%	10.5%	-7.3%
Taranaki	46.9%	16.8%	30.1%
Manawatu-Wanganui	12.0%	11.1%	0.9%
Wellington	13.4%	8.1%	5.3%
Tasman / Nelson	13.1%	9.4%	3.8%
Marlborough	12.6%	11.6%	0.8%
West Coast	23.8%	14.5%	9.2%
Canterbury	13.1%	9.7%	3.4%
Otago	15.5%	10.5%	5.0%
Southland	23.3%	16.4%	6.8%

Source: NZIER

# Appendix F Endnotes

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1 <http://bit.ly/1mtuLt9>

2 <http://bit.ly/1qdmjhi>

3 Penrose is less than 10km South East of Central Auckland. This is an approximation based on employee counts (16,290 in Penrose and 15,570 in the West Coast region in 2012)

4 The normalised Herfindahl-Hirschman index of concentration for industries in Penrose is 0.07 and for the West Coast it is 0.03. A value of 1 would indicate concentration of employment in a single industry.

5 The relative resilience of New Zealand regions is partly a function of the relative resilience economic activity in Australasia. Australian States and Territories have grown at similar and slightly faster rates to New Zealand regions.

6 Source data in Table 5

7 The table presents the first three components of Principal Components Analysis (PCA) which collectively explain 86% of the variation in growth across regions. The principal components are described as factors for explanatory purposes and are not the result of factor analysis which is technically different to principal components analysis.

8 The data used to conduct this analysis span 2000-2013 and includes official regional GDP statistics for 2007 to 2010. Growth for years outside the official statistics has been estimated using growth in employee and self-employed earnings where this is available (LEED) and growth in employee counts where earnings data is not available (Business Demography data).

9 Liu, G. (2011) "Measuring the stock of human capital for comparative analysis: an application of the lifetime income approach to select countries", *OECD Statistics Working Papers*, 2011/06, OECD Paris.

10 <http://bit.ly/1jiXiqd>

11 Hidalgo, C. and R. Hausmann (2009) 'The building blocks of economic complexity', *PNAS* 2009 106 (26) 10570-10575. For the 'product space' basis for the method see also Hausmann, R. and B. Klinger (2006) 'Structural Transformation and Patterns of Comparative Advantage in the Product Space', *CID Working Paper 128*, Kennedy School of Government, Harvard University, August 2006).

12 483 is the number of industries for which there national level employee counts are non-zero for all years 2000 to 2013.