Construction productivity

An evidence base for research and policy issues

NZIER report to the Building & Construction Sector Productivity Partnership

5 July 2013

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NZIER was established in 1958.

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Key points

The Building & Construction Productivity Partnership has asked NZIER for a broad assessment of productivity issues facing the New Zealand construction sector and testable hypotheses for its future work programme. The partnership has an aim to deliver a 20% increase in productivity by 2020.

The analysis is broad and canvasses a range of macroeconomic data, some novel, to look at productivity issues. The key outcomes are a high level assessment of current performance and and a number of hypotheses that require further attention.

Construction sector productivity has grown at half the pace of Australia over recent decades. The widening wedge supports productivity concerns and the Productivity Partnership's goal to raise productivity.

Some of the key findings of our analysis are:

Not all sub-sectors are the same: Across a number of productivity and competition measures, Construction Services and Heavy & Civil, compare unfavourably to other sub-sectors. The key sectors that stand out negatively are: structural steel erection; painting and decoration; tiling and carpeting; bricklaying carpentry; and plastering and ceiling. House construction performance is middle of the road and non-residential building typically appears at the more favourable end of most performance indicators.

Competition may be an issue: There are signs that competition and conduct may be an issue. Geographically, small and remote regions like Gisborne appear highly concentrated. By sector, Heavy and Civil and Non-residential Building are more concentrated.

Size matters: There is no consistent pattern of productivity differences across firm sizes, but there are large differences in practices related to productivity. For example, small firms tend to use assets inefficiently, perhaps indicating scale inefficiencies. Large firms use their assets more efficiently, but tend to have lazy balance-sheets. The issues and solutions to lift productivity across different firm sizes and sub-sectors may vary.

We build differently: We find typical construction costs are similar across New Zealand and Australia. But our construction sector is structured differently. For example, we use a lot more aggregate (in Civil & Heavy), forest products and architectural services (consistent with industry feedback of more customised homes) and there are much stronger linkages into retail and wholesale. This could mean that there are opportunities to change the building process and industry practices to mimic other more productive countries, or that the policies and processes in New Zealand need to be customised to local conditions.

Costs are not that different: We find little variation in construction costs between New Zealand and Australia. This is in contrast to findings by the Productivity Commission and requires further careful analysis. However, given hourly wages in New Zealand are around 30% lower than in Australia, it is unclear why construction costs are so similar across the two countries and whether this is due to productivity issues with labour or issues of conduct in the supply chain. This requires additional careful analysis.

Labour skills & mobility: Construction sector workers typically earn higher wages than other sectors with similar skills. This could mean low incentive to acquire skills, which may be productivity enhancing. Labour mobility across regions is also relatively low compared to other sectors like retail. This could mean that technological advances in one region are not readily adopted and diffused.

Technology apathy: Survey data hint at apathy over technology, efficiency and change.

There are a number of hypotheses that warrant further investigation. The following hypotheses are ordered as the analysis in the paper, but do not rank in order of the partnership's priorities.

Hypothesis 1: Construction productivity appears lowest in:

- Heavy & Civil - Heavy & Civil needs to be looked at in detail, with land development and road construction likely to perform very differently. When land development fell away sharply so did productivity in the sector.
- Construction Services - Construction Services sector is relatively low in productivity in Australia, suggesting it may be a feature of the sub-segment. High incidence of large profit margins in Construction Services, especially in particular trades, means a careful analysis is required.

Hypothesis 2: Management skills are below par with:

- Inefficient balance sheet use in Residential Construction, Construction Services and Civil & Heavy.
- Sluggish adoption of new technology and resistance to change.

Hypothesis 3: High market concentration inhibits competition and productivity growth, particularly in

- Civil & Heavy and Construction Services.
- Small regions.

Hypothesis 4: Return on equity in the construction sector is 'too high' meaning little incentive to invest in productivity gains.

Hypothesis 5: Long vertically integrated supply chains in the building industry may hide strategic or anti-competitive behaviour.

Hypothesis 6: House construction costs reflect general inflation and specification increases.

Hypothesis 7: Labour quality is a key lever for lifting productivity in the New Zealand construction sector.

Hypothesis 8: Low labour mobility slows diffusion of technology and productivity gains?

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1. Introduction

The Building and Construction Productivity Partnership (BCPP) has asked NZIER to look at macroeconomic data to provide a snapshot of productivity issues for the sector from a top-down perspective, to complement its own bottom-up investigation.

Motivation for the work is based on the BCPP's aim to lift New Zealand's construction sector productivity by 20% by 2020. This is an ambitious goal, as there has been very little productivity growth in recent decades.

1.1. Framework

We organise the paper as a collection of data, analysed for insights into the construction sector and hypotheses for more detailed work. The scope of this work is meant to be broad, rather than deep. We selected a wide range of novel datasets to ask typical productivity related questions in a different angle and light. The selection of data and their analysis is motivated by economic frameworks of economic growth and their drivers.

1.1.1. Measures of productivity

In our analysis we take a few liberties with statistical standards in order to test the limits of the data.

The basic tenet of productivity is making more with less. This has clear financial outcomes for the business, through greater profitability. There are also wider economic benefits, as inputs not used in creating this output can now be used for something else.

The measurement of productivity is challenging. The official measures are produced by Statistics New Zealand and are the best available. They adhere to international best practice standards and use a wide range of economic data that is collated and analysed by professional statisticians.

The output side of productivity measurement is generally straight forward. Typically output is measured as value added (total output less intermediate inputs) and can be proxied by the sum of returns to labour (compensation of employees) and returns to capital (profit).

Challenges in measuring productivity arise from constructing standardised measures of the value of primary factors of production: labour, capital and technology. Data on number of employees and wages paid are generally reliable but data on labour quality, capital and technology are not. As a result quite a bit of our analysis looks at unadjusted measures of labour productivity (value added per employee) for general insights.

The benefit of this short cut is that we can dig into sub-sector data and analyse differences between firm performance without recourse to the sorts of time consuming and costly analyses needed to produce 'ideal' productivity measures.

Published productivity data do not provide sufficient detail to understand the causes and consequences of productivity performance within the construction sector. Construction productivity estimates are for the entire sector at the national level.

In our search we hypothesise that there may be issues in a sub-sector (say carpentry) or that there are regional variations (for example small and remote regions may have low productivity). As a result we consider a range of data to look at symptoms of productivity, even though the official measures are the most comprehensive and reliable.

1.1.2. Caveats on combining disparate data

To analyse the data and shed light on the issues, we have purchased a large number customised data sets from Statistics New Zealand to ask the questions from a number of different angles. This gives us some surprising results, suggesting new research and policy questions.

An important caveat with disparate data sources is that they are not always directly comparable. Rather than judging this as a weakness, we view it as a strength. Inherent biases in data mean that a portfolio approach to analysis is helpful.

Regardless of their rigour official statistics can cause confusion due to changes in standards or classifications. For example, revisions to productivity statistics following the adoption of new industrial classification[1] lead to some aspects of construction to be counted in the construction sector, which were previously counted in government investment or in property services. As a result, construction sector productivity estimates were revised from showing a slump in recent years, to flat performance.

1.1.3. Drivers and diagnoses of productivity performance

We look at the macro economic data to identify if there are areas of the sector where productivity is low and what their drivers may be. We raise a number of hypotheses from our analysis that require further careful and detailed analysis.

Components of productivity performance

Productivity can be decomposed into its proximate components or into its fundamental drivers. The proximate components are technical change, technical efficiency, scale efficiency, and allocative efficiency. There is a rich literature on productivity decomposition.[2] In our analysis we dig into these components by analysing:

- overall productivity patterns
- attitudes to technology
- capital utilisation and profitability measures.

[1] To ANZSIC06

[2] For example, refer to Ma, Liu & Oxley (2012) Productivity growth and policy implications for China's dairy farms. China Economic Policy Review.

As we do not have perfect measures of these we make use of cross-country comparisons, principally with respect to Australia, but also among sub-sectors and regions within New Zealand.

Competition effects

The literature and empirical evidence on drivers of productivity growth is rich but full of observations that are context dependent.[3] As a rule of thumb, there is a causal relationship between competition and firm level productivity. This is because competition leads to reallocation of resources from lower to higher productivity firms. Competition can, however, lead to contrasting outcomes:

- Intense competition can reduce profits for innovators and reduce the incentive to innovate (that is, innovations are less durable, so the incentive to innovate is low).
- High competition can increase the incentive to continuously innovate to stay ahead of the pack and escape the competition (that is, lower monopoly rents, but the returns from escaping the competition is high enough and is an incentive to continuously innovate).

Irrespective of the impacts, it is also difficult to identify precisely how competitive an industry is. The existence of highly profitable firms can be an indicator of limited competitive pressure but can also reflect high performance. Similarly, highly concentrated market structure, with few firms in the market, may reflect strategic behaviour limiting competition but it may also reflect natural economies of scale in capital intensive industries.

In our analysis we consider both profitability and measures of market concentration (regionally and nationally) to understand whether competitive pressure might be an important driver of productivity in the construction sector.

Scale effects

Scale effects are likely to be important in the construction sector, at least for parts of the sector. This could limit the number of firms in the sector and possibly limit productivity gains but may also be an efficient way for the market to organise itself. To try understand whether this is the case this, wherever possible we decompose our analysis by firm size, sub-sector and region.

External effects

Productivity performance can often be explained by external or unavoidable influences (from the firm perspective) such as distance to market, policy and regulation or poorly functioning upstream and downstream markets. Furthermore, when benchmarking productivity performance across countries it is important to take account of the different demands and desires of customers which can affect the cost of production at home or abroad.

To understand these effects we focus on picking apart some of the key drivers of cost escalation in the sector and compare these to similar measures for Australia. We also

[3] Refer to the following for a helpful literature review: Ospina & Schiffbauer (2010) Competition and firm productivity. IMF Working Paper (WP/10/67)

refer to a case study of a model house to quantify the effects that regulatory and technical standards have on input costs.

This analysis is broken down by sub-sector wherever possible to reflect the considerable variation between construction tasks and products.

1.2. Defining the sector

Construction productivity for the purpose of this analysis is defined as below:

- Building construction
  - House Construction
  - Other Residential Building Construction
  - Non-Residential Building Construction
- Civil & heavy
  - Road and Bridge Construction
  - Other Heavy and Civil Engineering Construction
- Construction services
  - Land Development and Subdivision
  - Site Preparation Services
  - Concreting Services
  - Bricklaying Services
  - Roofing Services
  - Structural Steel Erection Services
  - Plumbing Services
  - Electrical Services
  - Air Conditioning and Heating Services
  - Fire and Security Alarm Installation Services
  - Other Building Installation Services
  - Plastering and Ceiling Services
  - Carpentry Services
  - Tiling and Carpeting Services
  - Painting and Decorating Services
  - Glazing Services
  - Landscape Construction Services
  - Hire of Construction Machinery with Operator
  - Other Construction Services n.e.c.

Our analysis of the construction sector does not include suppliers and users of construction sector services, such as architects, wholesalers and retailers.

2. Productivity performance

2.1. Official statistics

Official measures of productivity for the construction sector suggest very gradual improvement in productivity since the early 1990s (Figure 1).

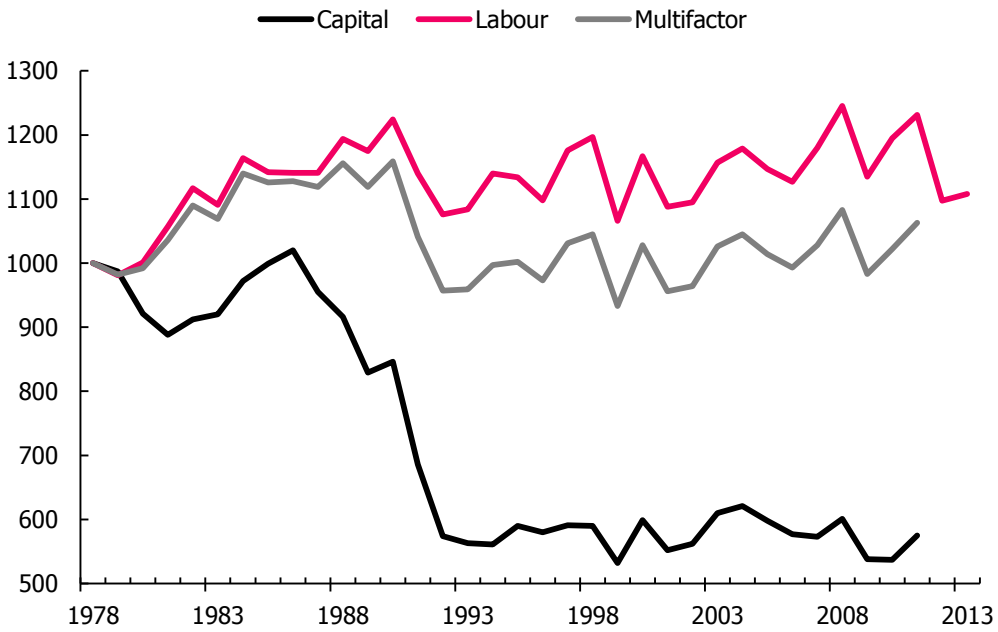
Revisions to official statistics when ANZSIC06 was adopted, now counts some previously unallocated activities such as bridge building and certain aspects of land development. Productivity performance as a result is flat over recent years, compared to steeply falling previously (Figure 2). These revisions do not mean that the productivity performance is good.

Construction productivity growth in New Zealand is about half the rate of Australia. Over the 15 years to 2011 (period of overlapping reliable data) construction labour productivity growth averaged:

- New Zealand: 0.8% pa
- Australia: 1.6% pa

Figure 1 Construction sector productivity

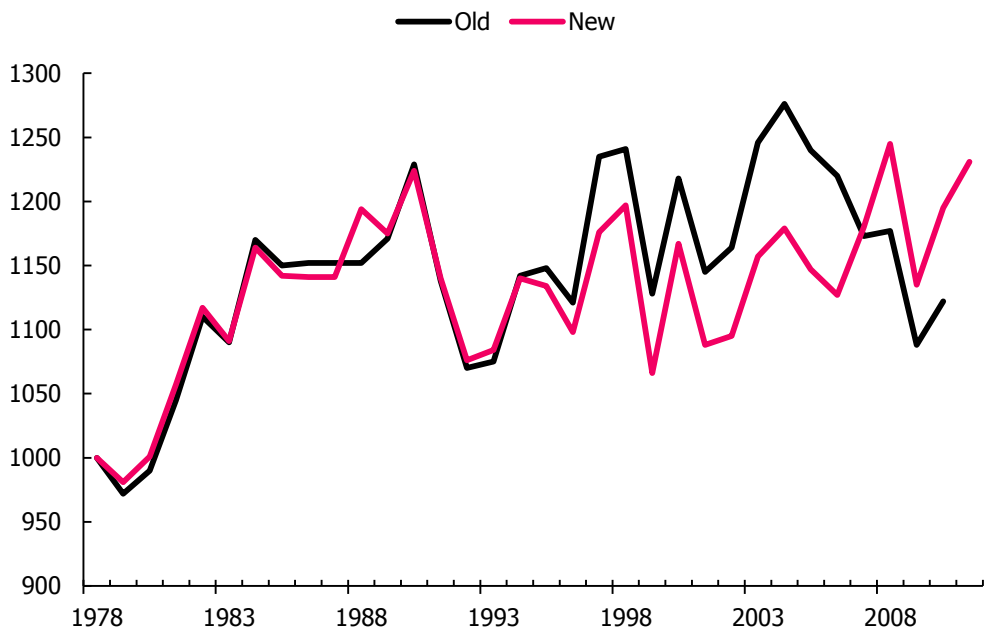
Index 1978 = 100



Source: Statistics New Zealand, NZIER estimates of labour productivity for 2012 and 2013

Figure 2 Construction labour productivity revisions

Index, 1987 = 100

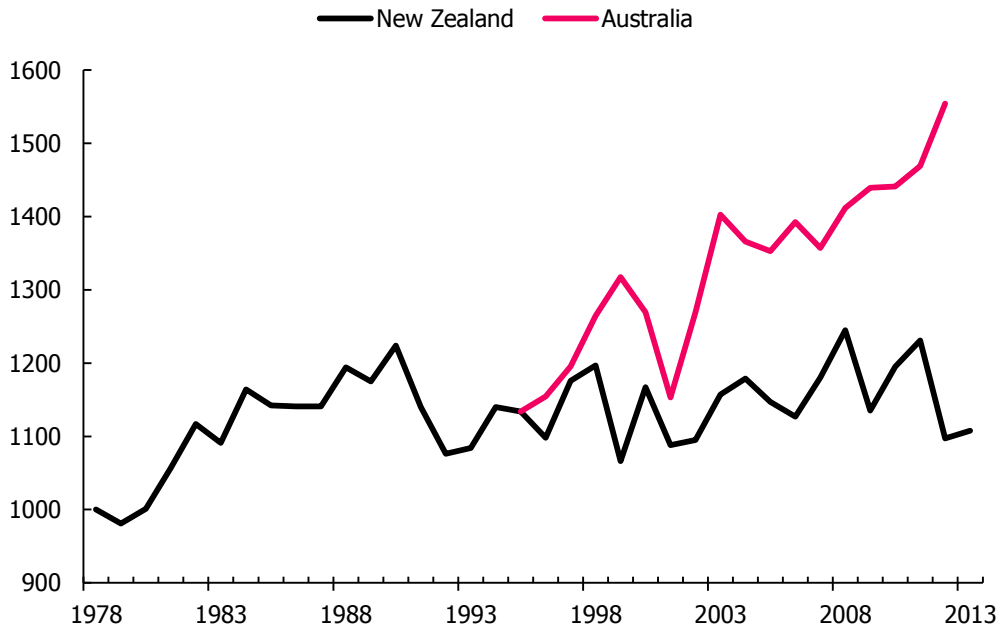


Source: Statistics New Zealand, NZIER

2.2. Australian comparison

Figure 3 Construction labour productivity: NZ & Australia

Index, 1989=100



Source: Statistics New Zealand, ABS, NZIER estimates for 2012 and 2013

Comparison of estimates of gross value added per employees from financial statistics between New Zealand and Australia highlight large productivity differences.

The comparison needs to be made with care. There are differences in data collection methods. The choice of exchange rate conversion matters too. The spot exchange rate is volatile and typically not used in these types of comparisons between economic structures. More reasonable choices are:

- PPP method: The OECD estimate of the NZD/AUD Purchasing Power Parity exchange rate is close to 1.
- Long run average: The Jan 1990 to May 2013 average of the NZD/AUD exchange rate is 0.83.

The key insights from comparison of the level of labour productivity across the two countries are:

- New Zealand construction suffers from a productivity deficit relative to Australia which is similar to the productivity deficit observed between the two economies as a whole.
- Within the sector:
  - Heavy & civil is the worst performer.
  - Building construction is the second worst performer.[4]
  - Construction services sector has relatively low productivity across both countries.

Table 1 Labour productivity: NZ & Australia (2011)

Gross valued added, $000 per employee, unless otherwise stated

	Australia		NZ	NZ % difference	
	A$[(1)]	NZ$ @0.83[(2)]	NZ$	A$	NZ$ @0.83
All	89	107	75	-16%	-30%
Construction	86	104	75	-13%	-28%
-building construction	114	137	84	-26%	-39%
-Heavy & civil	115	139	77	-33%	-44%
-Construction services	74	89	70	-6%	-22%

Source: ABS, Statistics NZ, RBNZ, NZIER. Notes: (1) the PPP exchange rate estimated by the OECD is close to 1, so we show the A$ value for ease of comparison; (2) we convert the A$ values using the long run average NZD/AUD exchange rate of 0.83.

[4] Combines residential and non-residential as a more detailed breakdown is not available.

2.3. Financial comparison (2011)

To understand productivity performance across different sub-sectors we analysed financial data from the Annual Enterprise Survey data. We use a proxy of value added, defined as profit before tax plus wages and salaries, to mimic returns to capital and labour and benchmark value added against number of workers as a proxy for labour productivity.[5]

The financial data highlight (Table 2 & Table 3):

- Output per worker in the construction sector is about the same as the whole economy as measured at around $75,000 per employee in 2011.
- Output per worker is lowest in two sectors:
  - Heavy & Civil
  - Construction Services.
- The industry is dominated by very small (owner operator) and large firms (19+ employees), but few medium sized firms.
- There is no clear correlation between our measure of productivity and firm size
- Firm size does appear to be related to other performance measures:
  - Large firms have lower profit margins, but use their assets more efficiently, invest more and have less leverage
  - Small firms use assets inefficiently (large stock of fixed assets, but relatively small amount of sales), invest less, but use more leverage.

[5] These are not perfect measures and are not directly comparable to National Accounts measures. One specific difficulty is measurement of owner operators.

Table 2 Construction sector financial performance by firm size (2011)

	Firm size (number of filled jobs)					
	0	0-1	1-5	5-19	19+	Total
ROE analysis of the sector						
Profit margin (Profit before tax (PBT)/Sales)	8%	8%	7%	8%	4%	5%
Sales turnover (Sales/Assets)	0.9	1.1	1.4	1.8	2.0	1.6
Leverage (Equity/Assets)	3.3	3.2	2.9	3.2	2.6	2.9
ROE (PBT/equity)	23%	27%	28%	44%	23%	24%
Value added analysis of the sector						
GVA (PBT + Wages), $m	1,095	204	344	536	6,344	8,523
GVA per employee, $000	na	63	50	81	65	75
Investment analysis of the sector						
Depreciation (% of FA)	1%	1%	1%	2%	5%	3%
Investments (net additions/FA)	8%	5%	8%	7%	14%	11%
Investments (net additions less dep./FA)	7%	5%	7%	5%	10%	8%
Market share analysis of the sector						
Share of sales	17%	2%	4%	8%	70%	100%
Share of wages	11%	2%	4%	5%	78%	100%
Share of profits	31%	3%	5%	9%	51%	100%
Share of fixed assets	33%	4%	5%	6%	52%	100%
Share of equity	26%	3%	4%	6%	61%	100%
P&L of the construction sector						
Sales	5,330	708	1,208	2,497	22,559	32,302
COGS	3,733	452	800	1,898	15,316	22,199
Wages	808	172	288	380	5,880	7,529
Indirect taxes	162	15	20	34	177	407
EBITDA	**627**	**69**	**100**	**185**	**1,186**	**2,167**
Op profit margin	12	10	8	7	5	7
Net interest income	528	52	90	153	687	1,509
Depreciation	22	2	3	6	135	169
Operating PBT	**4,866**	**571**	**987**	**2,230**	**17,044**	**25,696**
Non-operating net income	3,694	449	797	1,888	15,144	21,971
Change in inventory	1,728	88	172	341	952	3,282
PBT	**1,172**	**122**	**190**	**342**	**1,900**	**3,725**
Notional tax @ 28% tax rate	328	34	53	96	532	1043
Notional NPAT	**844**	**88**	**137**	**246**	**1368**	**2682**

Source: NZIER calculations from Statistics New Zealand data (AES).

Table 3 Financial indicators for the construction sector (2011)

	Construction: segment				Construction: firm size						All sectors
	Residential Building	Non-residential Building	Heavy and civil	Construction services	0	0-1	1-5	5-19	19+	Total	
Profit margin (PBT/Sales)	5%	3%	5%	7%	8%	8%	7%	8%	4%	**5%**	**10%**
Asset turnover (Sales/Assets)	1.6	1.8	1.8	1.4	0.9	1.1	1.4	1.8	2.0	**1.6**	**0.2**
Leverage (Assets/Equity)	3.7	2.9	2.2	3.0	3.3	3.2	2.9	3.2	2.6	**2.9**	**2.8**
ROE	**31%**	**17%**	**20%**	**27%**	**23%**	**27%**	**28%**	**44%**	**23%**	**24%**	**7%**
GVA (PBT+Wages), $m	1,230	740	2,199	4,353	1,095	204	344	536	6,344	**8,523**	**137,372**
- share of all construction	14%	9%	26%	51%	13%	2%	4%	6%	74%	**100%**	**...**
GVA per employee, $000	**83**	**85**	**77**	**70**	**...**	**63**	**50**	**81**	**65**	**75**	**75**

Source: NZIER calculations from Statistics New Zealand data (AES).

2.4. Financial comparison (2007-2011)

To move beyond descriptive performance measures we look at the sector's financial performance over time using a simple DuPont disaggregation. The measured profitability ratio is Return on Equity (ROE), which most firms seek to maximise. This can be decomposed into three components:

- Profit margin (PBT/sales): which rises and falls with the economic cycle (pro-cyclical) and can indicate ability to raise prices in response to cost pressures.
- Asset turnover (sales/assets): which measures efficiency of asset use with higher turnover indicating more efficient use of capital.
- Leverage (assets/equity): which measures the use of leverage to boost profits. Higher leverage can be symptomatic of easier access to credit and also speculative/risky behaviour.

These metrics provide high-level insights into market conduct and structure issues as well as overall performance.The analysis highlights a number of key issues (Table 4, Figure 4, Figure 5, Figure 6 & Figure 7):

- High profit margins in Heavy & Civil and Construction Services are suggestive of limited competitive pressure in these sub-sectors. ROE is also very high across the sector as a whole (24% compared to 7% for all industries), which may indicate little pressure to invest in productivity gains.
- Low asset turnover in Residential Construction and Construction Services indicates inefficiency and below par professional management skills because they are not 'sweating' the assets enough.
- High leverage in Residential Construction which may make these firms less resilient to shocks and less able to invest in new technologies and processes.
- Low leverage in the Civil & Heavy sector indicates scope for improvement or a lazy balance sheet and potentially below par professional management skills.

Table 4 Financial indicators (2007-2011 average)[1]

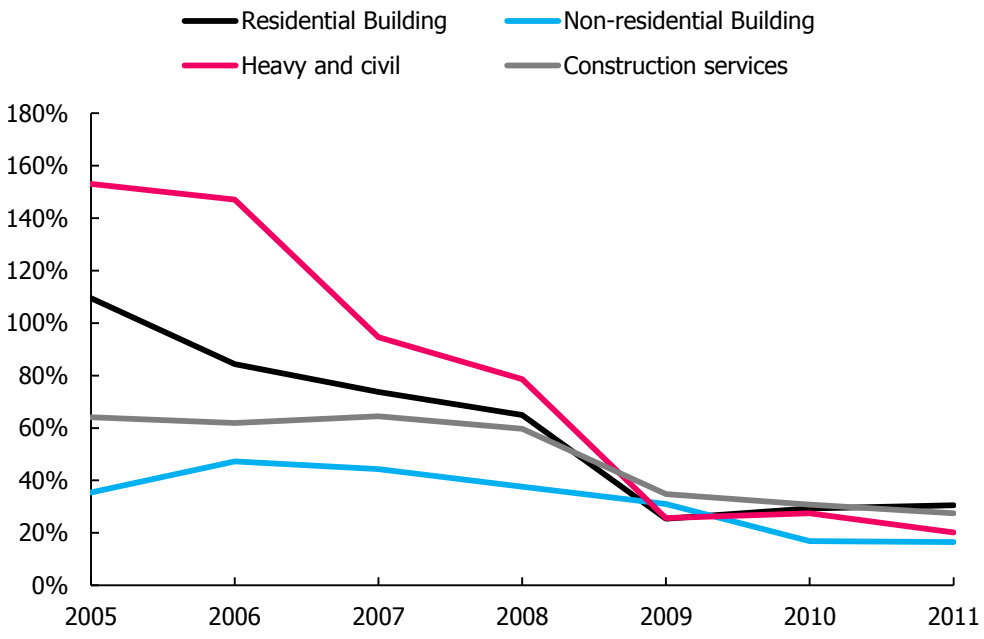
Key ROE indicators and their implications

	Residential Building	Non-residential Building	Heavy and civil	Construction services
Measure				
Profit margin	7%	5%	12%	11%
S/A	1.9	2.1	2.2	1.5
A/E	4.1	2.9	2.6	3.0
ROE	60%	33%	78%	49%
Interpretation				
Competition	✓	✓	✗	✗
Sector efficiency	✗	✓	✓	✗
Leverage	✓	●	✗	●
Profitability	✓	✗	✓	●

Source: Statistics New Zealand, NZIER. Note: 1. 2007-2011 incorporates a boom and a bust. The average across these years may give a reasonable approximation of the mid-cycle.

Figure 4 Construction return on equity (2005-2011)

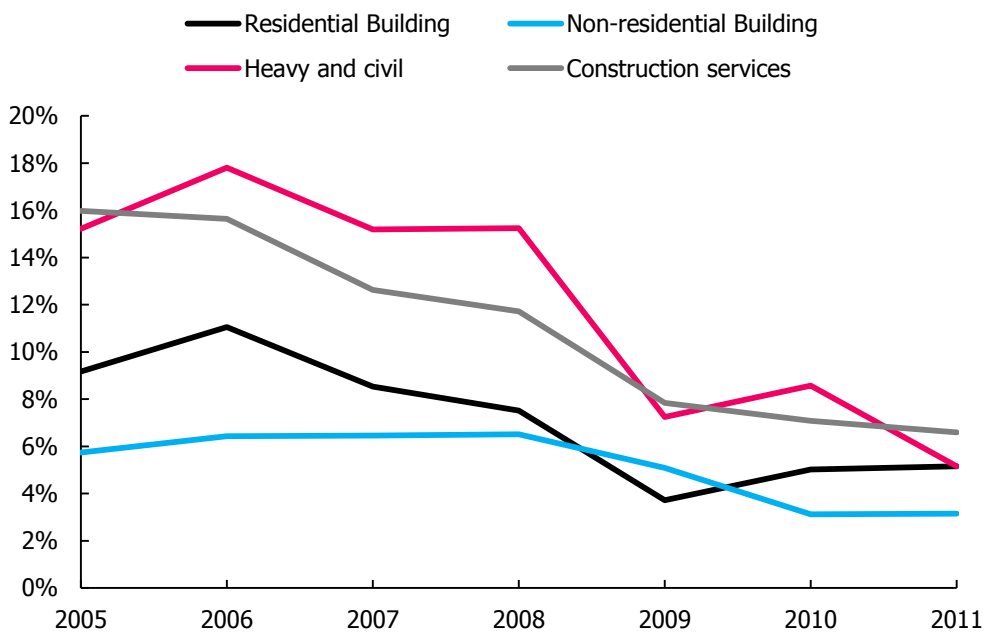
PBT/Equity



Source: Statistics New Zealand, NZIER

Figure 5 Construction profit margin (2005-2011)

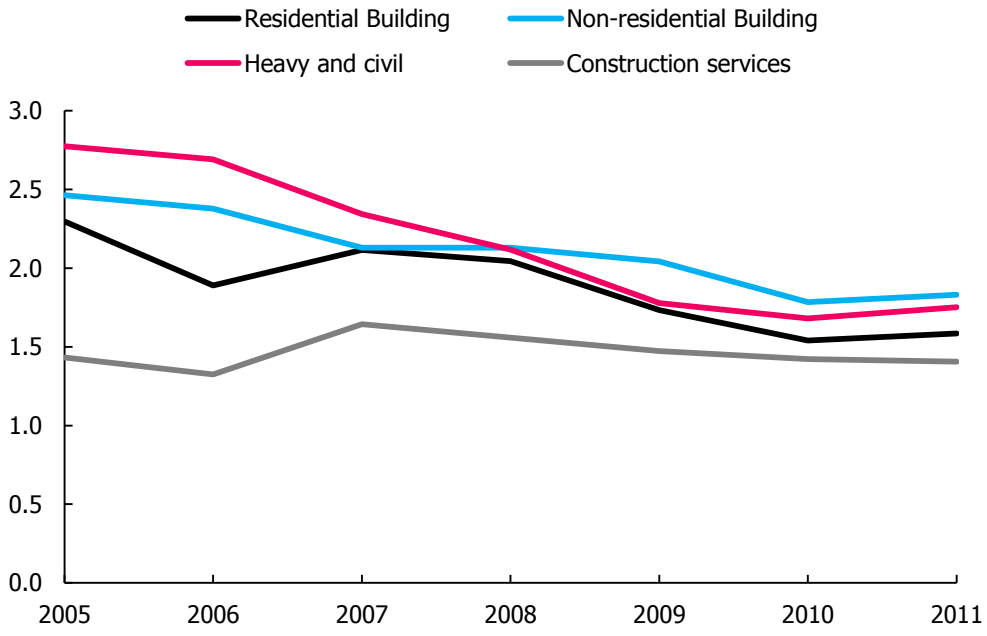
PBT/Operating sales



Source: Statistics New Zealand, NZIER

Figure 6 Construction asset turnover (2005-2011)

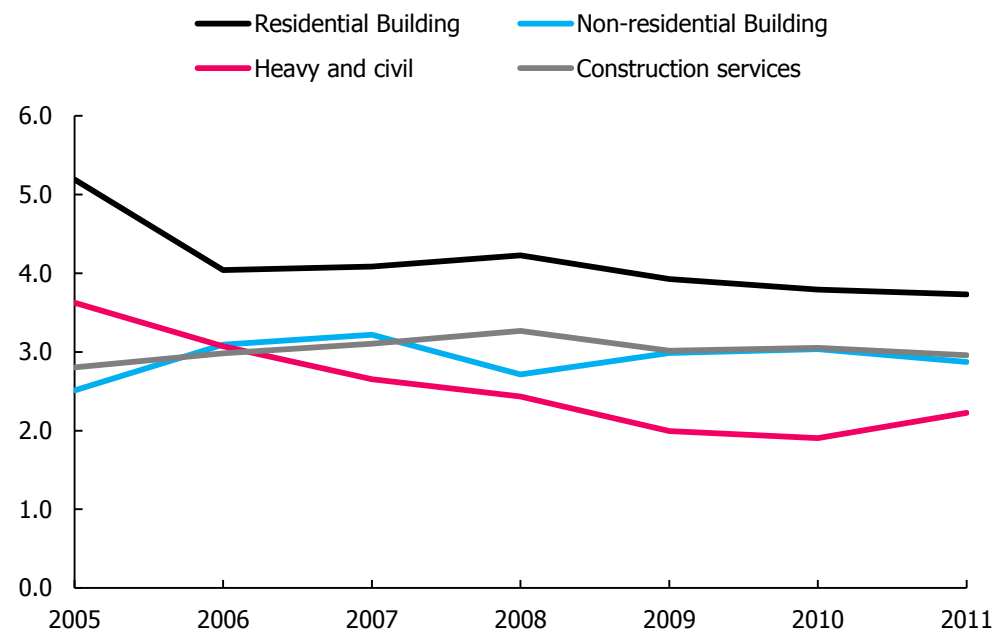
Sales/Assets



Source: Statistics New Zealand, NZIER

Figure 7 Construction leverage (2005-2011)

Equity/Assets



Source: Statistics New Zealand, NZIER

3. Market structure

We look at the construction sector structure within the economy, its prominence, connections and comparison with international peers (mainly Australia).

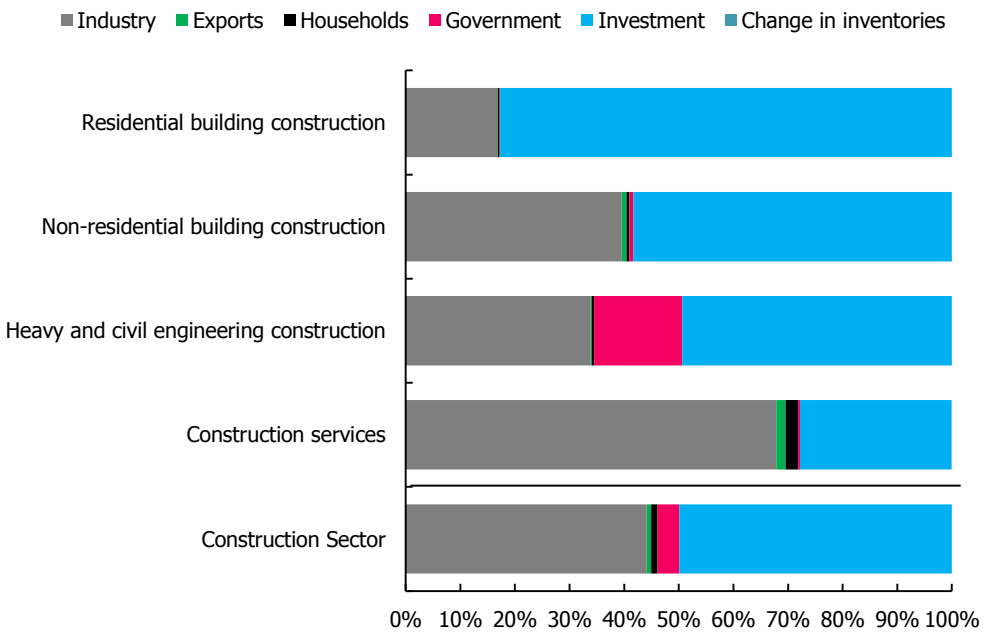
In the domestic economy, construction sector output is primarily attributed to the investment of structures (buildings, roads, bridges, etc.) (Figure 8). The government is a large purchaser of construction of roads and bridges from Heavy & Civil. A significant portion output of each sub-segment is provided to others in the construction sector, through the use of specialised inputs such as plumbing and carpentry, or as sub-contractors.

International comparisons show that:

- The structure and size of the New Zealand construction sector is similar to other small open OECD economies (Table 6)
- Compared to Australia, New Zealand has (Table 7):
  - Lower profits in Non-residential Buildings and Civil & Heavy for each dollar of sales
  - Higher value added in Construction Services for each dollar of sales.

Figure 8 Demand for construction in the economy

Share of total economy, (2012 NZIER input-output estimate)



Source: NZIER

Table 5 Final demand for construction (NZIER 2012 IO estimate)

% of total economy

Industry	Industry	Exports	Households	Government	Investment	Change in inventories	Total economy
Residential building construction	17%	0%	0%	0%	83%	0%	100%
Non-residential building construction	40%	1%	1%	1%	58%	0%	100%
Heavy and civil engineering construction	34%	0%	0%	16%	49%	0%	100%
Construction services	68%	2%	2%	0%	28%	0%	100%
Construction Sector	**44%**	**1%**	**1%**	**4%**	**50%**	**0%**	**100%**

Source: NZIER

Table 6 construction sector international comparison

$m and % share of gross output

Country	Relative size of Sector in Economy	Exports as % of Gross Output	Household Consumption as % of Gross Output	Government Consumption as % of Gross Output	Intermediate Demand as % of Gross Output	Value added / Gross Output	Employee compensation as % of Gross Output
Australia	7%	0%	0%	1%	38%	31%	45%
New Zealand	**3%**	**7%**	**1%**	**0%**	**63%**	**33%**	**52%**
UK	5%	0%	2%	0%	42%	37%	54%
Denmark	5%	0%	2%	4%	25%	40%	74%
Hawaii	1%	1%	0%	8%	92%	56%	39%

Source: NZIER

Table 7 Components of value added in Construction: New Zealand (2007) & Australia (2009)

$m

	NZ, NZ$m, 2007					Australia, A$m, 2009				
	Residential construction	Non-residential building construction	Non-building construction	Construction trade services	All sectors	Residential construction	Non-residential building construction	Non-building construction	Construction trade services	All sectors
Compensation of employees	534	596	1,381	2,347	*73,453*	4,787	5,199	10,256	26,710	*596,098*
Operating surplus	650	225	376	1,846	*50,373*	5,482	4,765	7,892	22,171	*536,909*
Total value added	1,298	873	2,032	4,638	*152,032*	10,626	10,251	18,521	50,243	*1,168,875*
Gross output	7,566	5,469	5,845	11,420	*339,496*	54,927	43,046	52,977	146,162	*2,437,108*
% of gross output										
Compensation of employees	7%	11%	24%	21%	*22%*	9%	12%	19%	18%	*24%*
Operating surplus	9%	4%	6%	16%	*15%*	10%	11%	15%	15%	*22%*
Total value added	17%	16%	35%	41%	*45%*	19%	24%	35%	34%	*48%*

NZ %pt differnece from Australia

Compensation of employees	-2%	-1%	4%	2%	-3%
Operating surplus	-1%	-7%	-8%	1%	-7%
Total value added	-2%	-8%	0%	6%	-3%

Source: ABS, Statistics New Zealand, NZIER

The New Zealand construction sector is structured differently from Australia's in a number of key ways:

- Aggregates is a larger input into Civil & Heavy and Construction Services
- Much greater use of forest products, in Residential and Non-residential buildings
- Much greater use of architectural and related services for Residential Building in New Zealand
- Glass is a larger input in New Zealand (possible due to double glazing rules)
- Plaster, concrete and cement are larger inputs in New Zealand
- Much stronger reliance on wholesale and retail trade (it may present an opportunity for rent seeking in other parts of the supply chain)

There are some obvious differences between New Zealand and Australia. In particular for the Civil & Heavy sector, which is dominated by mining sector projects in Australia. Also, weather differences can account for differences in preferences and work disruptions. Cross country comparisons need to be made carefully and in this case it illustrates that there may be particular areas of focus, but they may be simply a result of composition or external factors.

Table 8 Suppliers to construction: NZ ratio to Australia[6]

Contribution to gross output (NZ/Australia)

	Residential construction	Non-residential building construction	Non-building construction	Construction trade services
Non Metallic Mineral Mining	-	-	20.25	4.50
Textile Product mfg.	3.50	-	-	19.00
Sawmill Product mfg.	3.42	48.50	6.50	0.67
Other Wood Product mfg.	1.13	-	-	0.70
Pulp, paper, paperboard, books and stationery	1.60	-	0.20	3.00
Petroleum and Coal Product mfg.	1.09	0.33	2.16	1.48
Basic Chemical mfg.	-	-	0.06	0.33
Polymer Product mfg.	0.46	-	0.68	3.81
Natural Rubber Product mfg.	-	-	-	-
Glass and Glass Product mfg.	19.00	-	-	16.00
Cement, Lime and Ready-Mixed Concrete mfg.	0.08	0.33	2.14	0.21
Plaster and Concrete Product mfg.	1.95	7.55	6.73	3.06
Metal and structural metal	0.52	1.43	0.82	1.72
Other Fabricated Metal Product mfg.	0.38	0.35	1.57	3.22
Electrical Equipment mfg.	-	-	0.25	9.89
Domestic Appliance mfg.	3.33	-	-	0.50
Residential Building cons.	-	-	-	-
Non-Residential Building cons.	-	-	-	-
Heavy and Civil Engineering cons.	-	-	-	-
cons. Services	1.16	1.53	0.61	0.24
Other Repair and Maintenance	1.38	0.71	6.43	11.75
Wholesale Trade	1.03	1.59	1.55	2.81
Retail Trade	1.00	0.33	1.67	2.67
Road and rail freight transport	0.17	0.13	0.40	0.24
Auxiliary Finance and Insurance Services	-	0.03	-	0.04
Rental and Hiring Services (except Real Estate)	0.21	0.55	1.13	0.77
Non-Residential Property Operators and Real Estate Services	0.22	0.21	0.32	0.92
Professional, Scientific and Technical Services	1.69	0.21	0.19	0.89
Building Cleaning, Pest Control, Administrative and Other	0.29	0.03	0.08	0.25
Automotive Repair and Maintenance	3.67	1.00	9.00	3.92

Source: Statistics New Zealand, ABS, NZIER

[6] These are based on dollar values not material flows and differences may be due to either volumes or prices or both.

4. Competition & productivity

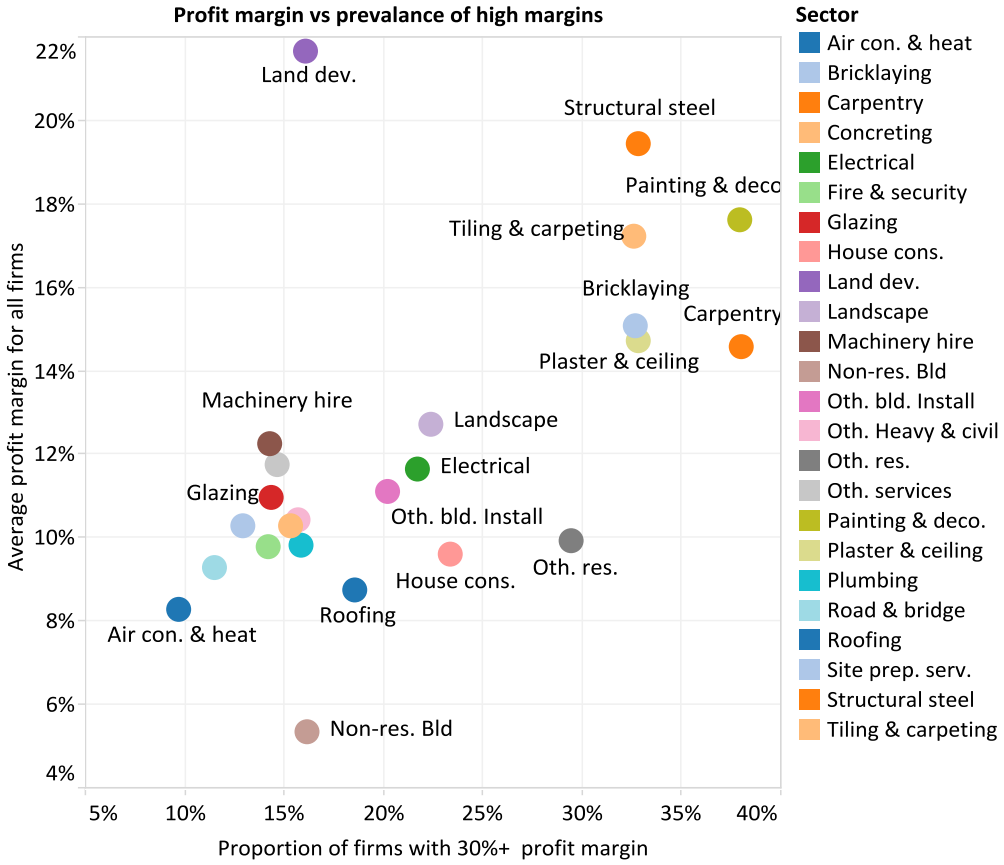
4.1. Profit margins & incidence of high profitable firms

Profit margins can be an indicator of high innovation rates or impediments to productivity growth. Analysis of the profit margins and the incidence of high profit margins at the detailed industry level shows (Figure 9 & Table 9):

- Concentration of very high profit margin businesses in Construction Services, in particular:
  - Carpentry Services
  - Painting and Decorating Services
  - Plastering and Ceiling Services
  - Structural Steel Erection Services
  - Bricklaying Services
  - Tiling and Carpeting Services
- There are some signs of high margins in Heavy & Civil and Non-residential Buildings, but less obviously so than in Construction Services.
- There does not appear to be a systematic pattern of very high profitability in the Residential Building sector.
- Non-residential Building appears to be competitive and have tight profit margins.

Figure 9 Industries with a high profit margins (2011)

Vertical scale is average profit margin for all firms; horizontal scale is proportion of firms with 30%+ profit margin



Source: Statistics New Zealand, NZIER

Table 9 Distribution of profit margins

% of business counts

	Profit margin (PBT/Sales)		
	Zero or less	**>0 but <30%**	**30%**
House Construction	44%	32%	23%
Other Residential Building Construction	44%	26%	29%
Non-Residential Building Construction	43%	41%	16%
Road and Bridge Construction	35%	54%	12%
Other Heavy and Civil Engineering Construction	44%	40%	16%
Land Development and Subdivision	57%	27%	16%
Site Preparation Services	45%	42%	13%
Concreting Services	44%	41%	15%
Bricklaying Services	38%	30%	33%
Roofing Services	42%	39%	19%
Structural Steel Erection Services	41%	27%	33%
Plumbing Services	39%	45%	16%
Electrical Services	40%	38%	22%
Air Conditioning and Heating Services	45%	46%	10%
Fire and Security Alarm Installation Services	47%	39%	14%
Other Building Installation Services	45%	35%	20%
Plastering and Ceiling Services	36%	31%	33%
Carpentry Services	34%	28%	38%
Tiling and Carpeting Services	41%	26%	33%
Painting and Decorating Services	34%	28%	38%
Glazing Services	44%	42%	14%
Landscape Construction Services	44%	34%	22%
Hire of Construction Machinery with Operator	50%	36%	14%

Source: Statistics New Zealand, NZIER

4.2. Creative destruction and barriers to entry

"Schumpeterian" creative destruction describes the cathartic process of poor performing firms dying and creating room for new and innovative companies to take their place. On the other hand, long surviving firms can accumulate skills and knowledge that translate into productivity gains.

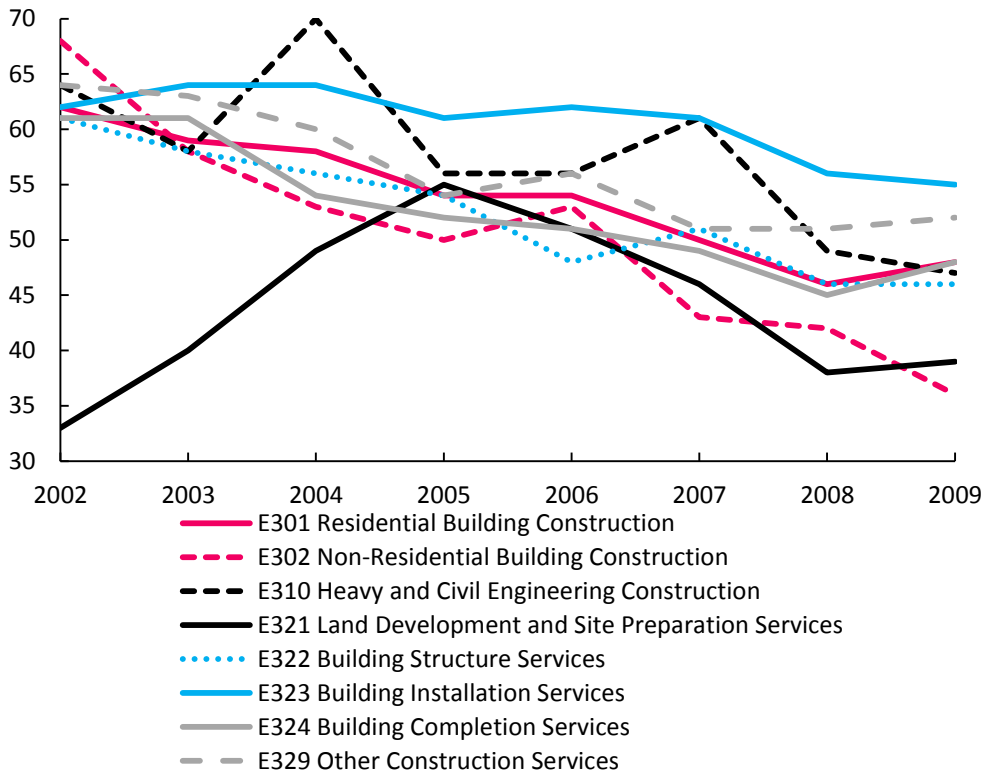
Rates of firm survival and birth rates can thus provide a measure of the 'health' of the sector in terms of potential (and potentially unseen) barriers to entry for new firms and inefficient advantages to incumbents.

The survival rate of firms three years from birth[7] during the recession in 2008 and 2009 shows some interesting patterns:

- Non-residential Building and Land Development & Site Preparation firms bore the brunt of it, suggesting the sectors are more cyclical and perhaps more competitive
- Building Service industries are more resilient to the cycle but perhaps less competitive.

Figure 10 Survival in year 3 from birth at reference year (2002-2009)

% of firms born 3 years earlier



Source: Statistics New Zealand, NZIER

[7] We choose three years to have a relatively long time series as well as looking at the impact of economic cycles. It is possible analyse this at other intervals, but the resulting patterns are similar.

4.2.1. Regional and industry concentrations & pricing

Industry concentration, that is few competing firms, can reflect low competition and thus low incentive to innovate.[8]

We construct market concentration indices based on firm size and employment count data by industry and region to calculate the Herfindahl–Hirschman Index (HHI). The HHI is an index of market concentration, which tends to be higher where there is more market power, or less competition. Because we use a number of simplifying assumptions, the calculations should be seen as indicative.

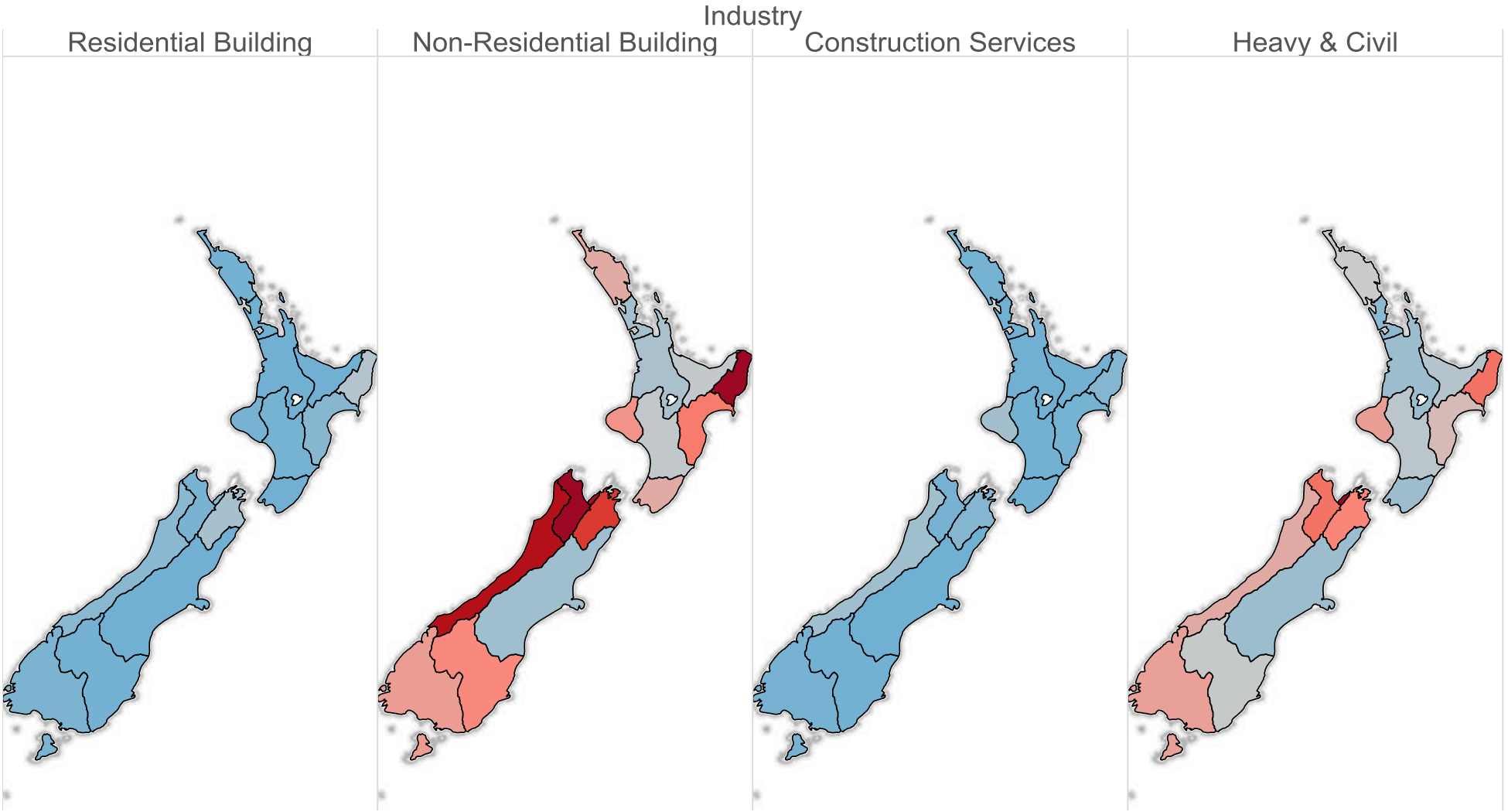
We find that the industry concentration varies by sector and region:

- Residential Building is fragmented and competitive (by this measure) across most regions, with the exception of the two small regions of Gisborne and Marlborough. There is a possibility that surrounding regions (Hawke's Bay for Gisborne and Nelson-Tasman for Marlborough) could provide these services even if they are not physically located in the region.
- Non-residential Building and Civil & Heavy are concentrated in the large metro areas of Auckland, Wellington and Canterbury, as well as Waikato, Manawatu-Wanganui and Bay of Plenty. Presence is small and concentrated in smaller regions.
- Construction Services is a diffuse industry across the country. Detailed breakdown of the sub-sector shows a similar pattern across the country, with high concentration is remote and small regions.

[8] Industry concentration measures are imperfect measures of competition and should be used in conjunction with other data.

Figure 11 Industry concentration by region (2012)

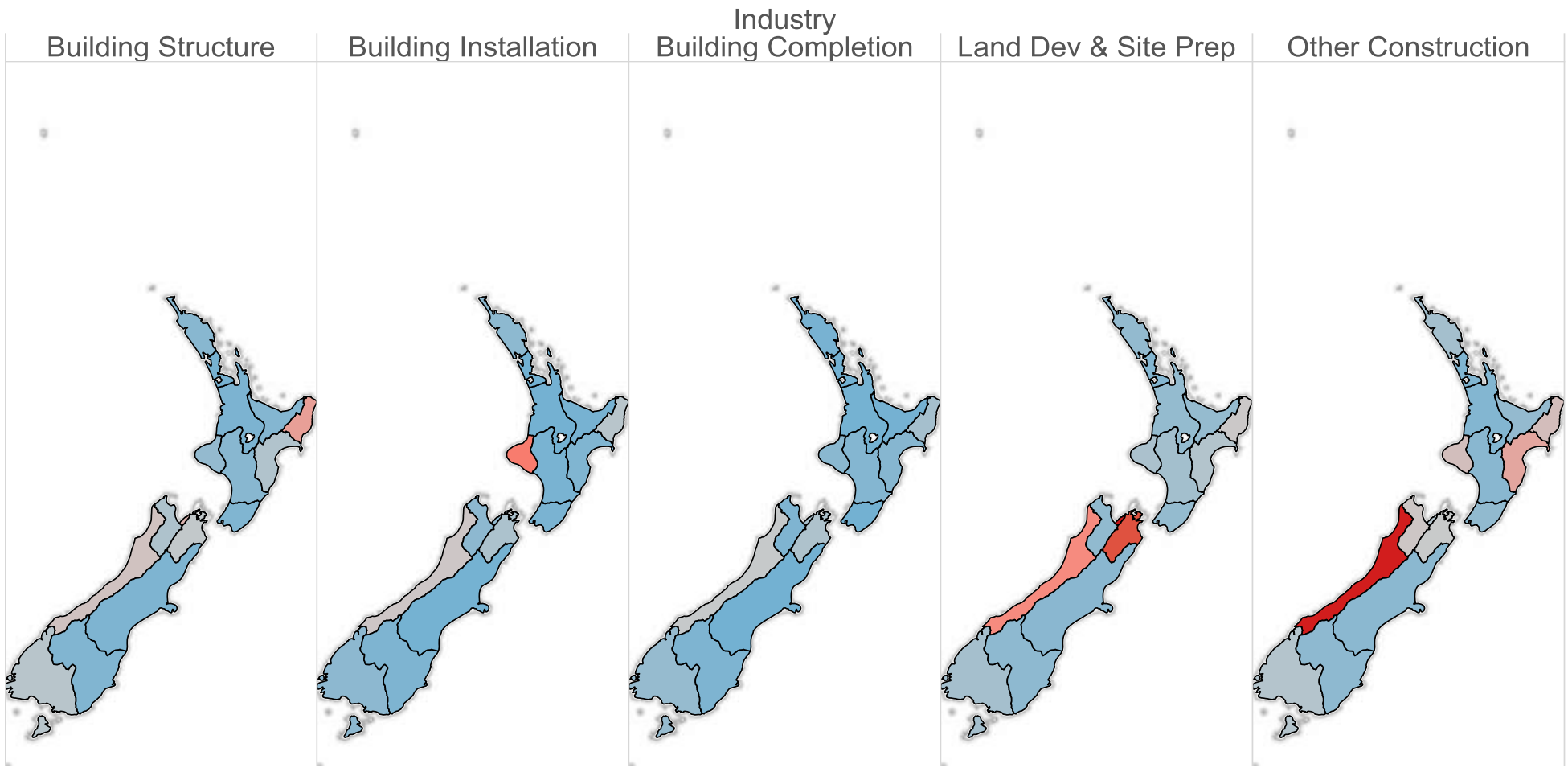
Indicative measure of concentration using HHI (red is high market concentration; blue is low market concentration)



Source: NZIER

Figure 12 Construction services industry concentration by region (2012)

Indicative measure of concentration using HHI (red is high market concentration; blue is low market concentration)



Source: NZIER

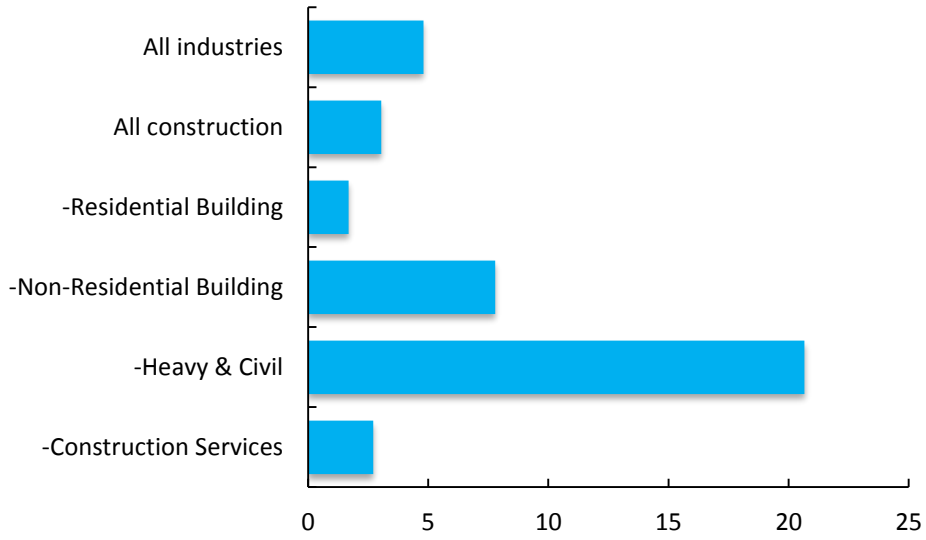
4.3. Scale

Literature suggests firm size can affect productivity through economies of scale; with, for example, larger firms having lower costs of capital and greater ability to manage capital utilisation rates than smaller firms.

Financial analysis earlier in the report shows no clear patterns of productivity differences due to firm size at the total construction sector. However, we do not have detailed firm size data for productivity at the sub-sector level. There are clear differences in firm sizes across the different sub-segments.

Figure 13 Average firm size by subsector (2012)

Number of employees*



Source: Statistics New Zealand, NZIER (*includes estimates for owner-operators, who are counted as an employee for this figure).

4.4. Pricing

Patterns of pricing across regions or internationally can shed some light on 'rent seeking' behaviour. The data collated here is from third party sources. They should be seen as indicative only, as a number of sources of third party data are used.

In the first instance we look at the dispersion of building consent issuance value per square meter across regions by type of building. It is an imperfect measure of construction cost, but a readily available source and we supplement it with other measures.

There does not appear to be a systematic difference in building costs, as measured by building consent value per square metre, across regions. The variations in many non-residential construction sub segments appear to be related to specialised nature of work in some regions, such as mining sector related work in Taranaki.

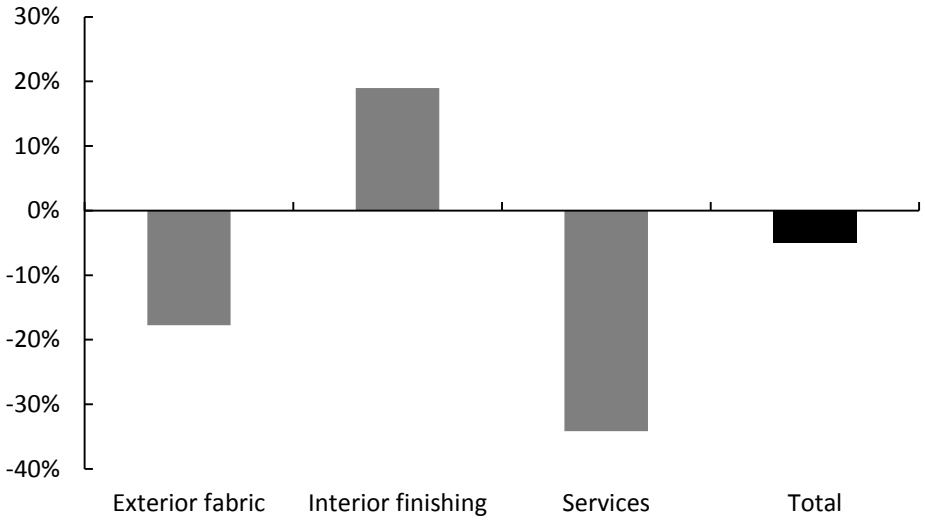
4.4.1. Residential

Comparison of houses across countries is made difficult by different legislative requirements, climate, tastes and preferences. As an indicative measure, we have collated data on a basic home in the Rawlinson's Handbook for Australia (2013) and New Zealand (2012). The key findings are (all refer to OECD PPP exchange rate adjusted comparison):

- On average the cost to build a basic home is slightly cheaper in New Zealand than Australia
- There are divergences in different components of work, with interior finishing (doors, wall finishes, ceiling finishes) more expensive in New Zealand. There may be an element of material price effects embedded in this, which is not in the scope of this piece of work. However, the productivity commission has raised the issue of potentially high plasterboard and paint costs in New Zealand.[9]
- These figures are in contrast to the Productivity Commission's Inquiry into Housing Affordability (page 176), which showed that prices of materials for a new home were 76% higher than Australia. Given the scale of the difference this requires further investigation and there is currently work under way.[10]

Figure 14 Difference in house build cost: NZ vs OZ

% difference, at PPP conversion



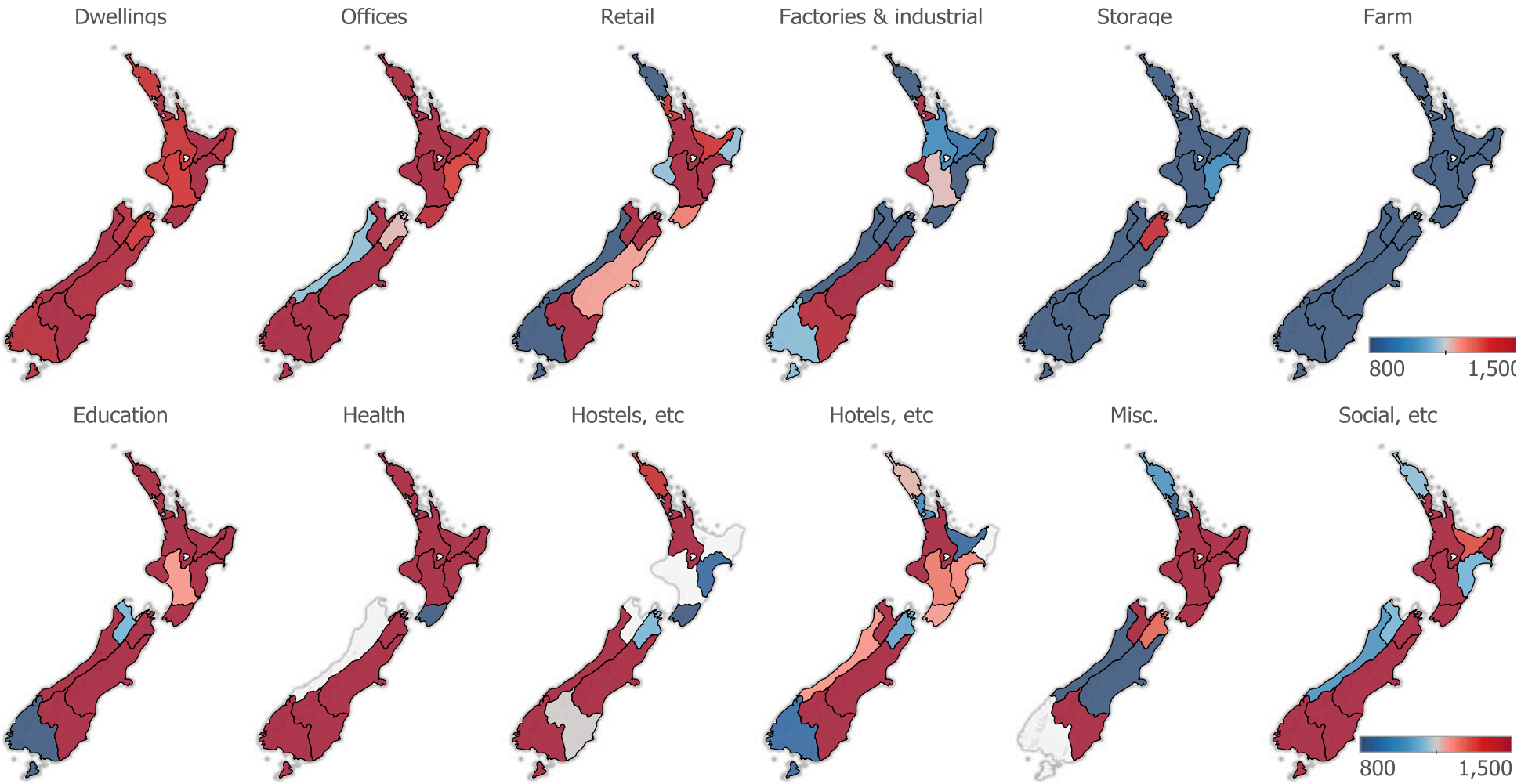
Source: Rawlinson's, NZIER

[9] Additional detailed supply chain analysis is required to establish any rent seeking behaviour. Industry participants have raised issues of vertical integration and rebate regimes (which are a transfer to the service provider at the cost of the consumer) which may reduce competition in the industry.

[10] MBIE (undated document, released in 2013) Residential construction sector market study. Issues Paper.

Figure 15 Indicative buildings costs by type fo building and region (2012)

$ per square metre, as recorded in building consents



Source: Statistics New Zealand, NZIER

Table 10 Model home prices: NZ & Australia

	NZ: House, one storey, Rental or investment type	Australia: Individual house, medium standard framed		Difference in price	
	NZ	In NZ$ @ 0.83	A$	In NZ$ @ 0.83	In A$
Site preparation	$ 16				
Sub structure	$ 134	$ 144	$ 120	-7%	12%
Frame	$ 82	$ -			
Structural walls	$ -	$ -			
Upper floors	$ -	$ -			
Structure	**$ 232**	**$ 144**	**$ 120**	**61%**	**94%**
Roof	$ 133	$ 274	$ 228	-51%	-42%
Exterior walls	$ 178	$ 213	$ 177	-16%	1%
Windows & doors	$ 118	$ 142	$ 118	-16%	1%
Exterior fabric	**$ 429**	**$ 629**	**$ 522**	**-32%**	**-18%**
Stairs	$ -	$ -			
Interior walls, partitions	$ 45	$ 108	$ 90	-59%	-50%
Interior doors	$ 94	$ 65	$ 54	45%	75%
Floor finishes	$ 39	$ 45	$ 37	-12%	6%
Wall finishes	$ 137	$ 59	$ 49	131%	178%
Ceiling finishes	$ 109	$ 86	$ 71	27%	53%
Fittings & fixtures	$ 73	$ 141	$ 117	-48%	-38%
Interior finishing	**$ 497**	**$ 503**	**$ 418**	**-1%**	**19%**
Sanitary plumbing	$ 85	$ 161	$ 133	-47%	-37%
Mechanical services	$ -	$ -			
Fire services	$ -	$ -			
Electrical services	$ 47	$ 77	$ 64	-40%	-27%
Lifts & escalators	$ -	$ -			
Special services	$ -	$ -			
Drainage	$ 34	$ 65	$ 54	-47%	-37%
Services	**$ 166**	**$ 303**	**$ 252**	**-45%**	**-34%**
Exterior works	$ -	$ 14	$ 12	-100%	-100%
Sundries	$ -	$ -			
Exterior works & sundries	**$ -**	**$ 14**	**$ 12**	**-100%**	**-100%**
Preliminaries	$ 53	$ 186	$ 154	-71%	-66%
Margins	$ 41	$ -			
Contingency	$ 21	$ 46	$ 38	-54%	-44%
Prelims, contingencies	**$ 116**	**$ 231**	**$ 192**	**-50%**	**-40%**
Total	**$ 1,440**	**$ 1,825**	**$ 1,515**	**-21%**	**-5%**

Source: Rawlinsons, NZIER

4.4.2. Housing case study

We analysed data supplied on a model home by Stonewood Homes, supplied by Prof. J. Tookey from AUT. This data provides a means of decomposing cost escalation pressures including compliance costs.[11] Using our analysis of the data, we estimate that construction cost inflation for the model home between 2002 and 2011 is explained by (Table 11):

- General inflationary pressures (62% of the increase)
- Specification change (31%)
- Compliance costs (12%)
- Small amount of underlying deflation in the sector (-5%)

Table 11 Estimated drivers of house cost change (2002 to 2011)

Components of price change

2011 vs 2002	$000	% of total
Total	72	100%
General inflation	44	62%
Specification	22	31%
Compliance	9	12%
Sector specific inflation	-3	-5%

Source: Prof J. Tookey supplied data for a model home by Stonewood Homes

4.4.3. Non-residential

We analysed the range of prices for various construction projects compiled by Rider Levett Bucknall. There does not appear to be a systemic bias of higher construction prices in the Non-residential Building sector in New Zealand (Table 12).

[11] The disaggregation of the price increases inevitably requires value judgements. Our assessment of compliance was focussed on additional processes required for OSH and other factors during the course of construction. We judged changes in regulation that changed the quality of the house to be a specification change.

Table 12 Non-residential building construction cost (Jan 2013)

Location/City	Local Currency	Range of cost per m^2 pf gross floor area																			
		Office Building				Retail				Hotels				Car Parking				Industrial		Residential Multi Storey	
		Premium Offices		Grade A		Mall		Strip Shopping		5 Star		3 Star		Multi Storey		Basement		Warehouse			
		Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Adelaide	$AUD	2,500	3,750	2,200	3,100	1,550	2,950	1,300	1,750	3,400	4,300	2,450	3,300	625	1,050	1,100	1,400	600	1,100	2,100	3,400
Auckland	**$NZ**	**2,750**	**3,500**	**2,100**	**3,200**	**1,100**	**1,800**	**1,200**	**1,400**	**3,450**	**3,800**	**2,800**	**3,200**	**550**	**750**	**1,000**	**1,500**	**450**	**700**	**2,100**	**2,900**
Brisbane	$AUD	2,500	3,850	2,000	3,000	2,150	2,950	1,050	1,550	3,200	4,300	2,500	3,600	600	900	1,100	2,000	600	1,000	2,100	3,050
Canberra	$AUD	2,930	3,810	2,380	3,000	1,960	2,780	1,030	1,730	3,610	4,220	2,630	3,670	670	920	890	1,240	620	960	2,430	3,450
Christchurch	**$NZ**	**3,500**	**4,500**	**3,000**	**4,000**	**1,500**	**2,000**			**3,500**	**4,000**	**2,800**	**3,200**	**800**	**1,200**	**1,600**	**2,000**	**700**	**1,000**		
Darwin	$AUD	2,645	3,870	2,160	3,520	1,420	2,255	960	1,815	2,990	4,020	1,785	2,795	540	1,080	695	1,420	675	1,225	1,645	2,750
Melbourne	$AUD	2,980	3,740	2,325	2,880	2,020	2,980	1,060	1,565	3,740	4,245	2,880	3,385	655	1,060	1,110	1,365	555	1,110	2,175	3,490
Perth	$AUD	3,180	4,780	2,605	3,745	2,010	2,885	1,030	1,780	3,730	4,580	2,740	3,785	685	1,125	990	1,455	635	1,030	2,235	3,935
Sydney	$AUD	2,900	4,030	2,200	3,020	1,600	3,280	1,250	1,560	3,700	4,680	2,600	3,170	600	910	900	1,410	600	910	2,150	3,520
Wellington	**$NZ**	**2,800**	**3,200**	**2,200**	**2,500**	**1,300**	**1,800**			**3,400**	**4,100**	**2,200**	**2,600**	**500**	**900**	**1,800**	**2,600**	**900**	**1,400**	**2,500**	**3,200**
% difference Auckland & Wellington average vs Melbourne & Sydney average																					
in NZ$ @0.83		-22 %	-28 %	-21 %	-20 %	-45 %	-52 %	-14 %	-26 %	-24 %	-27 %	-24 %	-27 %	-31 %	-30 %	16 %	23 %	-3 %	-14 %	-12 %	-28 %
in A$		-6 %	-14 %	-5 %	-3 %	-34 %	-42 %	4 %	-10 %	-8 %	-11 %	-9 %	-12 %	-16 %	-16 %	39 %	48 %	17 %	4 %	6 %	-13 %

Source: Rider Levett Bucknall (Jan 2013)

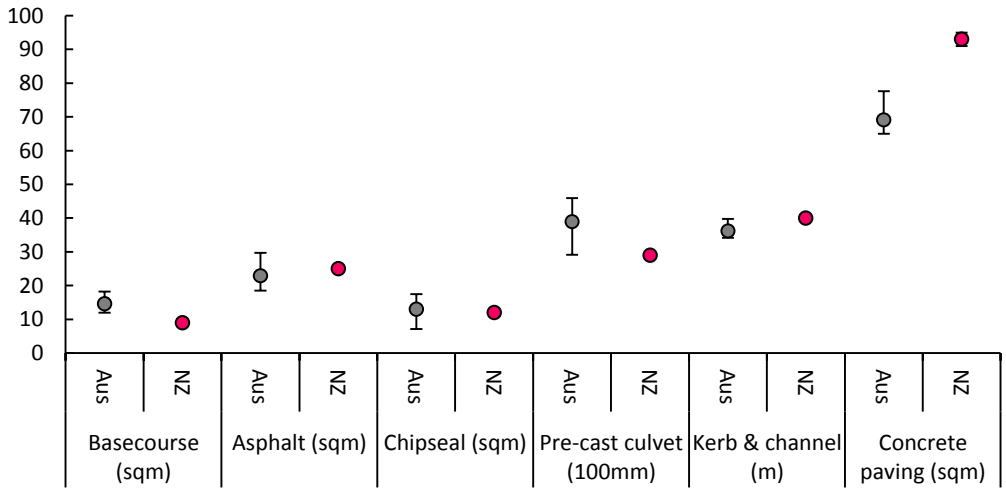
4.4.4. Civil and heavy

The data on quality and composition adjusted Civil & Heavy work is difficult to obtain with accuracy. In the absence of such, we have sourced a number of key commodities used in the industry from various sources (Figure 16):

- New Zealand prices appear to be within the range observed in Australia,
- Concrete prices appear to be high.

Figure 16 In situ material costs in Australia and New Zealand 2012

Cost per unit ($NZ, PPP equivalent)



Source: NZIER, Rawlinsons and OECD.

5. Labour

Much of our evidence points to similar construction costs between New Zealand and Australia. However, average hourly wages are lower in New Zealand. This means New Zealand uses more labour hours for the same work, and that labour productivity is lower than in Australia.

5.1. Skills

Distribution of incomes by qualification in the construction sector (Figure 17 – Figure 21), and compared to the retail and agriculture sectors send two key signals:

- The benefits of industry training clearly lifts incomes
- Construction workers are more likely to earn a higher income than retail or agriculture

Changes to the Licensed Building Practitioners regime means this analysis needs to be kept in the context of changed regulatory settings.

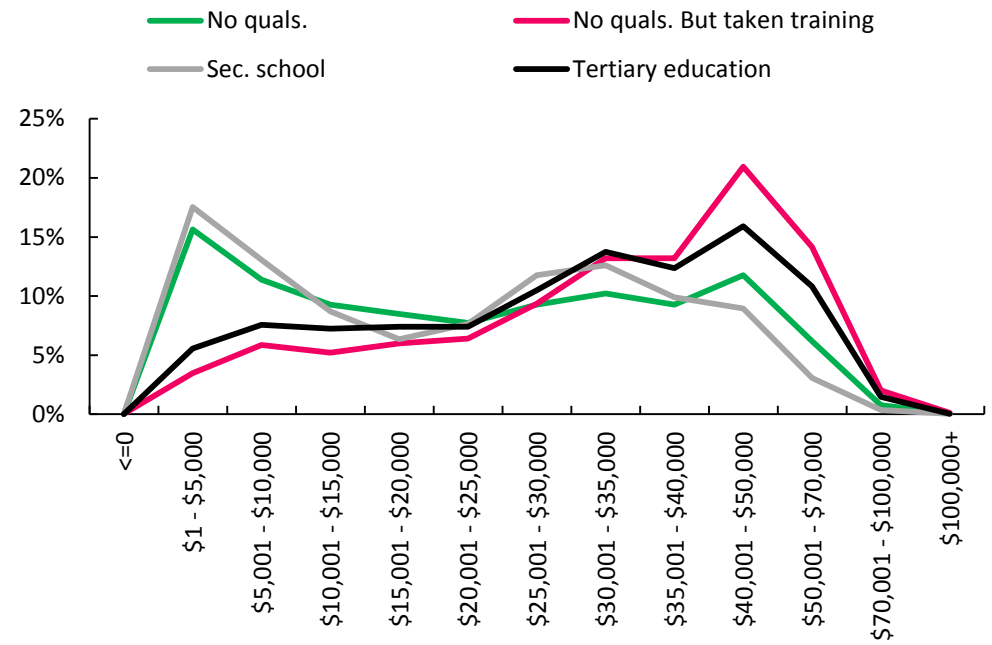
5.2. Labour mobility

Labour mobility is thought to encourage adoption and diffusion of technology. The evidence of labour mobility is mixed:

- Mobility of labour within regions is varied. When compared with wage inflation (Figure 22) it gives us a mixed picture. Most regions experience higher wages alongside rising worker turnover. However, there is a small group of regions where labour turnover is high, but wage inflation is low (eg Auckland, Waikato, Bay of Plenty, Gisborne and Northland). Interpretations may include: wages are kept low by a large and deep pool of the labour market, or there is insufficient demand in the regional economy to sustain higher wage, or there is sufficient inflow of labour from other regions or overseas to keep wages low, or a combination of all of them.
- Inter-regional labour movements between regions show that (Figure 23):
  - Labour mobility is most likely among contiguous regions (eg Auckland, Waikato and Bay of Plenty).
  - Net flows are modestly negative in large metro regions like Auckland and Wellington, but smaller regions tend to be net recipients.

Figure 17 Construction sector wage distribution by qualification (2011)

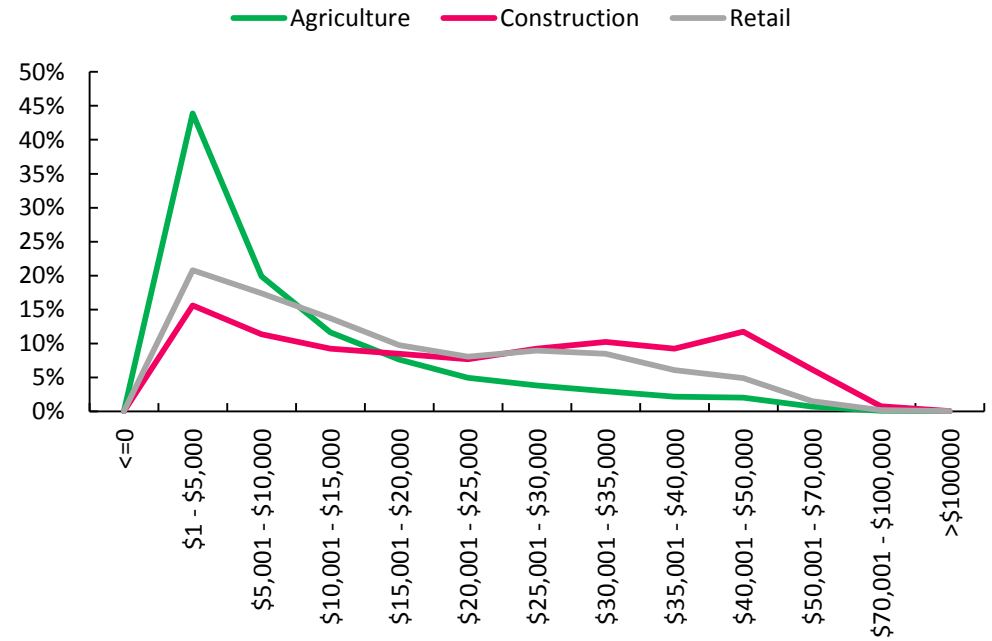
% of employees



Source: Statistics New Zealand

Figure 18 Distribution of annual income: no formal qualiffication (2011)

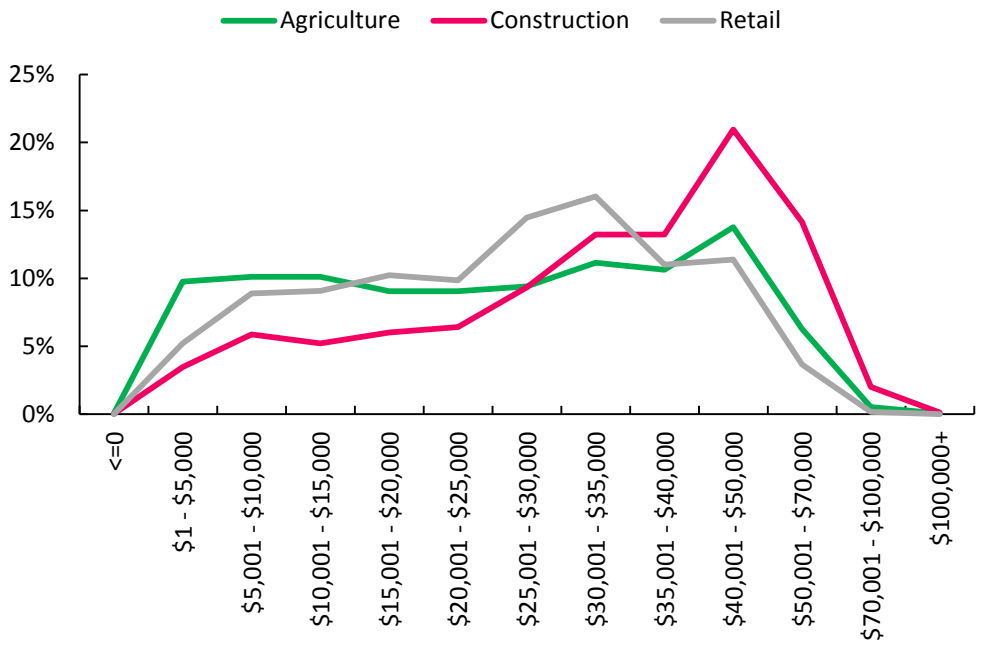
% of employees



Source: Statistics New Zealand, NZIER

Figure 19 Distribution of annual income: no formal qualiffication but has undertaken training (2011)

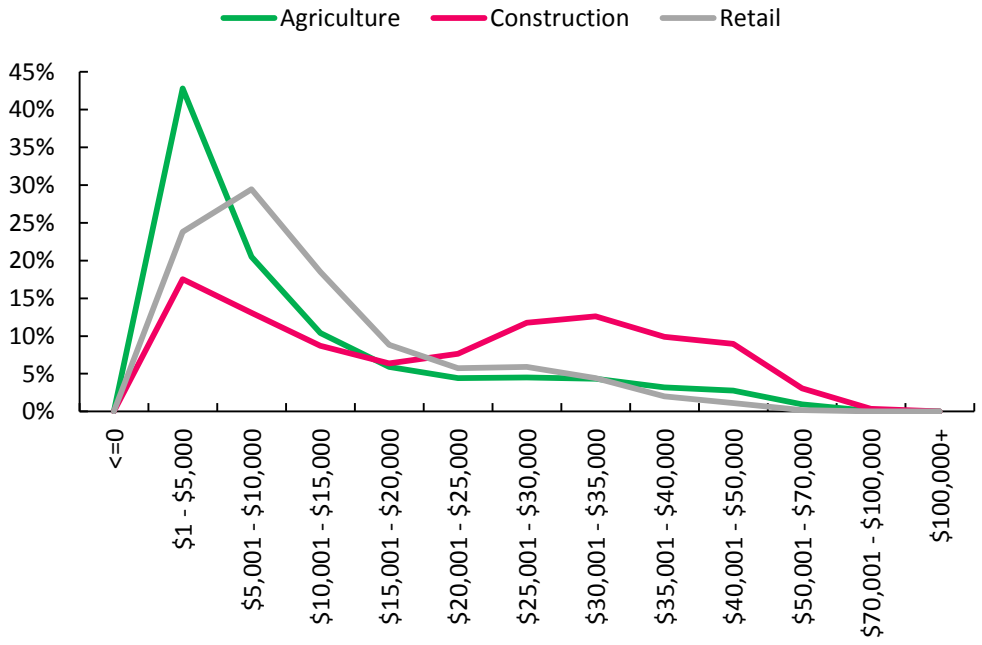
% of employees



Source: Statistics New Zealand, NZIER

Figure 20 Distribution of annual income: secondary school qualiffication (2011)

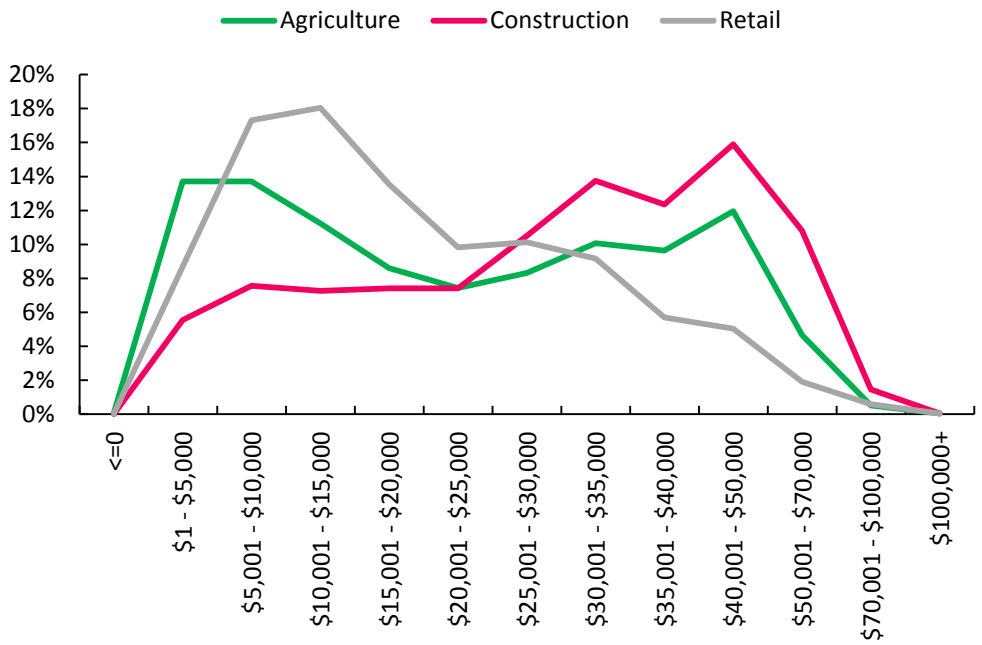
% of employees



Source: Statistics New Zealand, NZIER

Figure 21 Distribution of annual income: tertiary education qualiffication (2011)

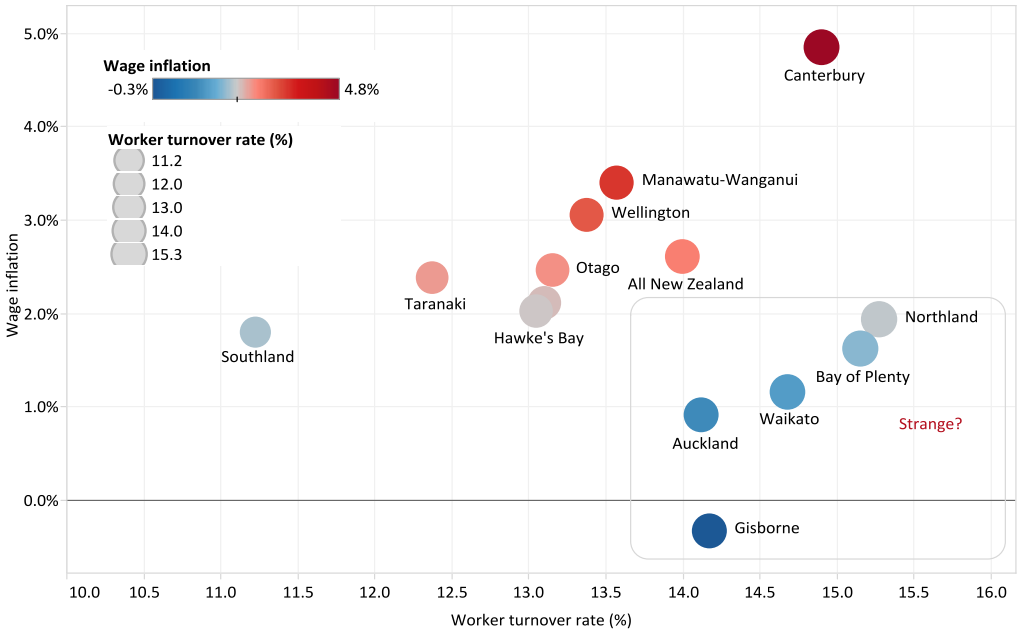
% of employees



Source: Statistics New Zealand, NZIER

Figure 22 Wage inflation and labour turnover by region (2011)

Wage inflation on the vertical scale; worker turnover rate on the horizontal scale



Source: Statistics New Zealand, NZIER

Figure 23 Movement of construction sector employees (2001-2011, March years)

Movement of people between regions with a construction job (% of total movements)

% of all flows		Destination region										
		Auckland	Bay of Plenty	Canterbury	Gisborne/Hawke's Bay	Northland	Otago	Southland	Taranaki/Manawatu-Wanganui	Waikato	Wellington	WC/Nelson/Tasman/Marlborough
Origination region	Auckland		3.3%	2.4%	1.1%	3.2%	1.3%	0.3%	2.3%	7.5%	3.0%	1.1%
	Bay of Plenty	3.0%		0.5%	0.7%	0.2%	0.1%	0.0%	0.8%	3.2%	0.7%	0.2%
	Canterbury	2.0%	0.4%		0.2%	0.1%	2.4%	0.4%	0.5%	0.6%	1.5%	1.9%
	Gisborne/HB	1.2%	0.7%	0.2%		0.0%	0.0%	0.0%	0.8%	0.6%	0.8%	0.0%
	Northland	2.7%	0.2%	0.0%	0.1%		0.0%	0.0%	0.2%	0.6%	0.1%	0.0%
	Otago	1.0%	0.1%	2.2%	0.0%	0.0%		1.3%	0.1%	0.2%	0.3%	0.4%
	Southland	0.3%	0.0%	0.5%	0.0%	0.0%	1.5%		0.0%	0.0%	0.0%	0.1%
	Taranaki/Manawatu-Wanganui	2.1%	0.8%	0.5%	0.8%	0.2%	0.2%	0.0%		1.6%	2.4%	0.4%
	Waikato	7.1%	3.5%	0.5%	0.6%	0.5%	0.3%	0.0%	1.5%		0.8%	0.2%
	Wellington	2.5%	0.8%	1.4%	0.8%	0.2%	0.4%	0.0%	2.8%	0.9%		0.6%
	WC/Nelson/Tansman/Marlbrough	0.7%	0.2%	1.8%	0.0%	0.0%	0.4%	0.0%	0.5%	0.2%	0.5%	
	Inflow per year	1,101	482	489	215	215	325	100	466	749	489	243
	Outflow per year	1,239	458	483	218	191	274	116	442	739	503	211
	Net flow per year	-138	24	5	-3	24	51	-16	25	10	-14	32
	Net flow % of employees	-0.5%	0.4%	0.0%	-0.1%	0.7%	0.8%	-0.7%	0.3%	0.1%	-0.1%	0.7%

Source: Statistics New Zealand, NZIER

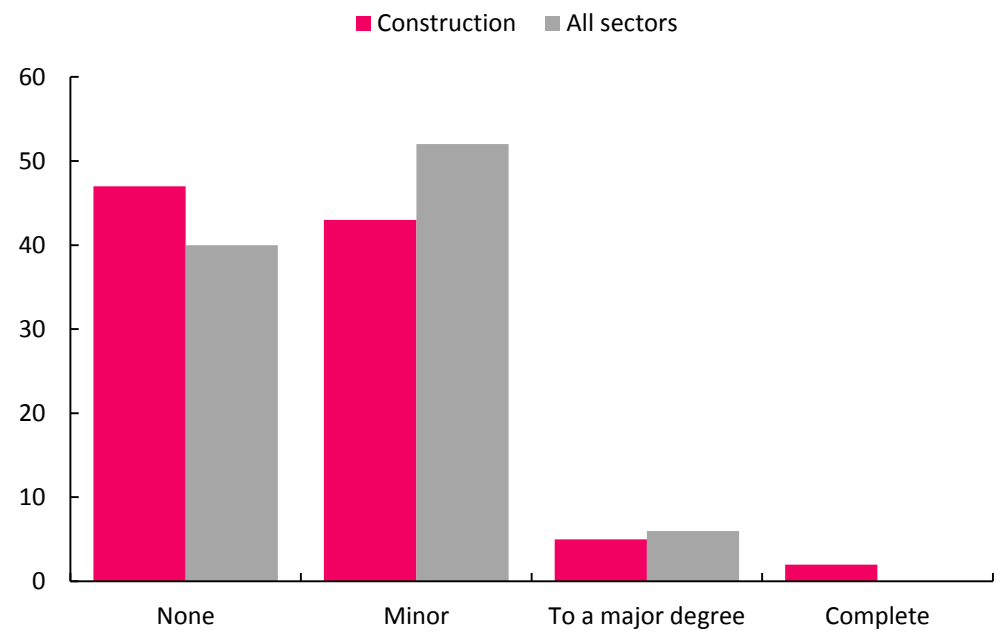
6. Technology

The construction sector is typically slow to adopt technology. Some examples include their attitude to the use of IT systems and adoption of new technologies.

- The construction sector is less likely to implement change in technology (net 3%) compare to the economy as a whole (net 18%).
- In the use of ICT the sector exceeds the national average only for apathy (none of the above).
- Behaviour of respondents to the Business Operations Survey suggests that there is a low level of engagement with innovation and change.

Figure 24 Degree of change in technology (2012)

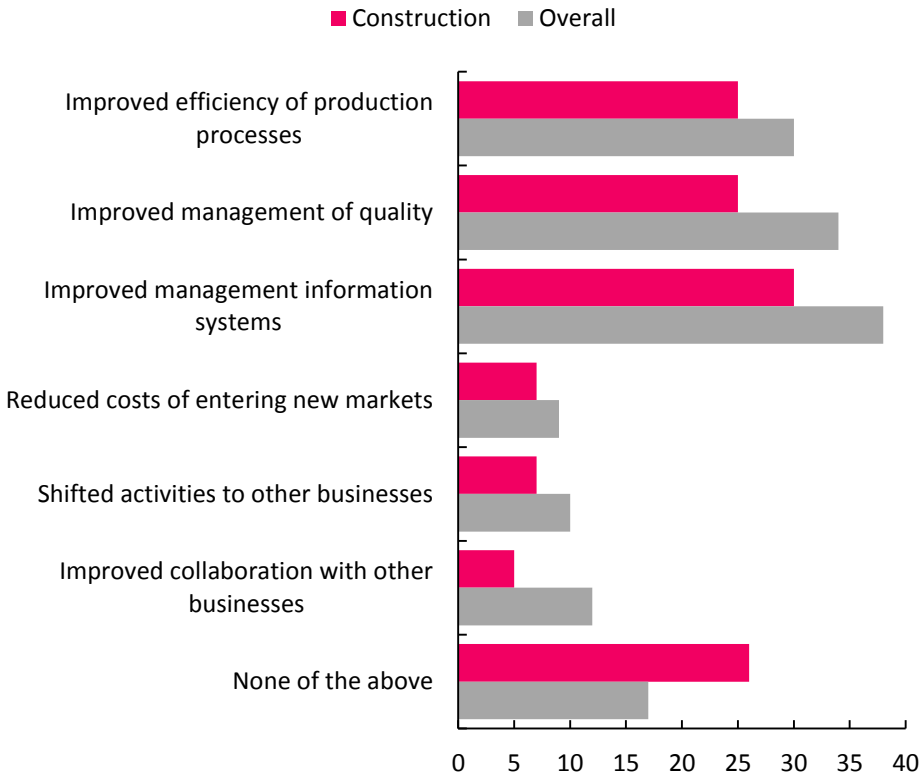
% of firms



Source: Statistics New Zealand

Figure 25 ICT outcome (2012)

% of firms



Source: Statistics New Zealand