Social Policy Evaluation and Research Unit

superu

Quantifying the impact of land use regulation: Evidence from New Zealand

JULY 2017

SENSE PARTNERS

DATA LOGIC ACTION

Our purpose

The purpose of the Social Policy Evaluation and Research Unit (Superu) is to increase the use of evidence by people across the social sector so that they can make better decisions – about funding, policies or services – to improve the lives of New Zealanders and New Zealand's communities, families and whānau.

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Disclaimer

This report has been commissioned through the Ministerial Social Sector Research Fund, which is managed by Superu. The topic has been determined by the Minister of Finance to meet policy concerns that might be addressed by expanding the available evidence. Superu is responsible for ensuring that appropriate research methods were used, including peer review and quality assurance. The Office of the Minister has managed the release of this report, including the preparation of associated communications materials. Once released, all reports commissioned through the Fund are available on the Superu website superu.govt.nz and further information on the report can be provided by Superu.

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Contents

Figures

Tables

Context

The Social Policy Evaluation and Research Unit (Superu) administer a Ministerial Fund for social sector research. Using this fund, in November 2016, Superu contracted Sense Partners to carry out research to quantify the cost of land use regulation in New Zealand by replicating methods in two specific United States studies.

Methods from the first study include comparing estimates of the per square metre price of land value needed to construct a home (what economists call the extensive land value) with the per square metre value homeowners place on having slightly more land, such as a backyard, (the intensive land value) to test for costly land use regulation.[1] We calculate the extensive land value by subtracting construction costs from house prices. Then we estimate the intensive land value using hedonic methods to separate demand for land. We applied this method to Auckland, Christchurch, Hamilton, Palmerston North, Queenstown, Tauranga and Wellington.[2]

The second study attributes large differences in apartment construction costs relative to sale prices to land use regulation. We applied this method to apartments in Auckland, Christchurch, Hamilton, Palmerston North, Queenstown, Tauranga and Wellington.

We often refer to costly land use regulation in the report, not because all land use regulation is costly but as a shorthand for regulation that drives house prices higher than they would otherwise need to be. Changes in house prices are essentially transfers so quantifying the cost of rising house prices requires identifying the winners and losers when house prices rise. But there are also broader costs of house price increases, relating to productivity and labour market mobility, that we do not examine in the paper. Nor do we examine any potential benefits of land use regulation.

We thank Chris Parker, Arthur Grimes, Paul Thorsnes, Jason Timmins, John Wren and participants at a workshop held at Superu for comments that have improved the paper. We also thank Auckland Council for providing unit record house sales data for Auckland.

1 See Glaeser, E.L., & Gyourko, J. (2003). The Impact of Building Restrictions on Housing Affordability. *Economic Policy Review*, 9(2), 21–39.

2 Glaeser, E.L., Gyourko, J., & Saks, R. (2005). Why is Manhattan so expensive? Regulation and the rise in housing prices. *Journal of Law and Economics*, October, 331–369.

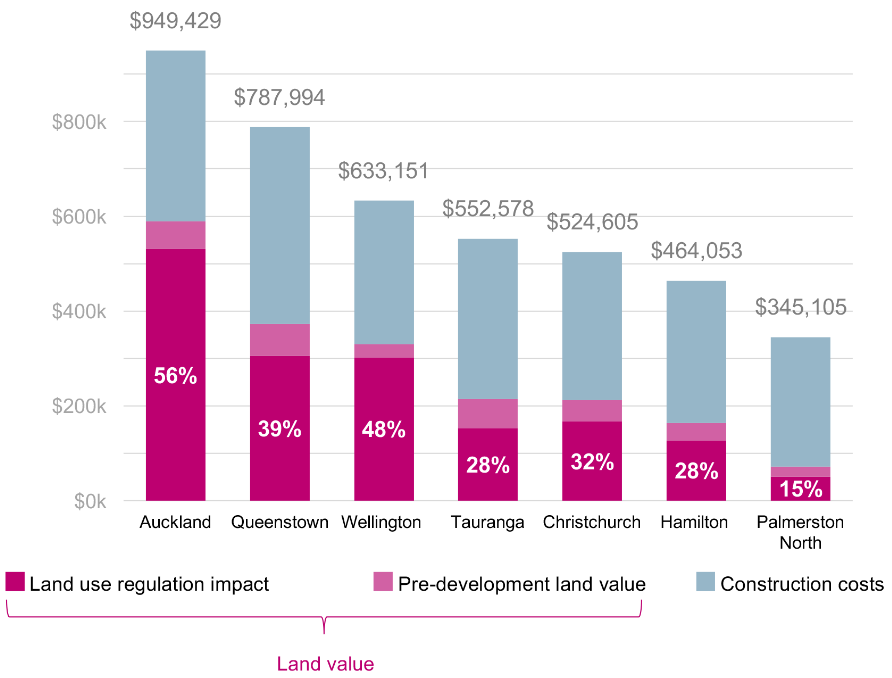
Executive summary

Land use regulation has pushed up property prices across our cities

- Land use regulation – the rules that determine what can be built where – is hampering the flexibility of housing supply to respond to demand pressures from population growth.
- Land use regulations vary in both the intensity of local geographic differences in application and the restrictions that apply, including height restrictions, minimum lot sizes and urban growth boundaries. We use a range of methods to test impacts.
- Cross-city comparisons need to account for terrain and the interaction with demand, but relative to a world with no land use regulation, we find land use regulation could be responsible for 15 to 56 percent of the cost of an average dwelling across a range of New Zealand cities (see figure 1 below and section 3.2 for further discussion). In Auckland, land use regulation could be responsible for up to 56 percent or $530,000 of the cost of an average home.

Figure 1 _ Land use regulation could cost 56 percent of an Auckland home

2015 estimates of the cost of land use regulation



N.B. The estimates above use CoreLogic residential dwellings data (excluding apartments) and closely follow the method in an existing US study by Glaeser and Gyourko (2003). We expect some difference in our house price measure relative to other published measures of house prices.

Source: Sense Partners

It's not construction – costly land use regulation is having an impact

- Often the construction sector is blamed for rising costs. But home prices are outstripping construction costs and rising. This could be a sign that the type of land market which underpins many New Zealand cities is not as effective as it could be in promoting a supply response.
- We also test the market for apartments and find prices are substantially higher than costs and the ratio of prices to costs is increasing over time.

Pre- and post-development land prices show significant restrictions

- When there are few restrictions on what can be built where, a piece of land prior to development should have a price close to the price of the same piece of land after development.
- Based on a method from a US study, we estimate the developed land price is anywhere between four and nine times higher than the price of land prior to development.
- Local geography such as the presence of steep terrain is likely to play a role, but we find a significant premium even in New Zealand cities with plenty of flat land.

Land use regulation is restricting high-demand areas from accommodating many more people

- When land use regulation is sufficiently flexible to accommodate demand, highly sought-after areas accommodate population demand and increase in density. Some demand will be captured by prices.
- But there is no clear relationship between density and house prices – most areas in the cities we study have failed to accommodate more people.

Policymakers concerned with affordability are right to look at regulation

- Our work closely follows existing methods to show land use regulation in some of our major cities is adding to house prices.
- There are many potential welfare costs arising from such high house prices, including labour market distortions, poor resource allocation and low productivity.
- We do not calculate benefits of land use regulation, but these would need to be large and increasing over time to offset potentially large costs associated with land use regulation.
- Monitoring a range of land market indicators over time could help identify where easing land use regulation would substantially reduce house prices.
- In some cases, easing land use regulation is not straightforward and could require change to the urban planning system, including, for example, infrastructure financing.

01

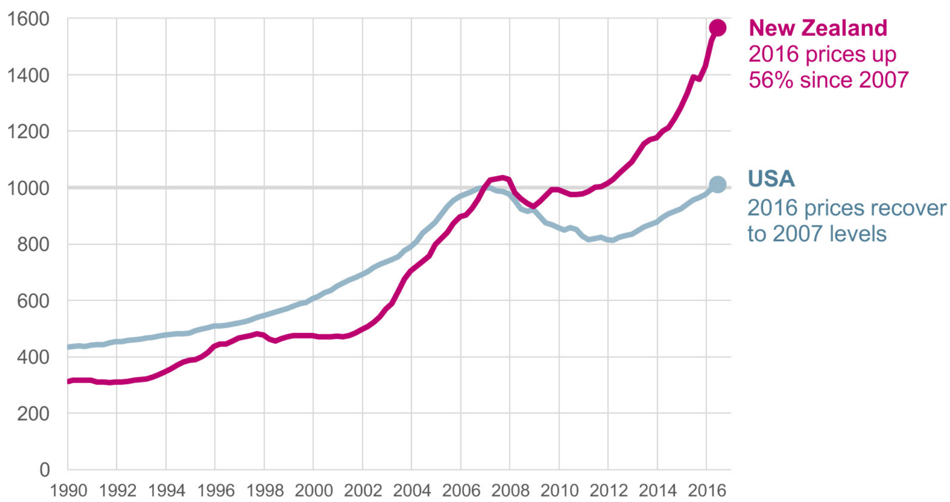
Introduction

1.1_ New Zealand's housing market defies gravity

The price of housing in New Zealand has soared in recent years. Since 2010, relative to income, New Zealand's house prices have increased more than any other OECD country.[3] While the US experience has been a slow grind to recover the pre-GFC price peak, figure 2 shows house prices in New Zealand have risen dramatically over the same period. Since the Productivity Commission's inquiry into housing affordability five years ago, house prices have risen 56 percent.[4]

Figure 2 _ House prices in New Zealand have continued to move higher

US (USFHFA) and NZ house prices indices (CoreLogic) indexed to March 2007 = 1000



Source: CoreLogic, US Federal Housing Finance Agency

Unlike earlier housing booms, marked differences across regions have persisted. Despite region-specific lending restrictions that might be expected to slow growth in house prices, the average Auckland house price is 76 percent higher than in July 2012. Other regions that earlier posted modest growth rates are now catching up.

3 See data.oecd.org/hha/housing.htm
4 See New Zealand Productivity Commission (2012).

1.2 Any policy response needs to address the underlying issue

Both central government and some local government councils have focused on housing affordability as a key issue to improve wellbeing. Knowing what drives house prices should help identify solutions to the problem. That means working out the right guidelines for when house prices are too high.

Glaeser and Gyourko (2003) argue that if existing houses are expensive, one response is to build more houses. But the price of newly built houses can never be lower than the cost of construction, so any gains from new house construction hang critically on the cost of building more houses. If, instead, housing is expensive because income is low, then anti-poverty measures are likely to be sensible policies.

However, we know there are a myriad of land and building regulations that set minimum lot sizes, minimum size standards on bedrooms and verandas, limits on maximum building heights and urban growth boundaries. Developers are also subject to costly delays and uncertainty that Grimes and Mitchell (2015) show to have large impacts on the costs of development. So it is worth testing the extent to which regulations push up house prices.

By international standards (for example, compared to OECD countries), New Zealand's population growth has tended to be high, and this is true of recent years. This brings increased demand for housing, and it is flexibility of housing supply to meet additional demand that determines house prices.

1.3 Extent of land use and building regulation hard to measure but could be costly

Regulations apply differently not just across cities but within cities. That makes measuring the extent of land use regulation difficult. And not only are there a myriad of regulations, but enforcement of rules can also vary across time and space.

Given the difficulty of measuring the incidence and impact of land use regulation, several approaches are taken to making estimates. These include case studies (see Glaeser and Ward 2006 for the case of Boston; Bertaud and Bruckner 2004, who examine Bangalore; and Grimes and Liang 2009 and Lees 2015a on Auckland), multi-city analysis (see chapter 9 of Angel 2012), building structural models (see Kulish et al. 2012, Desmet and Rossi-Hansberg 2013 and Lees 2014) and using data reduction techniques to develop measures of land use regulation intensity for use in regression analysis that tests for impacts (see Gyourko et al. 2008).[5,6]

Many of these studies and others in the literature suggest the high costs of land use regulation matter for not just GDP growth (see Hsieh and Moretti 2015) but also welfare (see, for example, Turner et al. 2014).

1.4_ We use different methods to triangulate on the costs of land regulation

Rather than rely on any single approach, this report uses four different methods or lenses to examine the impact of land use regulation. We adopt the frameworks in two empirical papers applied to US data. The first paper, Glaeser and Gyourko (2003), contains the first three methods, while the second paper, Glaeser et al. (2004), contains the fourth – showing how apartments can reveal the impact of land use regulation. Glaeser et al. (2004) use differences between construction costs and prices to test for the presence of land use regulation in Manhattan.

Glaeser and Gyourko (2003) note there are essentially two competing hypotheses to describe house prices that make for different policy conclusions. They go on to show how differences in what each hypothesis suggests for land prices, construction costs and density can be used to distinguish the most likely hypothesis.

They describe the first hypothesis as a classic approach that argues that house prices are expensive because there is demand for land in certain areas and the supply of well-located land is limited, so house prices must rise. This is the approach in the Alonso-Muth-Mills framework, which suggests demand for land and density is highest in the city centre with short commutes to where most of the jobs are located,[7] so prices are higher close to the city centre.

5 Gyourko et al. (2008) undertake a comprehensive study for the US to build an index of regulation over time from detailed survey information from 2,000 local authorities. But without recourse to such an index that provides time series information, researchers have little information that might be used to understand the impact of land use regulation over time.

6 Here we are not particularly interested in the political economy of how land use regulation which impacts on prices might develop. Fischel (2015) provides useful context on this issue.

7 See Alonso (1964), Mills (1967) and Muth (1969).

The second hypothesis argues that housing is expensive in high-cost areas because of regulation. Regulation includes, for example, restrictions on building and zoning. This hypothesis assumes there is enough land in high-cost areas that if new construction were permitted, the price of housing would fall. Crucially, the hypothesis says that barriers to constructing new homes drive a wedge between the price of a home and the cost of constructing a new home.[8]

1.5_ Our four methods

Before carrying out more specific tests, Glaeser and Gyourko (2003) ask whether house prices are close to construction costs. If there are only small differences, this suggests a limited impact of land use regulation on house prices. Comparing construction costs to house prices constitutes our first method.

Our second method to test for costly land use regulation exploits the idea that under a traditional view of development with well-functioning land markets, there should be no difference between the intensive value of land – that is, the value of additional land, such as a new backyard, to existing home owners – and the extensive value of land – that is, the value of land with a house on it. A large wedge between the intensive and extensive value suggests land use regulation may be playing a role in increasing house prices.

If land use regulation is flexible enough to accommodate additional demand, then demand for specific locations should be reflected in both prices and density as more people move to these high-demand locations. Our third method exploits this relationship to test for the impacts of land use regulation on house prices.

Our final method comes from Glaeser et al. (2004), who show how the cost structure of building apartments in Manhattan can be compared to prices to test for the impacts of land use regulation on prices. We also look at apartments as a complement to the results for houses that we construct for our first method.

Of course, the New Zealand apartment and housing market is different from Manhattan in particular and US housing markets more broadly. So we spend some time discussing the assumptions that underpin our methods, the unit record data we use as the basis for our empirical work and how our results should be reasonably interpreted.

Section 2 steps through each of our methods in detail, including how we apply the methods to New Zealand data concepts. We present our results in section 3 and discuss how they might be interpreted before making some brief concluding comments in section 4.

8 Grimes and Aitken (2010) show how the flexibility of housing supply helps drive housing market dynamics in New Zealand's regions.

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02

Methodology

2.1_ Method 1: Do prices reflect construction costs?

2.1.1 _ What do researchers find for the United States?

Glaeser and Gyourko (2003) describe three empirical tests to distinguish between the traditional hypothesis – that high house prices reflect demand for limited supply of well-located land – and the hypothesis that land use regulation drives up house prices.

Before carrying out more specific tests, they ask whether house prices are close to construction costs. If there are only small differences, this suggests a limited role for costly land use regulation.

Glaeser and Gyourko (2003) obtain measures of construction costs for different-quality homes across a range of metropolitan areas from a US construction pricing company, RS Means. They use estimates from the American Housing Survey on the median size of detached dwellings to obtain an average cost to build of $102,000 for a lower-quality economy home, with higher-quality builds a little higher. Self-reported house prices obtained from the 2000 United States census show the self-reported median home is valued at $120,000. Self-reported house prices tend to be a little higher than market prices, so house prices are, on average, a little less than 20 percent higher than construction costs for the United States.[9]

But Glaeser and Gyourko (2003) dig a little deeper. They show that the United States can be divided into three areas: (i) areas where housing is priced far below the cost of new construction (Detroit and Philadelphia, for example); (ii) areas where housing costs are quite close to construction costs; and (iii) areas where house prices run much higher than construction costs (San Francisco, for example), where land use regulation may play a role.

2.1.2 _ Applying the theory to New Zealand

To apply this method to New Zealand, we obtained two unit-record databases with detailed house sales information for 2012–2016.

The first database was supplied to Superu by Auckland Council and contains sales prices, the address of the property and many characteristics of the property that are useful for mass valuation purposes (for example, the condition of the house, whether the house has a view and if the property has a garage or off-street parking).

9 Glaeser and Gyourko (2017) argue that from an economic perspective, rather than comparing prices to income, comparing prices to these costs is the right gauge of whether house prices are too expensive – for all residents, not just families on low incomes.

Crucially, the size of each dwelling in square metres is given. That provides for a more accurate assessment of the construction cost of a dwelling than that made in the Glaeser and Gyourko (2003) study, which works with an average dwelling size.

The second database was purchased from CoreLogic and contains the size and many other characteristics of the dwelling, which we use to help determine construction costs.

Since construction costs can vary by region – because of local labour markets, for example – to estimate regional construction costs (across each city), we follow *The New Zealand Building Economist*, which uses Cuesko to provide estimates across four types of house: (i) a basic house; (ii) a medium-quality one-storey house; (iii) a medium-quality two-storey house; and (iv) an executive two-storey house. Descriptions of the four types of house are provided in Table 1.

We categorise each of the observations in our unit record data into the matrix of costs types by type and region. We use the characteristics of each house from our unit record data (including size, number of bathrooms and number of garages) to classify house type. We have no estimates of construction costs for Queenstown and choose to use Christchurch construction costs, rather than Dunedin construction costs, as the most appropriate proxy, based on anecdotal evidence that suggests costs of construction in Queenstown have outstripped the modest pace of growth in Dunedin.

We have regional construction costs for November 2015, but our dataset covers the most recent period to 2012. There is limited annual information from *The New Zealand Building Economist* on regional construction costs for earlier years (November 2011, November 2012, November 2013 and November 2014). However, these earlier years use a slightly different typology of building type (standard house, executive house and individually architect-designed house) with little indication to the characteristics of each house.[10]

Rather than use this information directly, we use Statistics New Zealand's Price Index of Capital Goods (Residential) to adjust regional construction costs for earlier years. This approach will miss any regional variation but has the advantage of retaining the more detailed building type typology in table 1, which, at least in principle, allows for a better estimate of construction costs at the unit record level. Box A on page 17 provides a worked example of our method. Figure 3 shows that building costs increased by 4 percent on average each year between 2012 and 2016.[11]

10 We take the same approach as Glaeser and Gyourko (2003) and make no adjustment to costs to capture developer profits.
11 As an alternative, we also examined the value of consents per square metre. That series is on average about 2 percent higher than the residential capital goods index and grew over 7 percent in 2016.

TABLE 01

Our construction costs estimates vary over four house types

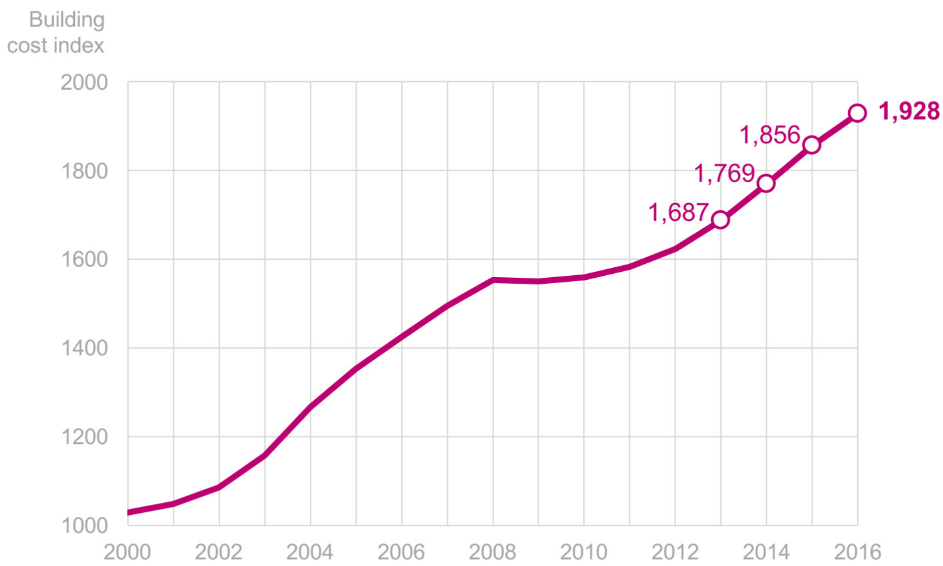
House type	Description
Basic house 90–130m^2	Concrete slab or particle board floor, kitchen, bathroom, WC, fibre-cement weather boards, galvanised steel roof, standard-quality fittings
Med-quality house One storey 100–250m^2	Concrete slab or particle board floor, kitchen, bathroom, WC, linea/cedar/pine weatherboards or painted fibre-cement cladding, Colorsteel® roof, standard-quality fittings
Med-quality house Two storey 150–300m^2	Concrete floor slab, concrete tile roof, kitchen, bathroom, en suite, double garage, medium-standard fittings, brick veneer to ground floor with cedar or pine weatherboards to upper storey
Executive house Two storey 200–600m^2	Executive quality, insulated concrete floor slab, standing seam roof, designer kitchen and bathroom, two en suites, security, TV, fire protection, underfloor heating, gas fire, multiple garages with concrete floor, expensive fittings

Source: *The New Zealand Building Economist*

Figure 3 shows that building costs increased by 4 percent on average each year between 2012 and 2016.

Figure 3 _ Residential construction costs have increased recently

Price index of residential capital goods



Source: Statistics New Zealand

We calculate the ratio of house sales to construction costs for every unit record. Then we produce a heat map at the area unit level that shows where house prices are outstripping construction costs – first pass evidence of a need to dig deeper.

Box A _ A worked example of calculating construction costs

As an example, we selected a property in the Auckland region that sold for \$689,000 in 2014. The property is 230m^2 with a freestanding, rather than internal, two-car garage. We classify that property as a medium-quality one-storey house with construction costs of \$1,888 per square metre for the Auckland region.

First, we adjust from 2016 to 2014 construction costs based on the Statistics New Zealand residential building cost index. That makes our 2014 construction costs (for a medium-quality one-storey house in the Auckland region) \$1,732.9 = \$1,888/(1927.7/1769.3).

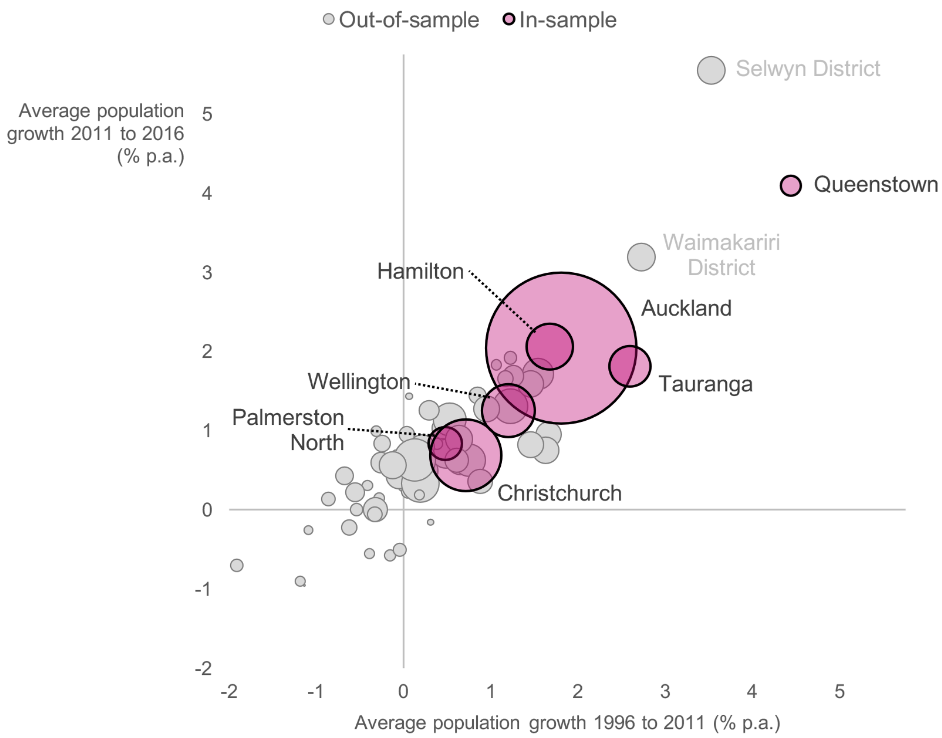
We estimate total construction costs in 2014 as \$398,567 = \$1,732.9*230m^2. For this property, the house price is 73 percent higher than construction costs. This property would fit squarely within Glaeser and Gyourko's (2003) third category – properties where house prices are much higher than construction costs.

As a cross-check, we can use the improvement value estimates provided in both our datasets. For this example, the improvement value estimate sits at \$420,000. Our construction costs estimates are also close to the \$2,000 per square metre some insurance companies would recommend as a starting point for home insurance.

When interpreting our results, it is important to understand the population growth in the cities we consider, since it is inflexibility of supply to respond to additional demand that we are concerned with. Figure 4 and table 2 show the cities we study are growing relatively quickly.

Figure 4 _ The cities we look at have experienced rapid population growth

Average population growth per annum '96 to '11 vs average population growth per annum '11 to '16, June year



N.B. Bubble area indicates relative population size at June 2016.

Source: Statistics New Zealand

TABLE 02

Our cities contain some rapidly growing areas

City	Ave. growth '96–'11	Ave. growth '11–'16	Order	Population
Queenstown	4.44	4.09	2ND	34,700
Hamilton	1.67	2.06	4TH	161,200
Auckland	1.81	2.04	5TH	1,614,400
Tauranga	2.60	1.81	8TH	128,200
Wellington	1.20	1.25	18TH	207,900
Palmerston North	0.48	0.83	29TH	86,300
Christchurch	0.71	0.69	35TH	374,900
TA average	0.47	0.82		70,042

Source: Statistics New Zealand

2.2_ Method 2: Does regulation drive land prices higher?

2.2.1 _ A little bit of theory

Glaeser and Gyourko (2003) distinguish a traditional view – where land prices reflect demand and supply – from an alternative view, where land prices are high because of land use regulation that constrains the supply response.

To test for the presence of costly land use regulation, we exploit a little bit of theory. Glaeser and Gyourko (2003) note that if costly land use regulation is not present, then there should be no difference between the intensive value of land – that is, the value of additional land, such as a backyard, to existing home owners – and the extensive value of land – that is, the value of land with a house on it. The key point of this is the value of land should not be distorted by its ability to be used for housing or for its next best alternative, such as a garden.

To test whether there is a difference between intensive and extensive land values, Glaeser and Gyourko (2003) use a hedonic model to estimate the intensive value of land and compare it to an estimate of the extrinsic value of land constructed by subtracting an estimate of the capital value of the property from the sale price. A little more technically, Glaeser and Gyourko (2003) formulate house prices as:

$$P(L) = T + K + pL \qquad (1)$$

where *P(L)* is the price of the house as a function of the number of land units *L* and is equal to the capital value of the house *K*, the land value of the property *pL* and any land use regulation costs *T*.[12] Glaeser and Gyourko (2003) observe equation (1) implies:

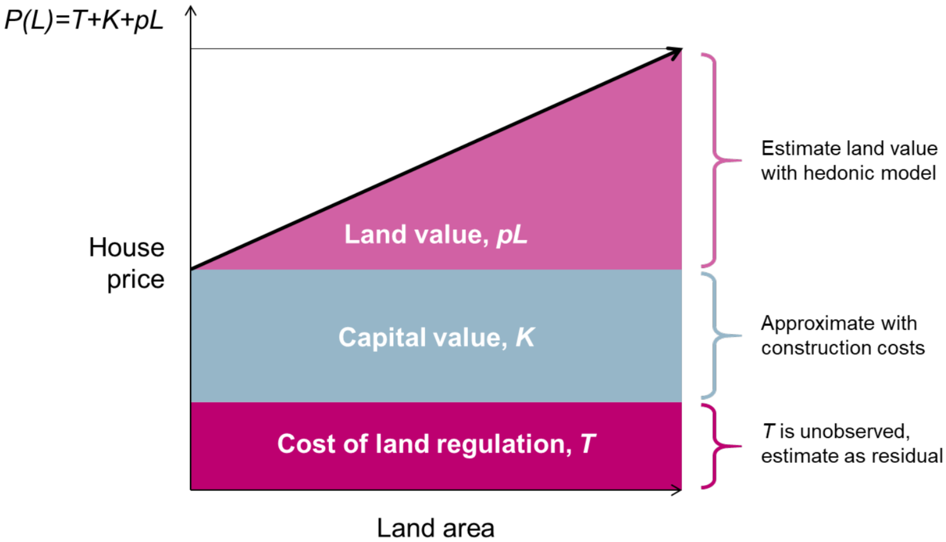
$$P(L) - K = T + pL \qquad (2)$$

Glaeser and Gyourko (2003) then work at a city level and note they can subtract the construction cost of an average dwelling *(K)* from the observed median house price *P(L)*. That equals $T + pL$, so any indirect estimate of the contribution of the intrinsic value of land towards the aggregate value of the house-land package leaves an estimate of the cost of land use regulation *T*. Figure 5 illustrates this.

12 Economists have a long history of thinking about the rate of taxation of activities with negative externalities that returns the best outcome for social welfare. In this context, Glaeser and Gyourko (2003) note that they choose to represent zoning and other restrictions with a tax on new construction but could equally assume the suite of regressions work by constraining the number of residents in a certain area.

Figure 5 _ Glaeser and Gyourko (2003) formulation of house prices

Stylised representation



Source: Sense Partners

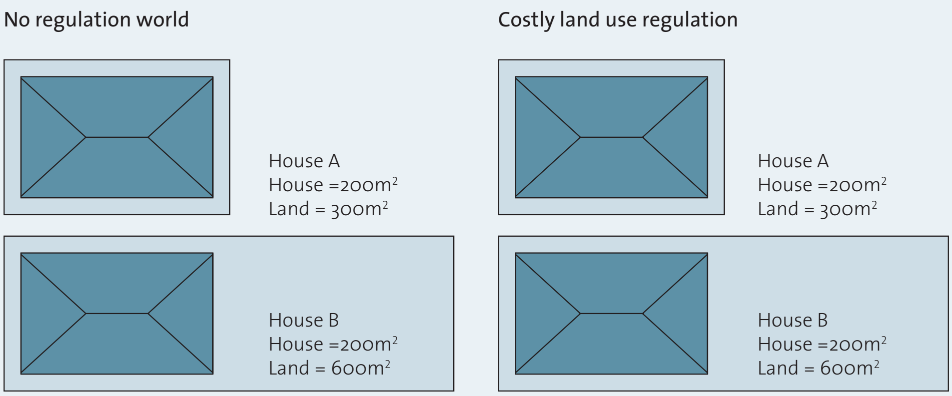
Following Glaeser and Gyourko (2003), we use a hedonic pricing model to estimate $p(L)$, that is, the extent to which house prices increase as the land plot within our unit record data increases. That provides an estimate of the price of land (independent of T). We use our estimate from the hedonic pricing model to test whether the intrinsic value of land is different from the extrinsic value, indicating costly land use regulation. Glaeser and Gyourko (2003) then compare p with $(P(L) - K)/L$, or equivalently $p + T/L$, to obtain the extent to which land use and building restrictions can drive house prices.

Box B _ A worked example of land valuation methodologies

Figure 6 below shows worked examples for houses A and B in a stylised world with no land use regulation and a world with costly land use regulation. House A is 200m² on a 300m² section, while house B is 200m² on a 600m² section. We assume construction costs are $2,000 per square metre, so each house costs $400,000 to build. We assume that the value of land to the householder is $200 per square metre.

In the absence of costly land use taxation, house A costs $460,000 while house B costs $520,000. When we introduce costly land use regulation of $150,000 per house, three things happen: (i) house prices increase; (ii) construction costs' share of the house prices falls; and (iii) in percentage terms, houses with backyards are only slightly more expensive than houses with no backyard. Glaeser and Gyourko (2003) exploit these features to estimate *T*, the cost of land use regulation. We calculate *T* in the context of our worked example below.

Figure 6 _ Stylised representation of the impact of land use regulation



No regulation world

House A = 0 + $400,000 + $60,000 = $460,000
House B = 0 + $400,000 + $120,000 = $520,000

Costly land use regulation world

House A = $150,000 + $400,000 + $60,000 = $610,000
House B = $150,000 + $400,000 + $120,000 = $670,000

The calculations show that our two land valuation methods – calculating the intensive value of land using hedonic methods and calculating the extrinsic value of land by subtracting construction costs from house prices – yield an identical result in the no regulation world: $200 per square metre.

When land use regulation is costly, the two land valuation methods differ. The extensive method still returns a value of $700 per square metre for house A and $450 per square metre for house B. That gives a value of *T/L* of $500 per square metre for house A and $250 per square metre for house B.

Source: Sense Partners

2.2.2 _ Taking the methodology to New Zealand

Like Glaeser and Gyourko (2003), we seek to identify the relative impact of land use and building regulation in equation (1). But unlike Glaeser and Gyourko (2003), we work with unit records throughout our analysis and then aggregate to cities or area units.

We use detailed unit record datasets on selected New Zealand cities (from CoreLogic) and Auckland apartments (from Auckland Council) that report the house and apartment sales $P(L)$. We first filter out outlier observations that are misrepresentative by removing:

- any house sales that are not residential dwellings (using the LINZ 'RD' identifier)
- any house sales with zero land area
- any house sales with a price less than $50,000
- any house sales with a price greater than $10m
- any house sales with a total floor area less than 40m^2
- any house sales with a total floor area greater than 2,000m^2.[13]

We then use our *New Zealand Building Economist* data on the cost of construction (see section 2.1.2) to obtain K for every house sale, and then we can compute $P(L) - K$, which provides an estimate of $T + pL$.

To estimate T, we then use a similar hedonic pricing model to Glaeser and Gyourko (2003). However, we use a term that captures local spatial variation in house prices, that is:

$$\log(\textit{home price}) = p'\log(\textit{land area}) + \textit{other controls} \qquad (3)$$

Note that p' is the price elasticity that needs to be first transformed into a price. We also allow for spatial correlation, and equation (3) produces an error term that measures the extent to which our model explains house prices based on the controls we include in our model. We allow for quarterly fixed effects. These other controls span a range of indicators likely to be important, which we list in table 3.

13 We also experimented with a more restrictive control on houses of leaving out observations with a total floor area of more than 600m^2. For Auckland, less than 0.07 percent of the observations lie within this range, and in practice we find very similar results.

Proposed controls within our CoreLogic unit record data

TABLE 03

Our hedonic price model includes several quality controls

	Field	Description
1	Units of use	This field gives the number of physical components within a rating unit. Each unit capable of separate use constitutes a single unit of use.
2	Off-street parking	Records the total number of formed car parks on a rating unit, including uncovered car parks.
3	Building age indicator	We take the three-character code that must be used to record the decade within which the principal building was built and create a dummy for each decade.
4	Build condition indicator	We average the building condition indicator for walls and the roof across a four-point characterisation where 4 = good, 3 = average, 2 = fair and 1 = poor. We remove the less than 1 percent of entries with no or a mixed assessment.
5	Build construction indicator, walls	We construct dummy variables for wood, brick, fibrous cement, concrete, roughcast construction and mixed construction, which form 97.4 percent of construction. We aggregate all other construction types into an 'Other' dummy.
6	Build construction indicator, roof	We construct separate dummy variables for iron and tile roofs that account for 84% of roof types. We aggregate all other construction types into an 'Other' dummy.
7	Building site coverage	This figure records the area of the site over which any floor or floors of the principal buildings extend to the nearest square metre.
8	Total floor area of building	This figure records the total floor area of the principal buildings, including connected, enclosed areas but excluding any areas covered by structures such as eaves, open porticos and open verandas.
9	Contour of property	We translate the two-character code to a 1–3 scale where 1 = level, 2 = easy to moderate rise/fall and 3 = steep rise/fall.
10	View from living area	We translate the view code to a 0–2 scale where 0 = no appreciable view, 1 = view other than water, such as city, suburban or landscape view, and 2 = view where the focal point is water.
11	Scope of view from living area	We translate the scope of view code to a 0–3 scale where 0 = no view, 1 = slight view of up to 45°, 2 = moderate view of up to 145° and 3 = wide view of over 145°.
12	Total living area	Total living area is the sum of all living spaces, recorded to the nearest square metre. Examples of living spaces include living rooms, kitchens, bedrooms and bathrooms.
13	Addition of deck	Takes a value of 1 if there is a deck that includes reasonably substantial open verandas, terraces and outdoor living areas attached to the principal building, made of any material; 0 otherwise.
14	Separate workshop or laundry	Takes a value of 1 if there is a separate workshop or laundry, including an unlined basement, a detached workshop or laundry, and any storage or workshop space in a basement garage excess to parking requirements; 0 otherwise.
15	Other improvements	Takes a value of 1 if there are other substantial improvements not already accounted for in another field, such as a swimming pool or tennis court.
16	Garage under main roof	The number of covered car spaces under the main roof.
17	Freestanding garage	The number of covered car spaces under a freestanding garage.

Source: Land Information New Zealand, CoreLogic, Sense Partners

In addition to splitting our unit record dataset by units of use, we test for complementarities across the factors that drive housing amenity. For example, large houses may complement large backyards, while smaller houses are less likely to contain families, so relatively small backyards might not lower the house price much.

Finally, we compare the land prices on the extensive and intensive margins and recreate table 4 on pages 29–30 of Glaeser and Gyourko (2003) at a city level (based on Statistics New Zealand's definitions of the relevant Territory Authorities). Note that we need to transform our estimate of the land elasticity *p'* into a price of land using the ratio of the mean home price to mean land area – the method in Glaeser and Gyourko (2003).[14]

2.3_ Method 3: Can density help identify costly land use regulation?

2.3.1 _ Density can also help show if land use regulation is holding back supply

Our third test for the presence of costly land use regulation is based on density. Glaeser and Gyourko (2003) argue that under the traditional view, if there are areas with a high cost of land, then people will consume less land and density will be higher in these locations. The alternative view suggests that highly regulated areas come with restrictions that prevent density.

Glaeser and Gyourko (2003) take a regression-based approach. They choose to work with a measure of density that is the log of the land area in a city per household, rather than per capita, but note a per capita measure yields similar results.[15] They then regress the fraction of units in each city value at 140 percent of construction costs. That provides a measure of areas where house prices are high. If the traditional view holds, then high prices reflect demand for scarce, well-located land, and density should be associated with high-price locations. We work with the 140 ratio but check our results for robustness by also conducting regressions at a price/marginal cost ratio of 115 and 170, approximately 20 percent lower and 20 percent higher than the 140 ratio respectively.

14 One other method that could be used is comparing the sale price of a leasehold property with that of a neighbouring freehold property. Leasehold properties sell for much less than freehold properties – a result consistent with house prices (of a freehold property) in Auckland largely comprising the land value.

15 Glaeser and Gyourko (2003) work with densities in level terms. Alternatively, densities could be presented in changes over time and regressed against changes in house prices. Councils may also wish to monitor changes in densities over time to better reflect changes in market conditions.

For the case of the United States, Glaeser and Gyourko (2003) generally find the right negative sign – so higher-priced areas are associated with higher density – but the relationship is far from significant, with variations across cities that Glaeser and Gyourko (2003) plot.

Subsequent regressions control for:

- richer people who might live in expensive areas and demand more land (using median income in the city in 1990)
- using the median house price as the dependant variable
- allowing for amenities by including the January temperature across each city.

None of the Glaeser and Gyourko (2003) regressions show any significant relationship between areas with high house prices and density.

2.3.2 _ What about the case of New Zealand?

Glaeser and Gyourko (2003) work with 40 cities, but for New Zealand we limit our analysis to seven rapidly growing cities. Rather than work at the city level, we use our unit record data to work at the area unit level. This also allows us to break our results into regressions that apply New Zealand wide and for the case of Auckland.

We first construct population density estimates at the area unit level based on data from the 2013 census. Then we:

- construct estimates of house prices at the area unit level across our seven cities
- estimate the correlation between density and house prices across the set of area units
- map our results before conducting regressions.

As our dependent variable, we use both the fraction of the area units where the house price to construction cost ratio is higher than 140 percent (the same variable used in Glaeser and Gyourko 2003) and the median house price. We also include the log of median family income from the 1991 census and the winter temperature as controls.

2.4_ Method 4: What can we learn from apartments?

2.4.1 _ Manhattan apartments have been used to identify land use regulation

Glaeser, Gyourko and Saks (2004) focus on the example of Manhattan since, they argue, the building sector is competitive and there are no technological constraints on building higher, so prices should reflect the marginal cost of building. Even so, they are relatively cautious and say only large gaps between marginal costs and prices should indicate the presence of land use and building restrictions.

If there is a wedge between the price and marginal costs, competition will drive builders to construct additional floors, driving down the prices. So Glaeser, Gyourko and Saks (2004) test the hypothesis that a wedge between prices and the marginal cost of adding additional floors signals the presence of costs from land use restrictions.

Glaeser, Gyourko and Saks (2004) note that while the straightforward test embodied in their approach is appealing, it comes with drawbacks:

- The method cannot distinguish between different types of regulation such as restrictions on the height of a building, setbacks from the street below and minimum apartment sizes.
- If the building industry is not fully competitive, or data do not reflect the marginal cost of constructing an additional floor, then the wedge between prices and marginal cost overestimates costs of land use regulation.

Glaeser, Gyourko and Saks (2004) counsel only interpreting very large wedges between price and marginal cost as evidence of costly land use regulation.

One of the key features of this approach is the need to accurately measure the marginal cost of construction of a home with its price. To abstract from the costs of land and land preparation costs, Glaeser, Gyourko and Saks (2004) look at Manhattan, arguing that the marginal cost of additional units is building up.

Glaeser, Gyourko and Saks (2004) find a large wedge between the marginal costs of constructing an apartment (unlikely to be more than $300/ft) and the prices (which have exceeded $600/ft). They argue that this wedge reveals the impact of land use regulation.

2.4.2 _ A closer look at the New Zealand data

To test the theory, we first obtain data on the cost of building apartments. We obtain estimates from the QV costbuilder across different apartment types (see table 4). Then we use construction costs data from the Statistics New Zealand capital goods index to rate the apartment cost data across our five years of analysis, 2012 to 2016.

On the price side, we have data on the level of most multi-storey apartment sales from 2012. We choose to work with apartments from Auckland and Wellington only, since other regions contain only a small sample of multi-storey apartments and the dynamics for this fraction of the housing market could be much different in smaller centres.

We use the full population of the available data. Then we construct the total cost of the eight different apartment types (described in table 4) and compare it to the price of the apartment.

Earlier unpublished work by Luen (2014) obtained construction costs for apartments from Levett Bucknall in May 2014 (see table 5). Rather than adopt these data as our benchmark, we use the difference in construction costs by floor as a robustness check on our core results that compare prices to construction costs.

TABLE 04

Our construction costs vary over eight apartment types

House type	Description
Two- or three-storey townhouse 100–200m^2	Concrete floor slab, kitchen, bathroom, two WCs, en suite, double garage, excludes balconies and decks
	Cedar or pine weatherboards, Colorsteel® roof, medium-quality fittings
	Polystyrene or fibre cement cladding with textured plaster or acrylic coating, Colorsteel® roof, medium-quality fittings
	Brick veneer to ground floor, polystyrene or fibre cement cladding with textured plaster acrylic coating to upper storeys, concrete tile roof, high-quality fittings
	Brick veneer, cedar or pine weatherboards to upper storey, concrete tile roof, high-quality fittings
Small apartment 50–100m^2	Concrete floor slab, kitchen, bathroom, WC, en suite, garaging, small balcony
Multi-storey apartment	Kitchen, bathroom, WC, laundry, lift to each floor, excludes balconies and loose fittings, two or three bedrooms, medium-quality fittings
	Kitchen, bathroom, WC, laundry, lift to each floor, excludes balconies and loose fittings, two or three bedrooms, en suite, high-quality fittings

Source: QV costbuilder

Apartment construction costs from Luen (2014)

TABLE 05

Apartment construction costs vary by apartment height

	Size of apartment	Number of storeys	Low quality	Medium quality	High quality
1.1	Small (20–35m^2)	1 to 3	$2,604	$3,100	$3,348
1.2		4 to 7	$2,695	$3,209	$3,468
1.3		8 to 24	$2,976	$3,472	$3,720
2.1	Medium (50–70m^2)	1 to 3	$2,108	$2,852	$3,100
2.2		4 to 7	$2,171	$2,938	$3,209
2.3		8 to 24	$2,480	$3,224	$3,472
3.1	Large (90m^2+)	1 to 3	$1,860	$2,356	$2,604
3.2		4 to 7	$1,916	$2,427	$2,682
3.3		8 to 24	$2,232	$2,604	$2,976

Source: Luen (2014)

2.5_ Our methods can help categorise cities to a typology

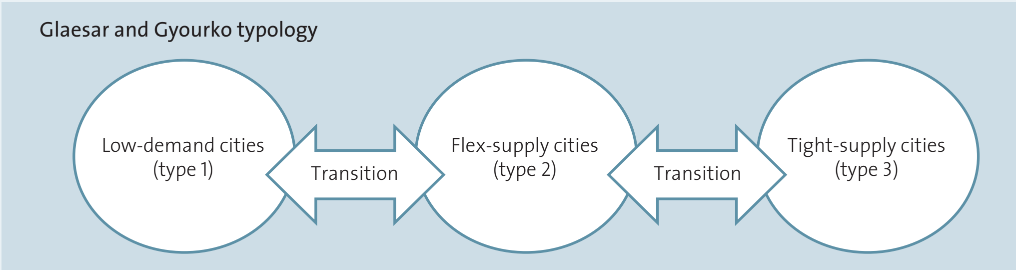
Usefully, Glaeser and Gyourko (2017) show how US cities can be characterised according to a simple typology, which we show in figure 7 in Box C. That typology has three elements:

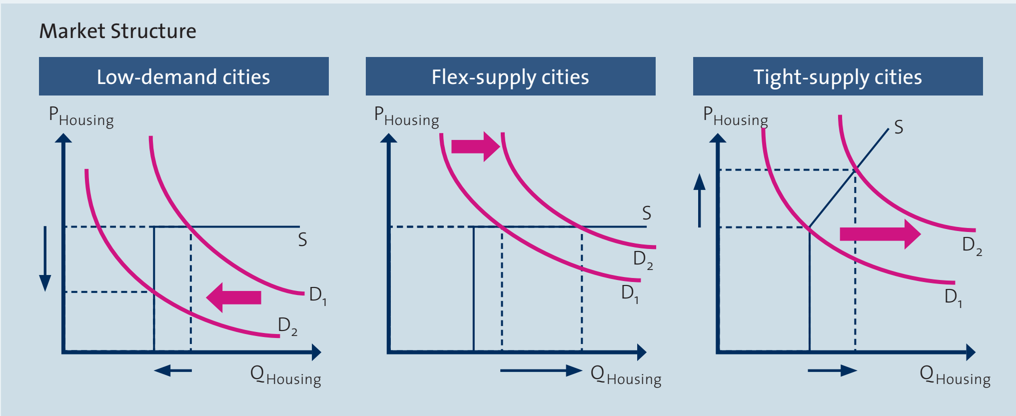
- *Low-demand cities* (type 1 in the Glaeser and Gyourko 2017 naming) have low or falling housing demand (for example, Detroit). Since the existing housing stock depreciates only slowly, prices can fall rapidly and there is very little new construction.
- *Flex-supply cities* (type 2 in the Glaeser and Gyourko 2017 naming) have sufficiently flexible land supply to accommodate increasing demand. Within these cities, a large supply of new construction activity keeps prices stable.
- *Tight-supply cities* (type 3 in the Glaeser and Gyourko 2017 naming) have tight land use regulation, so supply cannot respond flexibly enough to accommodate increasing demand. Within these cities, there is insufficient new construction, and house prices rise.

Importantly, each of our methods can help gauge the extent to which each city can be categorised within the typology (see Box C). Moreover, the typology could be used by councils to track movements across the city types. The market structure makes clear it is the interaction between demand and supply that matters.

Box C _ A land market typology can help track the types of land markets that determine outcomes

Figure 7 _ A simple typology can relate housing markets to our methods





	Low-demand cities (type 1)	Flex-supply cities (type 2)	Tight-supply cities (type 3)
1. House prices vs construction costs	Prices lower than costs – price-to-cost ratio < 1.4	Prices similar to costs – 1.4 < price-to-cost ratio < 2	Prices higher than costs – 2 < price-to-cost ratio
2. Intensive vs extensive land	Intensive (hedonic) value close to extensive valuation	Intensive (hedonic) value close to extensive valuation	Intensive (hedonic) value lower than extensive valuation
3. Density	Density falls with lower demand for housing	Density increasing – supply accomodates demand	Density mostly static – supply not accomodating demand
4. Apartments vs construction costs	Prices lower than costs – price-to-cost ratio < 1.4	Prices similar to costs – 1.4 < price-to-cost ratio < 2	Prices higher than costs – 2 < price-to-cost ratio

Source: Adapted from Glaeser and Gyourko (2017). Sense Partners

The table shows that our four approaches to tracking the cost of land use regulation essentially map the characteristics of each market type. For example, type 2 cities tend to increase in density to accommodate people, while type 3 cities are likely to exhibit high ratios of house price to construction cost.

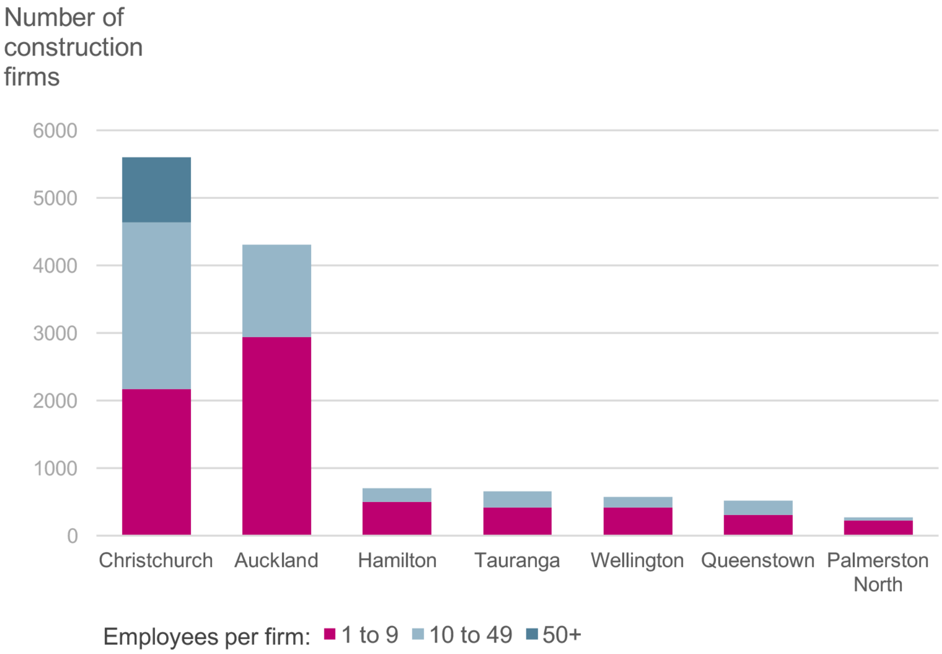
2.6_ Testing some of our key assumptions

One of the key tenets of our approach is that competition within the building sector is high enough that we can ignore any excess profits that would add to the size of the wedge between marginal cost and prices.

On the labour side, one of the characteristics of the New Zealand building industry is the presence of many small firms (see figure 8). While the materials side of the industry is dominated by a small number of large players, with prices for materials higher than in other countries, these costs are embedded within our measures of construction costs rather than determining the size of the wedge between construction costs and prices.

Figure 8 _ The New Zealand building industry has many players

Selected New Zealand cities, 2012–2016

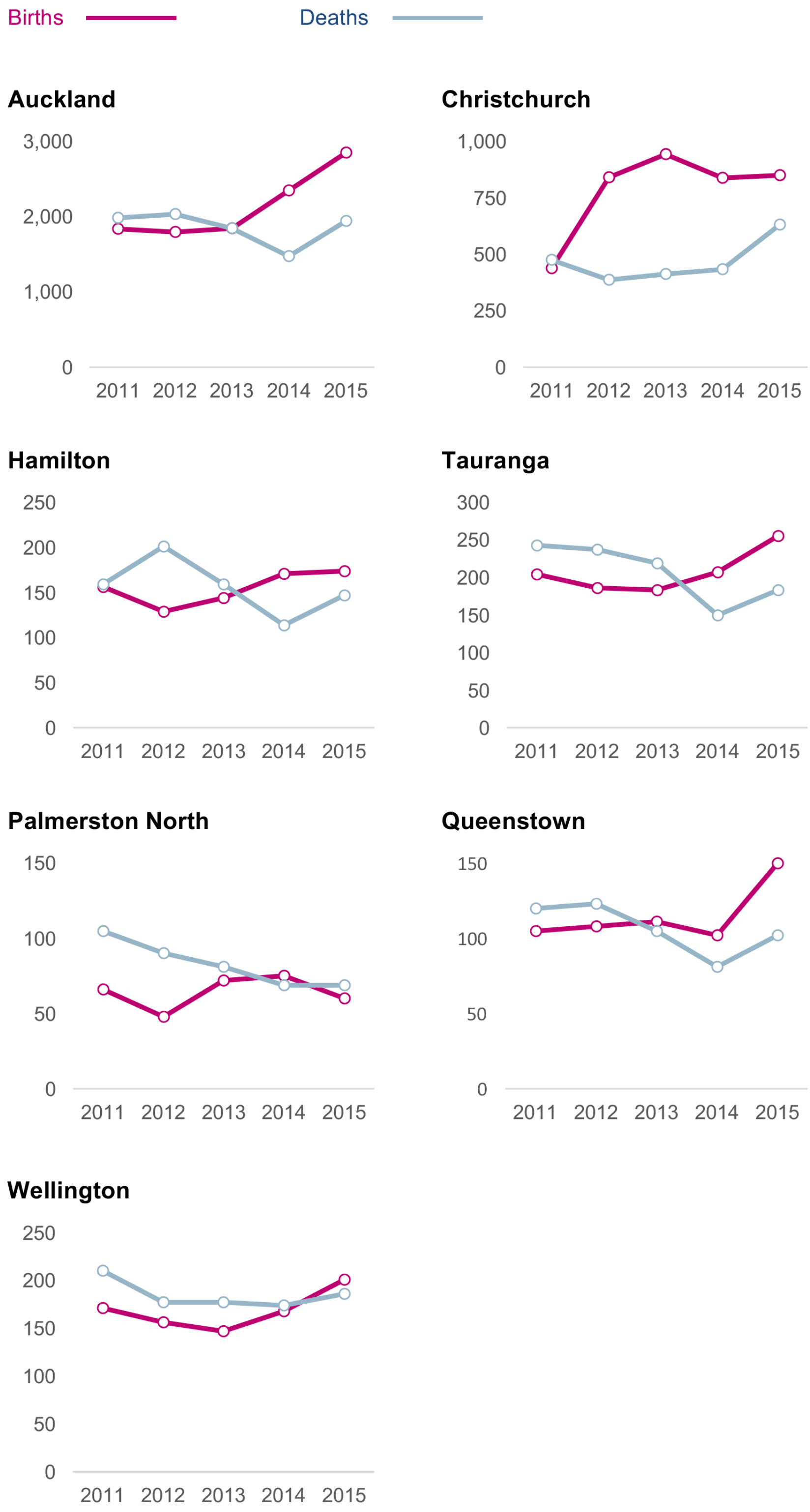


Source: Statistics New Zealand

Moreover, firm turnover within the New Zealand construction industry is high. Many new firms enter the market each year and many firms exit the industry each year. This is consistent with a competitive building industry. Figure 9 shows the births and deaths for New Zealand construction firms (including commercial and residential) across the regions we consider. Each market contains high levels of entry and exit. On balance, characterising the building industry as competitive seems reasonable.

Figure 9 _ Turnover within New Zealand's construction industry is high

Construction firms, 2011–2015



Source: Statistics New Zealand

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03

Results

3.1_ House prices outstrip construction costs

Throughout our results, there are many assumptions that underpin our analysis. These include, for example:

- that the construction market is competitive
- that our sales databases are accurate and capturing the right housing concept
- that our estimate of construction costs is a reasonable match for each property.

Moreover, our construction cost estimates do not include development costs, council fees, professional fees, finance costs and valuation costs. These costs might run as high as 10–15 percent of the cost of constructing a new dwelling.[16] Our cost estimates do not include GST and we do not track how renovation costs, such as the cost of adding a bedroom or additional bathroom, might impact on our analysis. Nor do we include any home-builder profit. We work with a margin of 20 percent to approximate these additional costs and follow Glaeser and Gyourko (2003) by adopting a 20 percent margin for land as reasonable for the cost of a new dwelling.[17]

That makes us cautious, so we attribute only large differences between prices and construction costs to the presence of costly land use regulation. Glaeser and Gyourko (2003) choose to label cities where house prices are 40 percent higher than construction costs as expensive. While our unit record estimates might be expected to deliver a more accurate representation of construction costs (Glaeser and Gyourko 2003 works on city-level estimates for an average house), there may be cross-country differences that make our construction cost estimates lower than might be expected in the United States. So, on balance, we work with a 40 percent indicator of expensive housing relative to costs.[18]

Relative to Glaeser and Gyourko (2003), our work includes a mix of cities. We study New Zealand's four largest cities; Tauranga, New Zealand's sixth largest city, which is growing rapidly; and two other regions, Palmerston North and the Queenstown-Lakes District, facing different pressures. On average, these cities might be expected to be growing more rapidly than other cities in New Zealand, a point that should be kept in mind when comparing our results to other studies. Our sample includes about 55 percent of the population at the 2013 census.

16 See Beacon Pathway Incorporated (2015), which estimates these costs as 13.7 percent of the cost of a new affordable home based on a sample of 69 new builds across Glen Innes, Avondale, Papatoetoe, Sunnyvale, New Lynn, Hobsonville, Mt Wellington, Papakura, Weymouth and West Auckland.

17 More recent work by Glaeser and Gyourko (2017) includes home-building profit but works with a lower margin beyond where construction costs are expensive at 1.25. A like-for-like comparison suggests working with a boundary at 1.45 if we adopt the Glaeser and Gyourko (2017) cost calculations, effectively the same as the 1.40 we adopt based on their earlier (2003) paper.

18 Glaeser and Gyourko (2005) argue that the durability of housing drives much of the population demographics in the US, where people remain in less productive regions where prices are below construction costs since housing depreciates only slowly.

We chart our key indicator for each of the cities in figure 10 and include an aggregate measure of all seven cities in our study. What is immediately striking is that in every period and across every city, house prices outstrip construction costs by over 40 percent, and the ratio shows a strong upwards trend over our time frame. Across our sample, the price-to-cost ratio increased 41 percent from 2012 to the data we have for 2016 (approximately half the year). This identifies the cities we study as type 3 cities, characterised by increasing demand and supply that is not flexible enough to meet it.

Individual cities also reveal a very large wedge between our measure of construction costs and prices. For example, at the end of our data period, prices are more than double our measures of costs for Hamilton, Tauranga, Queenstown and Wellington, while prices are 3.68 times higher than costs for Auckland. According to the method we follow based on US literature, this suggests the presence of costly land use regulation that is not flexible enough to respond to demand.

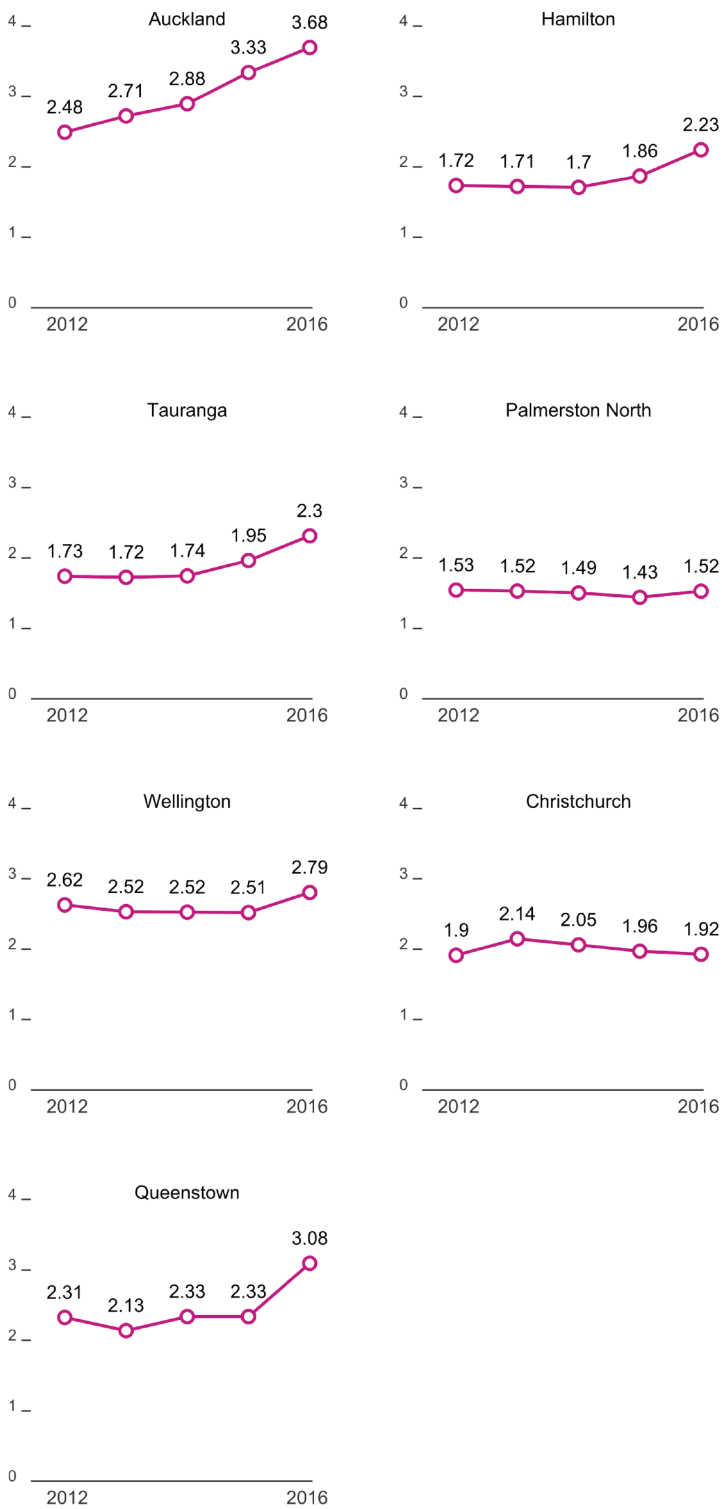
To dig a little deeper into the wedge between prices and costs, figure 11 shows how the distribution of the price-to-cost ratio shifted between 2012 and the first half of 2016 for every house sale in our database. The distribution shows that in 2012, 22 percent of houses in our sample sold for up to a 40 percent premium over construction costs – the point at which house prices might be considered expensive relative to costs. But by the start of 2016, only 12 percent of sales fell in that category.

We also map how the price-to-cost ratio is distributed across each city for 2015 in figures 12 to 18, using Statistics New Zealand area unit classification. These maps show a variety of experiences, but for several cities, such as Auckland, they show few areas where housing might be considered inexpensive relative to construction costs. These maps might prove a useful monitoring tool for councils to check the extent to which prices in local housing markets are running ahead of costs.

Taken on their own, our estimates might not prove conclusive, but the size of the wedge suggests costly land use regulation is not able to respond sufficiently to demand.

Figure 10 _ Our estimates suggest a large gap between prices and costs

Price-to-cost ratio

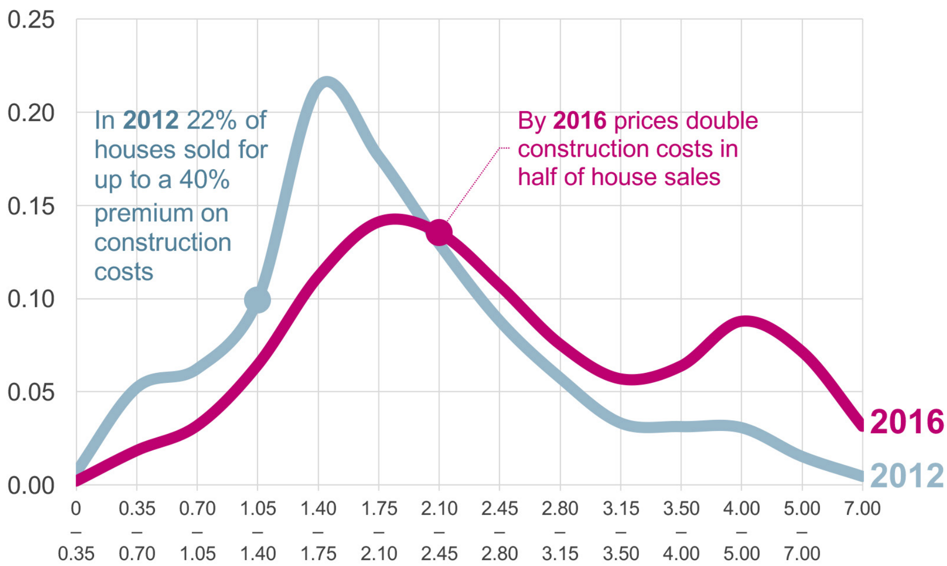


N.B. Our measures of the price-to-cost ratio for 2016 are for approximately the first half of the year only.

Source: Sense Partners

Figure 11 _ The distribution of the price-to-cost ratio is shifting higher

Distribution of price-to-cost ratio, all seven cities, 2012–2016

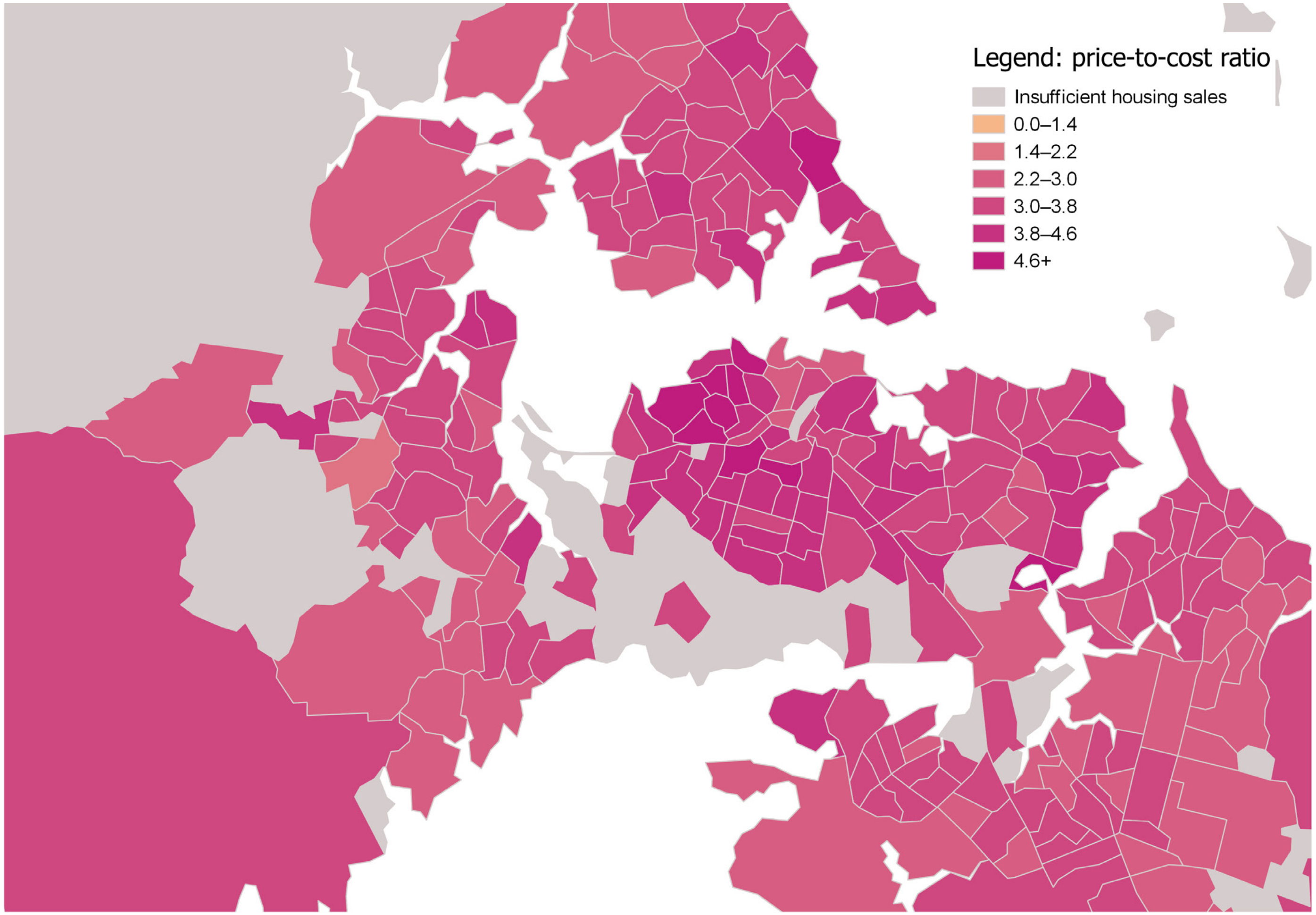


N.B. Our measures of the price-to-cost ratio for 2016 are for approximately the first half of the year only.

Source: Sense Partners

Figure 12 _ Auckland is overheated and characterised by tight supply

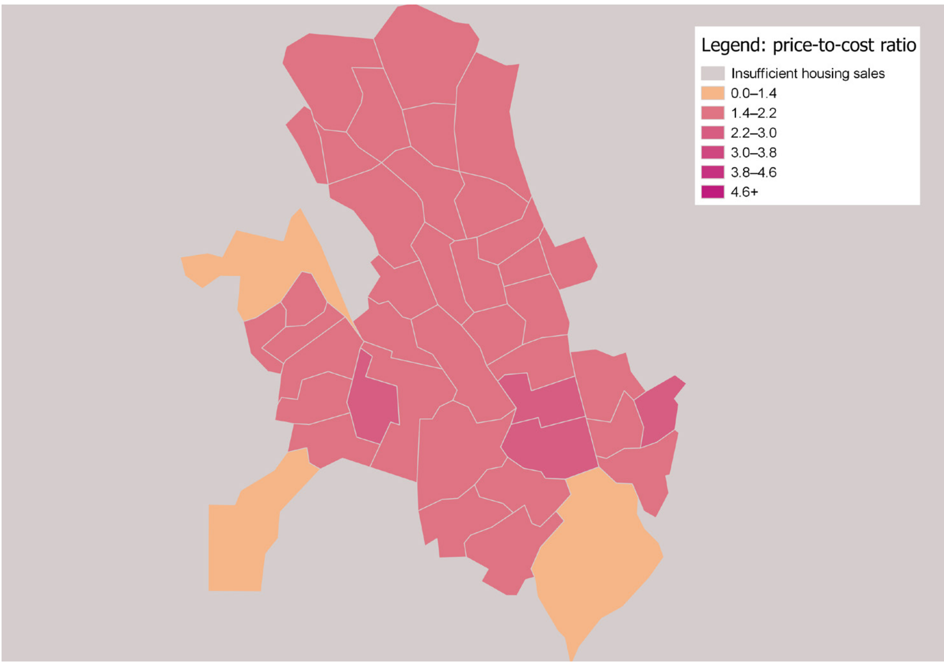
Price-to-cost ratio by area unit, Auckland, 2015



Source: Sense Partners

Figure 13 _ Hamilton shows more modest variation

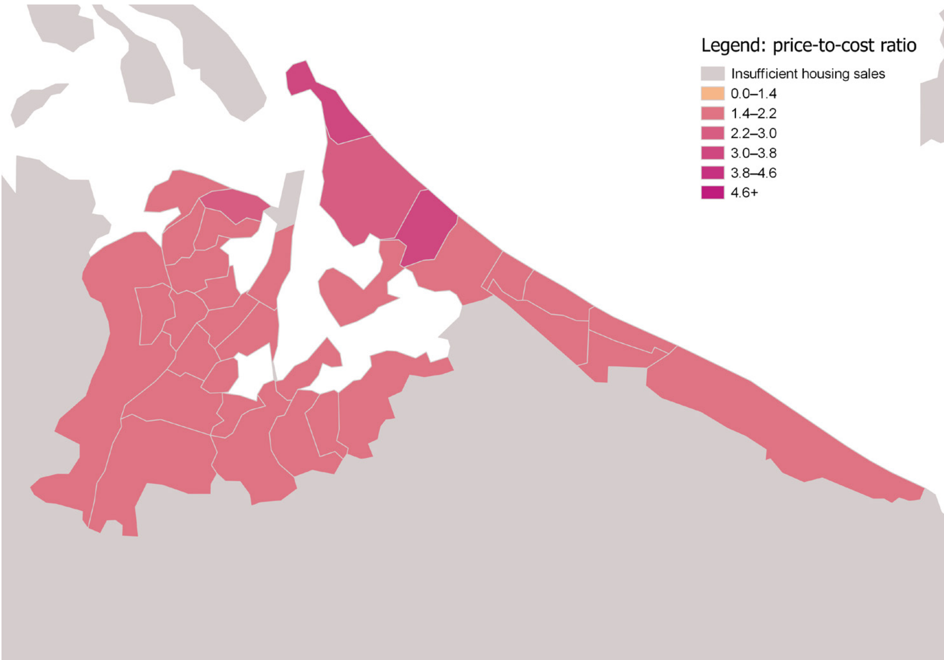
Price-to-cost ratio by area unit, Hamilton, 2015



Source: Sense Partners

Figure 14 _ Tauranga also shows variation across the city

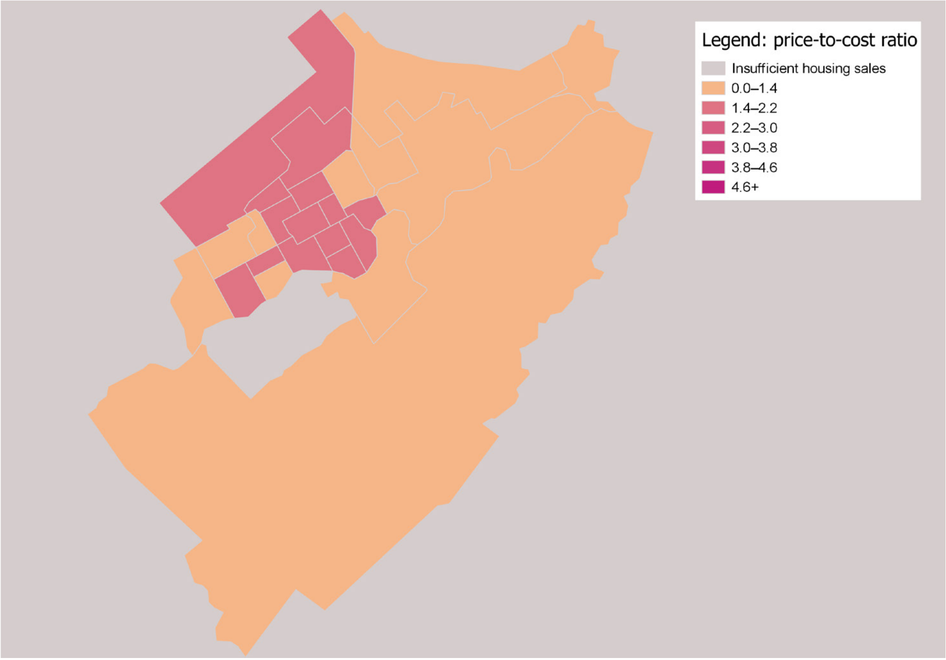
Price-to-cost ratio by area unit, Tauranga, 2015



Source: Sense Partners

Figure 15 _ The price-to-cost ratio is more even in Palmerston North

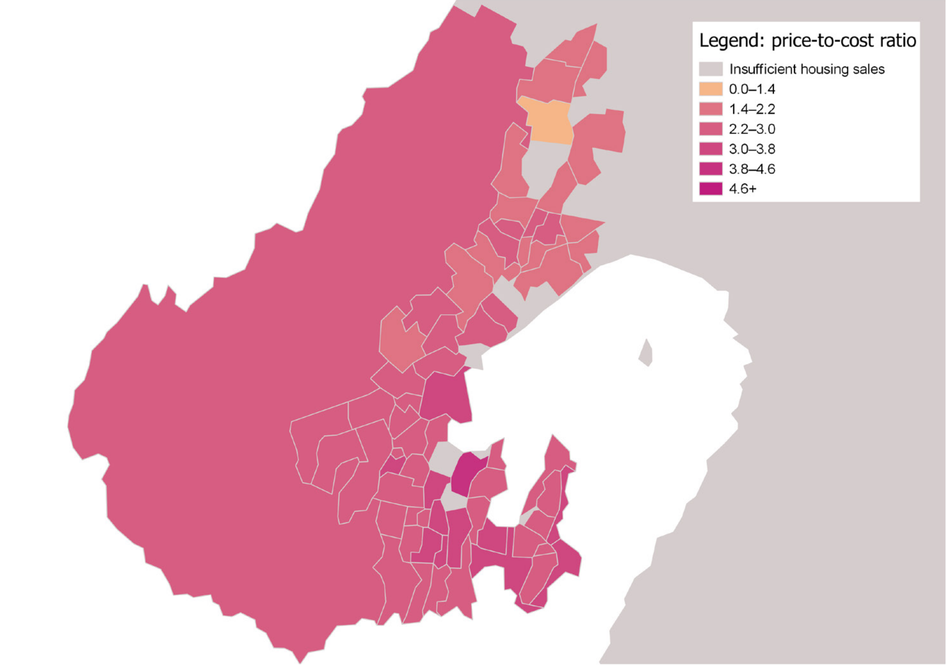
Price-to-cost ratio by area unit, Palmerston North, 2015



Source: Sense Partners

Figure 16 _ Wellington shows high price-to-cost ratios – a sign of tight supply

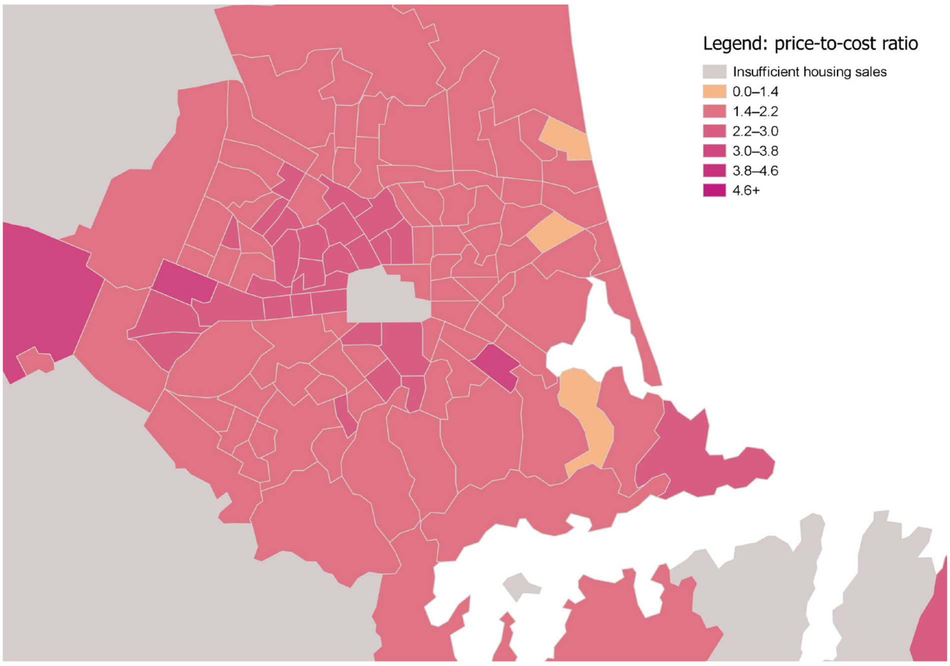
Price-to-cost ratio by area unit, Wellington, 2015



Source: Sense Partners

Figure 17: The price-to-cost ratio is also high in many parts of Christchurch

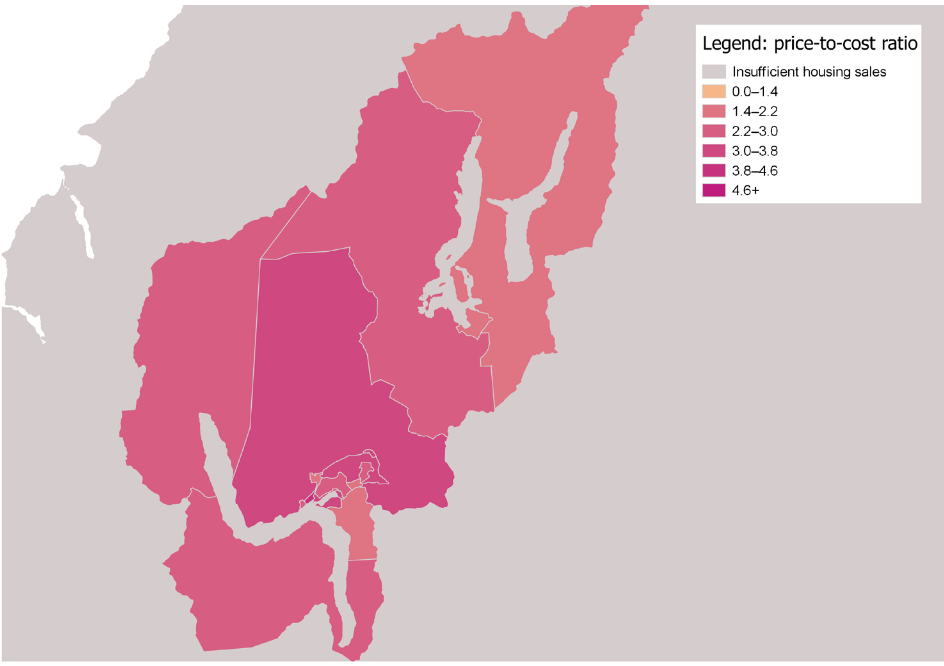
Price-to-cost ratio by area unit, Christchurch, 2015



Source: Sense Partners

Figure 18: The suburbs in Queenstown-Lakes District are large

Price-to-cost ratio by area unit, Queenstown, 2015



Source: Sense Partners

3.2_ Land prices suggest costly land use regulation

Our second method for testing for the presence of costly land use regulation uses Glaeser and Gyourko's (2003) suggestion to compare the extensive price of land (with a house on it) to the value of land in determining an existing house package (for example, a backyard). Recall we use the equation in Glaeser and Gyourko (2003) to test for costly land use regulation *T*:

$$P(L) - K = T + p(L)$$

Column (V) of table 6 shows the mean house price from CoreLogic. Column (III) estimates the price of land as the sales price minus the cost of replacing the capital based on construction costs. Column (IV) provides a cross-check of the CoreLogic capital value estimate. Columns (I) and (II) are estimates of the intensive value of land from hedonic regressions.[19]

19 We follow the standard approach developed in Rosen (1974) and Roback (1982) and applied to New Zealand data in Nunns et al. (2015) and Timar et al. (2014). See tables A1 and A2 for the results.

TABLE 06

Estimates of the extensive and intensive price of land

City	(I) Hedonic land price (*p*) per sqm, intensive margin log model	(II) Hedonic land price (*p*) per sqm, intensive margin linear model	(III) Land price as house price minus costs (*p+T/L*), extensive margin	(IV) CoreLogic implied land price	(V) Mean house price
Auckland	$52.51‡	$83.06‡	$766.48	$638.55	$949,429
	(4.638)	(4.071)			
Christchurch	$80.69‡	$66.13‡	$319.36	$259.42	$524,605
	(4.196)	(3.005)			
Hamilton	$95.24‡	$49.66‡	$266.82	$193.26	$464,053
	(3.338)	(1.816)			
Palmerston North	$28.02‡	$26.20‡	$194.06	$103.18	$345,105
	(1.111)	(1.265)			
Queenstown	59.38‡	$55.85‡	$310.23	$328.35	$787,994
	(2.744)	(3.191)			
Tauranga	$103.72‡	$82.34‡	$312.61	$233.22	$552,578
	(4.671)	(3.483)			
Wellington	$44.454‡	$48.24‡	$386.48	$455.40	$652,500
	(5.679)	(3.589)			

N.B. Standard errors are in parentheses beneath the coefficient estimates, the log model estimates and associated standard errors are transformed to a land price by multiplying by the average land area/average land sale as per Glaeser and Gyourko (2003), * denotes 10% significance, ‡ denotes 5% significance, † denotes 1% significance level.

Source: Sense Partners

What is most striking is the large differences between the intensive and extensive prices of the land, with the extensive prices on average five to six times higher. For example, our estimates for Auckland suggest that the cost of an average home on $800m^2$ of land is only $32,424 (or 3.5 percent) more than the cost of a home on $400m^2$ of land. According to Glaeser and Gyourko's (2003) method, this suggests a substantive impact of the cost of land use regulation *T*.

TABLE 07

Estimates of the extensive and intensive price of land – land use regulation cost estimates

City	(A) Mean house price	(B) Construction cost estimate	(C) Hedonic land value estimate	(D) Cost of land use regulation tax estimate	(E) Reg tax (% of price)
	P	$-K$	$-p(L)$	$=T$	T/P (%)
Auckland	$949,429	$359,710	$58,930	$530,790	55.91%
Christchurch	$524,605	$311,626	$45,892	$167,445	31.89%
Hamilton	$464,053	$299,455	$37,005	$128,634	27.66%
Palmerston North	$345,105	$272,954	$20,714	$51,806	15.00%
Queenstown	$787,994	$414,896	$67,822	$305,276	38.74%
Tauranga	$552,578	$338,413	$61,142	$153,023	27.69%
Wellington	$633,151	$302,621	$27,851	$302,678	47.81%

Source: Sense Partners

It is worth pausing to consider what is contained within T – the impact of land use regulation that can be thought of as a 'tax' that raises the cost of a house. In principle, T contains anything that drives a wedge between prices and construction costs. This could include a multitude of land use regulations, such as height restrictions, urban growth boundaries, minimum lot sizes, minimum parking requirements and heritage restrictions. Moreover, these regulations are often a function of the broader urban planning system, including infrastructure funding.

T could also include geographic restrictions that make it more difficult to build in some areas than others. For example, steep terrain in parts of Wellington and Queenstown is likely to play a role, whereas Christchurch and Hamilton are less likely to be affected by geographical constraints.[20] In addition, there are time lags for construction to respond to new demand. Monitoring the price-to-cost ratio over a period of years, similar to figure 10, could help show what might be reasonably attributed to delays in the construction sector to respond to demand.[21] Moreover, land use regulation inhibits the supply response to demand for housing, so cross-city comparisons need to consider the role of demand. Monitoring a broad set of indicators and assessing the typology of the underlying housing market would help in this regard.

20 Saiz (2010) documents the role of geography on land prices for US cities. Future work could use unit record data on terrain to estimate the impact of geography on T. Calculating the evolution of T over a longer history would also be useful.

21 If risk appetite in the construction sector varies over time, our estimate of T might also reflect this change. Given estimates of the variance of the cost of capital, these movements are likely to be small relative to the price-to-cost ratios in figure 10.

3.3_ The message from density is more nuanced

Moving beyond construction costs, Glaeser and Gyourko (2003) show how density can also be used to help determine whether land use regulation is driving up prices. If local areas can accommodate some demand, then we expect to see population density (and housing density) increase in highly sought-after areas and house prices to also reflect demand in these areas.

Areas where land use regulations are particularly restrictive might not accommodate any new residents and might push demand entirely into prices, generating a negative correlation between density and prices.

Following Glaeser and Gyourko (2003), we construct the log of the land area per household as a measure of density. Since land area per household declines when more people move into an area, if local areas are accommodating new residents, we expect a negative relationship between our density measure and our price-to-cost ratios. Like Glaeser and Gyourko (2003), we focus on a single year (in our case 2015) for our analysis.

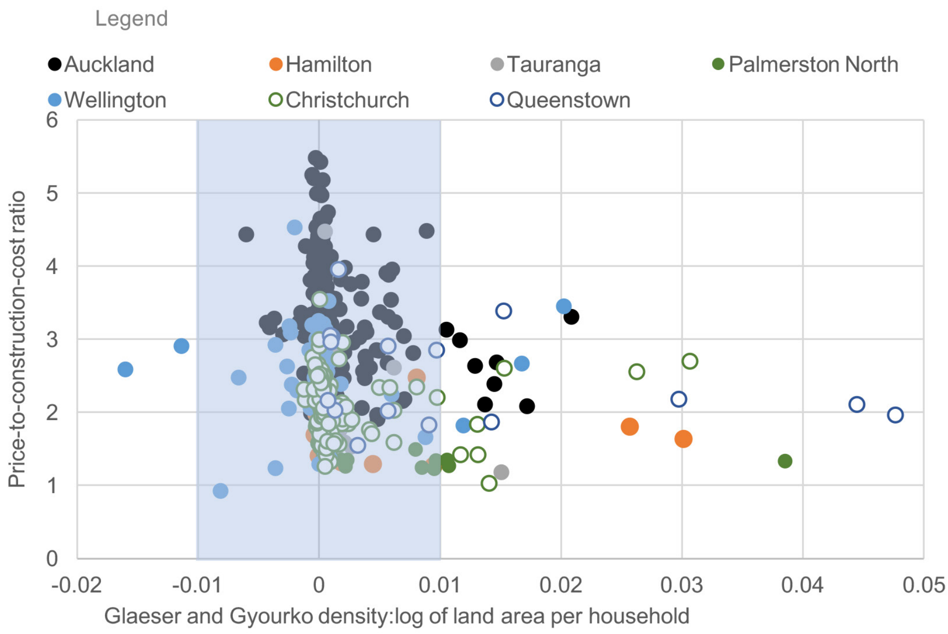
Figure 19 charts our density measure data at the suburb level (using Statistics New Zealand's area unit definitions) against the price-to-cost ratio at the area unit level by each of our key Territory Authorities. Since we conduct our regressions to test for the relationship between density and prices at the Territory Authority level, we colour code each of the area units that form our dataset. The number of observations varies by Territory Authority, from 18 area units for Queenstown to 353 area units for Auckland.

Although we cannot see a clear relationship, there are many factors that can drive prices and density.[22] To test the robustness of our analysis, we also conduct regressions of our density variable and the proportion of sales within an area unit greater than 140 percent (bounding the observation at the area unit level between 0 and 1). Some of our observations contain low densities (to the right of the chart), some of which are associated with Queenstown-Lakes District, which might not be considered an urban area in some contexts, and a handful of observations are particularly dense. So we also calculate our regressions on a subsample of data that contains more moderate densities – depicted in the shaded rectangle in figure 19.

22 As an alternative, future work might consider regressions of the change in density against the change in price.

Figure 19 _ Density relative to the price-to-cost ratio

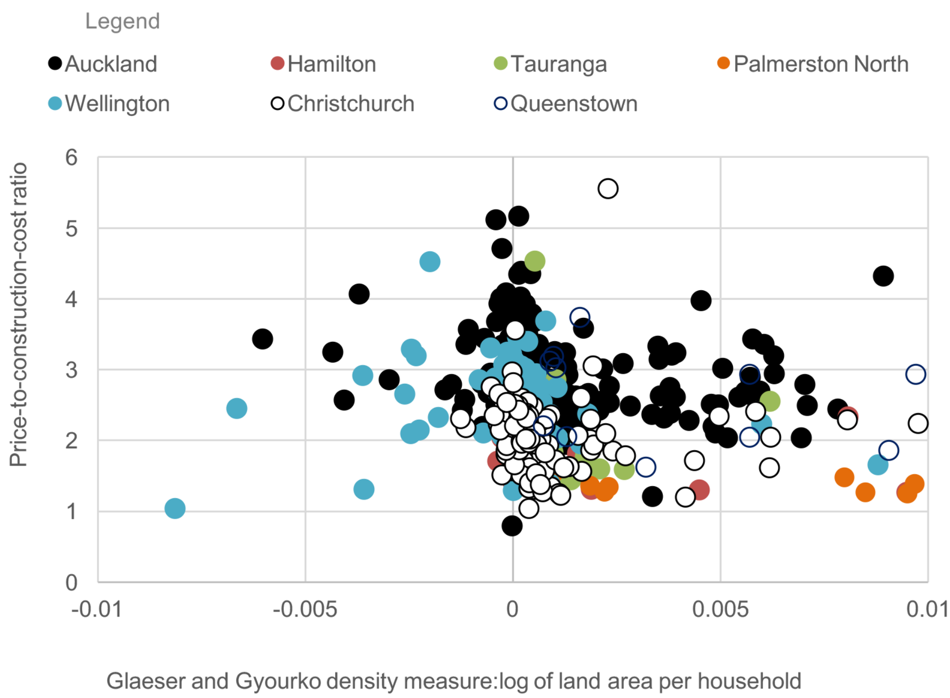
Glaeser-Gyourko (2003) density measure vs price-to-cost ratio by area unit, 2015



Source: Sense Partners

Figure 20 _ Density relative to the price-to-cost ratio – subsample

Glaeser-Gyourko (2003) density measure vs price-to-cost ratio by area unit, 2015



Source: Sense Partners

We report our estimation results for each city and for the four regressions in table 8, reporting the coefficient and standard error of the relationship between our density measure and the dependant variables, the price-to-cost ratio and the fraction of house sales with a price-to-cost ratio over 140 percent for each suburb.

The results are mixed. Across the 28 regressions, 20 have a negative sign, providing some weak evidence that density and our price variables are correlated. But only 25 percent of the regressions have the correct sign and are significant (at the 10 percent level). Moreover, the coefficients are suggestive of very small increases in density when the price-to-cost ratio increases. We know from Lees (2016) that aside from inner-city apartments, most suburbs in Auckland (and elsewhere) have accommodated very few new residents between 1996 and 2013. We conclude there is in general only a small relationship between density and prices, certainly much smaller than if the response to high demand were sufficiently flexible to encourage large inflows.[23] This is consistent with the findings of the other methods that there are severe regulatory restrictions that characterise most cities as type 3 cities that fail to accommodate much demand.

Finally, we also test whether the density relationship is similar across each of our Territory Authorities or best characterised as different. We do this by conducting an F-test for each regression that allows the intercept terms to vary but enforces that the relationship (or slope coefficients) is identical across the Territory Authorities. We find that for each of the four regressions, we can reject the idea that the density–price relationship is the same. Evidently, our city structures respond differently to demand pressure. Digging deeper to identify what types of structure are more accommodating under different demand pressures requires future work outside the scope of this paper.

23 We also considered a subsample restricted to values that lie between -0.005 and 0.005. We obtained very similar estimates – for example, the coefficient on the fraction of suburbs greater than 140 percent is -0.00034 for Auckland but not quite significant at the 1 percent level.

TABLE
08
Our results are mixed – supply response varies by city

City	Log land area per household			
	Full sample		**Restricted sample**	
	Regression 1: Fraction of suburb > 140%	**Regression 2:** Price-to-cost ratio	**Regression 3:** Price-to-cost ratio	**Regression 4:** Fraction of suburb > 140%
Auckland	-0.00688	-0.00266***	0.00009	-0.00038***
	(0.00735)	(0.00077)	(0.00124)	(0.00013)
Hamilton	-0.00608	-0.00295	-0.00307	-0.00114
	(0.00745)	(0.00357)	(0.00265)	(0.00115)
Tauranga	-0.0105***	-0.00073	0.00251	0.00021
	(0.00212)	(0.00082)	(0.00181)	(0.00035)
Palmerston North	-0.03117***	-0.02901**	-0.01108**	-0.01549***
	(0.00813)	(0.01082)	(0.00414)	(0.00428)
Wellington	0.00402	0.00019	0.002833**	-0.00010
	(0.00276)	(0.00086)	(0.00118)	(0.00041)
Christchurch	0.00519	0.00087	0.00005	0.00006
	(0.00717)	(0.00110)	(0.00126)	(0.00170)
Queenstown	-0.04376	-0.00401	-0.01998*	-0.00123
	(0.04861)	(0.00785)	(0.00894)	(0.00153)
F-test for differences	2.2099	2.2475	6.8778	5.6081
	(0.0405)	(0.0373)	(0.0000)	(0.0000)

Source: Sense Partners

3.4_ Apartments also suggest costly land use regulation

Finally, we make use of data on the costs and prices of apartments. The New Zealand apartment construction sector is clearly much different from Manhattan, where developers must build up rather than develop new land parcels. Rather than present our findings as new techniques, we encourage interpretation as a complement to section 3.1, which looks at dwellings.

Figure 21 presents results for each city and an aggregate across the cities we study. At the aggregate level, we see a similar profile. The price-to-cost ratio is elevated, sits at 3.37 for the final year and has increased 24 percent since 2012. The aggregate numbers are largely determined by the Auckland market, where the price-to-cost ratio sits at 3.50 in the final year, broadly similar to the ratio of 3.68 that we observe for dwellings. There do not appear to be large differences between our results for dwellings and apartments that might otherwise indicate a degree of segmentation between these markets.

Across the other regions, the price-to-cost ratio is generally very high. For Hamilton, the price-to-cost ratio is 1.93 in the final year, with Tauranga a little higher at 2.40. Wellington, Christchurch and Queenstown all produce prices three times our cost estimates for 2016. Palmerston North in 2016 is the only location where construction costs exceed the sales price across both apartments and dwellings.

Our baseline estimates use construction cost estimates from QV costbuilder that do not vary with the height of the apartment (see table 4). But the marginal costs of multi-storey apartment construction presented in Luen (2014) show construction varies by floor type. For a medium-quality apartment of medium size, costs are 21 percent higher at higher floors than at lower levels.

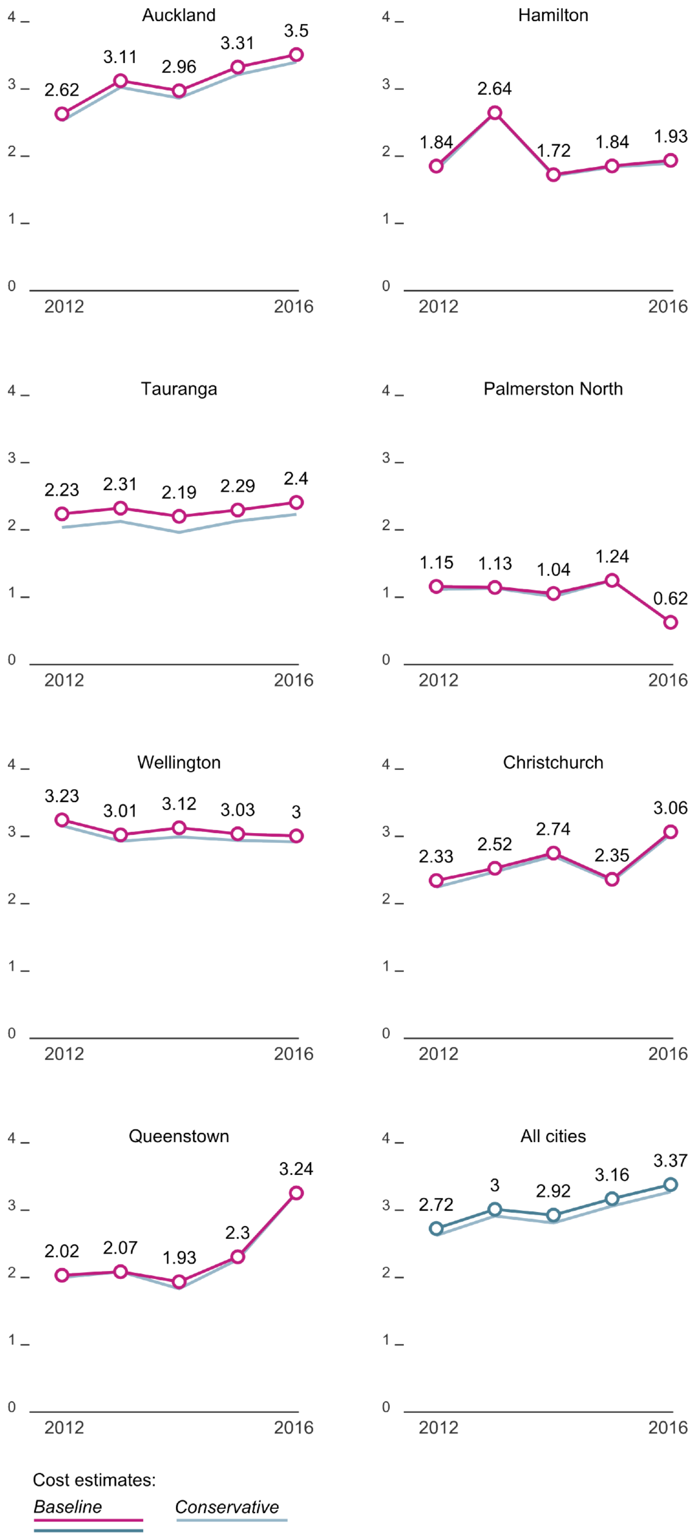
To test the extent to which this might matter, we present results in figure 21 that add 21 percent to construction costs of multi-storey apartments. These conservative estimates show similar profiles to our base case.[24]

While we have fewer observations for apartments than dwellings, these results are consistent with the findings in section 3.1 that suggest a large role for costly land use regulation. The ratios move over time. For large councils with many apartments, monitoring these indicators alongside dwellings may well prove useful for planning purposes, particularly for periods when prices and construction costs move rapidly.

24 Since some cities contain many townhouses and small apartments not affected by this adjustment, the difference from the baseline estimate to the conservative case is not uniform across the cities we study.

Figure 21 _ Apartments also suggest a gap between prices and costs

Price-to-cost ratio



N.B. Our price-to-cost ratio measures for 2016 are for approximately the first half of the year only.

Source: Sense Partners

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04

Conclusion

The nature of land use regulation – in that it varies with complexity and intensity across a city – makes measuring the impacts at an aggregate level complex (see table 9). The four different methods we use to indicate the extent to which costly land use regulation might be present all suggest that there are potentially large impacts which make housing supply relatively unresponsive to increases in demand. This drives prices higher when confronted with additional demand for highly sought-after locations.

TABLE 09

All four of our methods suggest impacts of land regulation

City	Theory	Our approach	Results	Inference
Method 1	High prices relative to costs indicative of poorly functioning markets	Compare unit record sales to construction costs estimates	Large differences between prices and costs that increase over time	Prima facie evidence of impact of land use regulation. Monitor price-to-cost ratio over time
Method 2	A wedge between intrinsic and extrinsic land prices could be land use regulation	Use hedonic tools for intensive prices and calculate extensive price	Extensive prices are four to nine times intensive prices	Likely presence of impacts from land use regulation
Method 3	Density and prices should correlate in high-demand areas	Compare density and prices at the area unit level	Mixed results – many regions have no strong effect and behave differently	Some locations accommodating but restrictions push demand into prices in many suburbs
Method 4	High prices relative to costs indicative of poorly functioning markets	Compare unit record sales to construction costs estimates	Large differences between prices and costs that increase over time	Prima facie evidence of impact of land use regulation. Monitor price-to-cost ratio over time

Source: Sense Partners

In the Territory Authorities we study, housing looks expensive relative to our measures of construction costs. Even allowing for additional costs such as financing and council fees, prices far outstrip costs in most major cities. Time lags in the construction of new homes suggest that periods where demand is higher than supply are pushing up prices. These results for residential homes broadly carry over to apartments, corroborating our story.

Our results show prices in most cities were expensive relative to construction costs in 2012 and have only increased. Moreover, our estimates that compare the price of land with a home to the extra value from a backyard suggest land use regulations are preventing sufficient supply response to meet demand. When a house with 400m² of land is not much different in price from a house with 800m² of land, we can use land more effectively to produce cheaper houses.

There are many potential welfare costs arising from such high house prices, including labour markets distortions and inhibiting productivity and resource allocation. Well-functioning housing markets with flexible supply in high-demand locations should produce a strong correlation between prices and density. We expect supply to adjust and accommodate more residents and some extra demand to push up house prices a little. But our results suggest only mixed and modest relationships between density and prices. Only a few areas, such as downtown Auckland, are accommodating more households with new dwellings accommodated on the periphery of the city.

There are other factors that help determine prices within our key cities, including geography, political economy, financing, demographics and the growth of location-specific demand. But our results, while not decisive, suggest land use regulation is playing a large role in driving up prices.

Applying the Glaeser and Gyuorko (2017) typology suggests New Zealand cities with elevated house prices are generally cities with tight supply, rather than flex-supply cities. So if authorities wish to lower house prices, Glaeser and Gyourko's (2003) policy recommendation seems even more appropriate for many housing markets in New Zealand today:

> *If policy advocates are interested in reducing housing costs,*
> *they would do well to start with zoning reform.*

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Appendix 1:

Land price regressions

Following Glaeser and Gyourko (2003), we run hedonic regressions to estimate the price of land. We use large unit record databases with access to many features likely to be important for determining house prices. Often, we use the CoreLogic and Auckland Council databases to construct indicator variables. We also geocode the unit records and use suburb level (Statistics New Zealand's area unit classification) as dummy variables, and we calculate the distance to the city centre for every sale as an explanatory variable.

For each regression, we begin with a general specification and then remove insignificant parameters. When confronted with many indicator variables (for example, suburbs) we use F-tests of significance to decide whether to include the class as a whole as opposed to including the subset of significant indicator variables.

We run linear regressions – as do Glaeser and Gyourko (2003) – that we present in table A1 but tend to favour the log-log specification in table A2.

TABLE A1

Linear regression model results

Explanatory variable	Auckland	Hamilton	Tauranga	Palmerston North	Wellington	Christchurch	Queenstown
Intercept	494000	-280900	479100	-326300	-256400	-5518000	558500
	(86820)	(69670)	(133700)	(66960)	(95010)	(622700)	(239800)
Land area	83.07	49.66	82.34	26.2	48.24	66.13	33.04
	(4.07)	(1.816)	(3.483)	(1.265)	(3.589)	(3.005)	(3.191)
Bedrooms: 2	N/A	292000	216700	274900	369200	365200	294600
		(14520)	(22220)	(23340)	(30750)	(24870)	(41100)
3	N/A	378200	282900	354600	503500	457100	355400
		(14370)	(21480)	(23240)	(30490)	(24800)	(39590)
4	N/A	433000	374200	405600	611200	533600	479300
		(14450)	(21620)	(23270)	(30510)	(24920)	(39770)
5+	N/A	493800	483400	470300	750200	641100	650500
		(14590)	(22080)	(23420)	(30790)	(25270)	(41330)
Floor area per bedroom	N/A	3640	5737	3703	7287	5403	7868
		50.21	85.05	61.2	111.4	92.6	214.8
Build year	39060	204.6	-1678			94.38	-593.7
	(3348)	(35.6)	(537.6)			(14.19)	(136.3)
Construction: Other	-2143	8558	25800	15560	13710	25880	63690
	(3081)	(1447)	(2766)	(1950)	(7982)	(2902)	(11810)
Construction: Weatherboard	0	9808	7937	14400	15280	28870	31470
		(1801)	(4384)	(2274)	(7560)	(4075)	(13090)
Build cond: Average	27900	-10720	35440	12720		-27880	
	(3189)	(10640)	(34210)	(35420)		(23540)	
Fair	-51230	-40370	-40510	-26280		2361	
	(9486)	(12270)	(38970)	(35940)		(25140)	
Good	27900	-588.7	55550	29390		-1462	
	(3189)	(10560)	(34110)	(35430)		(23440)	
Mixed	-106300	5856	20090	-106400		-203300	
	(13020)	(18380)	(44930)	(39760)		(24450)	

Explanatory variable	Auckland	Hamilton	Tauranga	Palmerston North	Wellington	Christchurch	Queenstown
Poor	-106300	-52280	7649	-20460		-79150	
	(13020)	(23600)	(34490)	(39310)		(30830)	
Site contour: Easy fall/rise		157100		-159700			319800
		43480		41570			125700
Level	6603	151900		-165700	29760		268900
	(2502)	(43490)		(41460)	(3464)		(125500)
Steep rise/fall	-25660	148200		-166100	-39330		366600
	(5260)	(43630)		(42480)	(3910)		(126500)
Weathertight	N/A	-3808	-2606	-4185	-9813	-3901	-5727
		(845.7)	(1018)	(1112)	(1740)	(871.5)	(3842)
Distance to CBD		-3036	11460		-27320	-10280	-10840
		(1723)	(1864)		(3714)	(1300)	(1794)
Half-year: 2012H2	26170	7186	11710	5910	12780	6822	57790
	(4731)	(1944)	(4253)	(2299)	(5013)	(2008)	(12220)
2013H1	71660	17910	18960	9005	29070	17010	28950
	(4731)	(2196)	(4706)	(2584)	(5356)	(2274)	(13350)
2013H2	116600	27510	29340	12740	28370	25220	79990
	(4749)	(2045)	(4373)	(2402)	(5198)	(2116)	(12690)
2014H1	146900	33650	54110	16170	49820	31970	101800
	(4841)	(2506)	(5031)	(2956)	(6053)	(2594)	(14070)
2014H2	195600	51270	74890	20030	36060	50610	139700
	(4744)	(2211)	(4507)	(2603)	(5616)	(2289)	(13470)
2015H1	288600	58440	96590	19320	56910	57740	196500
	(4628)	(2617)	(5408)	(3178)	(6933)	(2705)	(14690)
2015H2	371200	113900	158200	34850	73660	113000	227600
	(4726)	(2188)	(4637)	(2744)	(6144)	(2258)	(14150)
2016H1	434500	201900	267000	55520	150400	200100	440600
	(4894)	(2658)	(5510)	(2980)	(7030)	(2750)	(15760)
Construction: 1900s		-445200	0	10170	-103200	-415700	875600

Explanatory variable	Auckland	Hamilton	Tauranga	Palmerston North	Wellington	Christchurch	Queenstown
		(45580)	(0)	(16890)	(28770)	(46810)	(270900)
1910s		-428400	0	10790	-110800	-411900	779400
		(45240)	(0)	(16450)	(28790)	(46070)	(258400)
1920s	-160900	-464600	2435000	24980	-126700	-425200	981400
	(8780)	(45150)	(1039000)	(16220)	(28730)	(45910)	(255600)
1930s	-220400	-479000	2472000	33930	-152300	-430100	964800
	(10620)	(45430)	(1043000)	(16460)	(29210)	(46240)	(250300)
1940s	-341100	-469000	2399000	11340	-208700	-431800	678700
	(9711)	(45690)	(1048000)	(16520)	(29540)	(46330)	(253200)
1950s	-450400	-486400	2406000	8332	-212600	-452400	896100
	(8200)	(45870)	(1053000)	(16470)	(29720)	(46560)	(242300)
1960s	-519200	-487500	2426000	20210	-248800	-461400	910000
	(7959)	(46100)	(1058000)	(16560)	(30020)	(46800)	(242900)
1970s	-558800	-490500	2397000	14050	-288300	-467700	817100
	(8158)	(46320)	(1063000)	(16720)	(30560)	(47020)	(243800)
1980s	-556600	-485000	2427000	19510	-257900		796200
	(8466)	(46580)	(1068000)	(16930)	(31170)		(245100)
1990s	-565500	-468900	2430000	52770	-259500		808900
	(8441)	(46890)	(1074000)	(17210)	(32110)		(246500)
2000s	-537400	-450200	2480000	89630	-195700		879900
	(8420)	(47080)	(1078000)	(17280)	(32470)		(247400)
2010s	-610400	-510200	2342000	39960	-357800		684200
	(8499)	(47330)	(1083000)	(17420)	(33110)		(248200)
Quality: A	164800						
	(6458)						
B	54120						
	(5478)						
No workshop	-58380						
	(3334)						
No deck	-7069						

Explanatory variable	Auckland	Hamilton	Tauranga	Palmerston North	Wellington	Christchurch	Queenstown
	(2495)						
Other improvements	139400						
	(3777)						
Internal garages: 1	24260						
	(4036)						
2	-167800						
	(4627)						
3	-252300						
	(10350)						
4	-274100						
	(26620)						
5	-584300						
	(63850)						
More garage dummies	-433.5						
View dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AU dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2 adjusted							

Source: Sense Partners

Note: standard errors are in parentheses

TABLE A2

Log-log regression model results

Explanatory variable	Auckland	Hamilton	Tauranga	Palmerston North	Wellington	Christchurch	Queenstown
Intercept	12.4784 (-0.0985)	11.45 (-0.168)	11.78 (-0.2367)	10.52 (-0.169)	12.11 (-0.2393)	10.02 (-0.085)	11.568 (-0.244)
Land area	0.1332 (-0.0037)	0.1395 (-0.0056)	0.1759 (-0.0079)	0.142 (-0.006)	0.0474 (-0.0066)	0.1589 (-0.0083)	0.106 (-0.0086)
Bedrooms: 2		-0.0441 (-0.0483)	-0.1907 (-0.0456)	0.241 (-0.068)	0.1409 (-0.0515)	0.6391 (-0.046)	0.35 (-0.0509)
3		0.0527 (-0.0538)	-0.2048 (-0.0571)	0.283 (-0.075)	0.2356 (-0.057)	0.8202 (-0.0459)	0.5173 (-0.0491)
4		0.0715 (-0.0589)	-0.2028 (-0.0571)	0.259 (-0.082)	0.2943 (-0.063)	0.9684 (-0.0462)	0.6985 (-0.0493)
5+		0.0734 (-0.0638)	-0.2101 (-0.0635)	0.233 (-0.088)	0.3439 (-0.0694)	1.094 (-0.0469)	0.8289 (-0.0512)
Construction: 1900s		-0.6092 (-0.1037)		-0.025 (-0.0419)	-0.0299 (-0.0429)	0.0187 (-0.0258)	1.2431 (-0.3315)
1910s		-0.5923 (-0.1029)		0.0219 (-0.0409)	-0.0159 (-0.043)	0.0201 (-0.0247)	1.1131 (-0.3167)
1920s	-0.1617 (-0.0097)	-0.6298 (-0.1027)	10.15 (-1.759)	0.0669 (-0.0403)	-0.0438 (-0.0427)	0.055 (-0.0254)	1.4305 (-0.3135)
1930s	-0.2777 (-0.0117)	-0.6553 (-0.1034)	10.13 (-1.765)	0.0923 (-0.0408)	-0.0794 (-0.0432)	0.0702 (-0.0263)	1.393 (-0.3068)
1940s	-0.4075 (-0.0107)	-0.6609 (-0.104)	10.18 (-1.774)	0.0187 (-0.041)	-0.142 (-0.0435)	-0.0316 (-0.0259)	1.074 (-0.31)
1950s	-0.5415 (-0.009)	-0.6988 (-0.1044)	10.17 (-1.782)	0.0055 (-0.0409)	-0.1614 (-0.0436)	-0.0127 (-0.0253)	1.2397 (-0.297)
1960s	-0.6269 (-0.0088)	-0.7008 (-0.1049)	10.22 (-1.791)	0.0522 (-0.0411)	-0.1947 (-0.0437)	0.0335 (-0.0257)	1.1696 (-0.2973)
1970s	-0.683 (-0.0092)	-0.6934 (-0.1054)	10.2 (-1.799)	0.0368 (-0.0415)	-0.2295 (-0.0442)	0.0163 (-0.0263)	1.0986 (-0.2984)
1980s	-0.6808 (-0.0093)	-0.6788 (-0.106)	10.26 (-1.808)	0.0623 (-0.042)	-0.1798 (-0.0447)	0.0392 (-0.027)	1.0932 (-0.2999)
1990s	-0.6458 (-0.0093)	-0.6292 (-0.1067)	10.32 (-1.818)	0.139 (-0.0427)	-0.162 (-0.0456)	0.0979 (-0.0277)	1.1034 (-0.3016)
2000s	-0.551 (-0.0093)	-0.6066 (-0.1072)	10.45 (-1.826)	0.2045 (-0.0429)	-0.0655 (-0.0457)	0.1902 (-0.0269)	1.1897 (-0.3028)
2010s	-0.5773 (-0.0094)	-0.8086 (-0.1077)	10.05 (-1.833)	0.0145 (-0.0432)	-0.3848 (-0.0462)	-0.1795 (-0.0265)	0.6635 (-0.3038)
Construction: Other	0.0489 (-0.0034)	-0.0047 (-0.0033)	0.0087 (-0.0047)	0.0203 (-0.0049)	0.0069 (-0.0111)	0.0165 (-0.0054)	0.0446 (-0.0145)

Explanatory variable	Auckland	Hamilton	Tauranga	Palmerston North	Wellington	Christchurch	Queenstown
Weatherboard	0.0592	0.0017	-0.0141	0.0226	0.0367	0.028	-0.0111
	(-0.0037)	(-0.0041)	(-0.0074)	(-0.0057)	(-0.0106)	(-0.0075)	(-0.016)
Building con.: Average	-0.039	-0.0333	-0.0584	0.026		-0.0486	0.1091
	(-0.0144)	(-0.0242)	(-0.0574)	(-0.0878)		(-0.0435)	(-0.1306)
Fair		-0.1155	-0.2187	-0.1193		-0.0262	-0.1958
		(-0.0279)	(-0.0655)	(-0.0891)		(-0.0465)	(-0.1485)
Good	0.0421	-0.0073	-0.0171	0.0766		0.03	0.1532
	(-0.0035)	(-0.024)	(-0.0573)	(-0.0879)		(-0.0434)	(-0.1303)
Mixed		0.0233	-0.1183	-0.223		-0.5223	0.1051
		(-0.0418)	(-0.0755)	(-0.0988)		(-0.0452)	(-0.182)
Poor	-0.0679	-0.3116	-0.0874	-0.2188		-0.2735	0.3743
	(-0.0105)	(-0.0537)	(-0.0579)	(-0.0975)		(-0.057)	(-0.27)
Watertight indicator		-0.0046	-0.05	-0.0057	-0.0133	0.0104	-0.0121
		(-0.0019)	(-0.0017)	(-0.0028)	(-0.0024)	(-0.0046)	(-0.0047)
Distance to CBD		-0.0212	0.02		0.0735		-0.0055
		(-0.0107)	(-0.0086)		(-0.0128)		(-0.0015)
Distance to CBD (distance squared)		0.0033	0.0001		-0.004		
		(-0.0011)	(-0.0005)		(-0.0008)		
Half-year: 2012H2	0.0402	0.0148	0.0176	0.0375	0.022	0.0576	0.0473
	(-0.0052)	(-0.0044)	(-0.0072)	(-0.006)	(-0.007)	(-0.0064)	(-0.0149)
2013H1	0.1132	0.0443	0.0393	0.0241	0.0411	0.1002	0.0519
	(-0.0051)	(-0.005)	(-0.0079)	(-0.0057)	(-0.0075)	(-0.008)	(-0.0163)
2013H2	0.183	0.0678	0.0642	0.0342	0.0452	0.1685	0.1162
	(-0.0052)	(-0.0047)	(-0.0074)	(-0.0064)	(-0.0073)	(-0.0091)	(-0.0155)
2014H1	0.2346	0.0792	0.1101	0.0375	0.0798	0.2479	0.1432
	(-0.0053)	(-0.0057)	(-0.0085)	(-0.006)	(-0.0084)	(-0.0112)	(-0.0173)
2014H2	0.2965	0.1232	0.1537	0.06	0.0563	0.2977	0.235
	(-0.0052)	(-0.005)	(-0.0076)	(-0.0065)	(-0.0078)	(-0.0099)	(-0.0165)
2015H1	0.4132	0.1401	0.1997	0.0676	0.0877	0.3444	0.2996
	(-0.0051)	(-0.006)	(-0.0091)	(-0.0079)	(-0.0097)	(-0.0121)	(-0.018)
2015H2	0.5088	0.2712	0.336	0.0973	0.1351	0.4286	0.359
	(0.0052)	(-0.005)	(-0.0078)	(-0.0068)	(-0.0086)	(-0.0106)	(-0.0173)
2016H1	0.6221	0.4483	0.5052	0.1732	0.2466	0.4743	0.6442
	(-0.0075)	(-0.0061)	(-0.0093)	(-0.0074)	(-0.0098)	(-0.0128)	(-0.0193)
r2-adjusted	0.6079	0.6618	0.5753	0.7085	0.6167	0.5124	0.5527

Source: Sense Partners

Note: standard errors are in parentheses

Families Commission Kōmihana ā Whānau

The Families Commission operates under the name Social Policy Evaluation and Research Unit (Superu)