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

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Abstract: Land use regulations vary in the restrictions and enforcement that applies across time and space. That variation makes it difficult to determine when land use regulations hinder the flexibility of housing supply using a single time series method, so a range of approaches and country case studies may be most appropriate to test impacts. We use four methods to test for impacts of land use regulation in New Zealand and extend existing efforts by utilising unit record data on house sales and construction type. We find: (i) house prices outstrip construction prices in many New Zealand cities; (ii) land with a house is valued 4 and 9 times higher than land with no house attached; (iii) density and house prices are only weakly correlated; (iv) prices of apartments and townhouses are much higher than their construction costs. All four results suggest land use regulations play a material role in constraining housing supply, driving up house prices. Local geography, such as steep terrain, might matter, but relative price differentials between land with a house and land without a house suggest only a minor role for geography.

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1. Introduction

New Zealand house prices continued to appreciate after the GFC

The price of housing in New Zealand. Relative to income, New Zealand's house prices are the most expensive in the OECD. While the US experience has been a slow grind to recover the pre-GFC price peak, house prices in New Zealand have risen dramatically over the same period. In the five years after the Productivity Commission's inquiry into housing affordability in April 2012, house prices have risen 56 percent.[1]

Unlike earlier housing booms, marked differences across New Zealand's regions and cities have persisted. Despite regional specific lending restrictions that might be expected to slow growth in house prices, the average Auckland house is 76 percent higher in late 2016 than in July 2012.

Both central government and local government councils have focussed on improving housing affordability to lift well-being. A targeted policy response requires discerning the right approach and understanding when and where land use regulations play a role.[2]

Glaeser and Gyourko (2003) argue that if existing houses are expensive, one response is to build more houses. But the effect of house building on the price of new houses can never be lower than the cost of construction so any gains from new house construction hangs critically on the cost of building more houses.

Moreover, we know a myriad of land and building regulation sets minimum lot sizes, minimum size standards on bedrooms and verandas and limits on maximum building heights. Developers are also subject to costly delays and uncertainty that Grimes and Mitchell (2015) show to have large impacts on the costs of development in New Zealand.

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. It is difficult to know with precision what a counterfactual of unrestrictive land use

[1] See New Zealand Productivity Commission (2012).

[2] We refer to costly land use regulation in this paper, not because all land use regulation is costly but because we focus on regulation that could drive prices higher than they would otherwise need to. We do not examine potential benefits of land use regulation.

regulation and modest demand population growth looks like. But the interaction of the population growth and the responsiveness of housing supply might be expected to matter for house prices in the short- to medium-term.

The extent of land use regulations is hard to measure but could be costly

Regulations apply differently not just across cities, but within cities and apply differently to different suburbs within district plans. That makes measuring the extent of land use regulation difficult. And not only are there are 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, there are several approaches to estimating the impacts of land use regulation. These include case studies (see Glaeser and Ward 2006 for the case of Boston, Bertaud and Brueckner 2004 who examine Bangalore, Grimes and Liang 2009 and Lees 2015 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).[3,4]

Many of these studies and other in the literature attribute high costs to land use regulation that matter for not just GDP growth (see Hsieh and Moretti 2015) but also welfare (see for example Turner et al. 2014). This suggests governments concerned with well-being are right to look closely at land use regulation.

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.

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[3] 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 inform the impact of land use regulation over time.

[4] 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.

We use four methods to triangulate potential impacts

Rather than rely on any single approach this report uses four different methods or lenses to triangulate the impact of land use regulation.

Our first method originates with Glaeser and Gyourko (2003). They ask whether house prices are close to construction costs. If there are only small or trivial differences, this suggests a limited impact of land use regulation on prices.

Our second method exploits the second hypothesis of Glaeser and Gyourko (2003). 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.

Our third method uses the hypothesis that if land use regulation is sufficiently flexible 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. We use this relationship between density and house prices to test for the presence of land use regulation impacts 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. The composition of the New Zealand housing market is much different to Manhattan and the US. So we interpret our results as a complement to the results bases on stand-alone dwellings we obtain from our first method.

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 how they might be interpreted before making some brief concluding comments in section 4.

2. Methodology

2.1 Method 1: Do prices reflect construction costs?

2.1.1 Glaeser and Gyourko (2003)

To test if house prices match construction costs, 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 US 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 under 20 percent higher than construction costs for the US.[5]

But Glaeser and Gyourko (2003) dig a little deeper. They show that the US 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 there may be a role being played by land use regulation.

2.1.2 Taking the method to New Zealand data

To apply this method to New Zealand, we were able to work at the unit record level by obtaining two unit-record databases with detailed house sales information for 2012-2016.

The first database was supplied by Auckland Council. It 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 there is a garage or off-street parking).

Crucially, each property records the size of the dwelling in square metres. That provides for a more accurate assessment of the construction cost of a dwelling relative to the Glaeser and Gyourko (2003) study that works with an average dwelling size.

The second database was purchased from CoreLogic and contains unit record sales for other major New Zealand cities including Christchurch, Hamilton, Palmerston North, Queenstown, Tauranga and Wellington. It is similar in structure to the Auckland Council database and contains many fields that relate to the characteristics of the

[5] Glaeser and Gyourko (2017) argue that 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.

dwelling in addition to the size of the dwelling that we use to help determine construction costs.

Since construction costs can vary by region (because of local labour markets for example), to obtain estimates of construction costs for each city we use the New Zealand Building Economist who use the quantity surveying company Cuesko to provide estimates across four types of house that span: (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.

Our approach is to categorize 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. Since 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 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 houses) with little indication to the characteristics of each house.

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 that, at least in principle, allows for a better estimate of construction costs at the unit record level. We calculate the ratio of house sales to construction costs for every unit record.

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 – with an alternative view, where land prices are high because of land use regulation.

To test for the presence of the costs of land use regulation we exploit a little bit of theory. They 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.

To test whether differences 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:

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

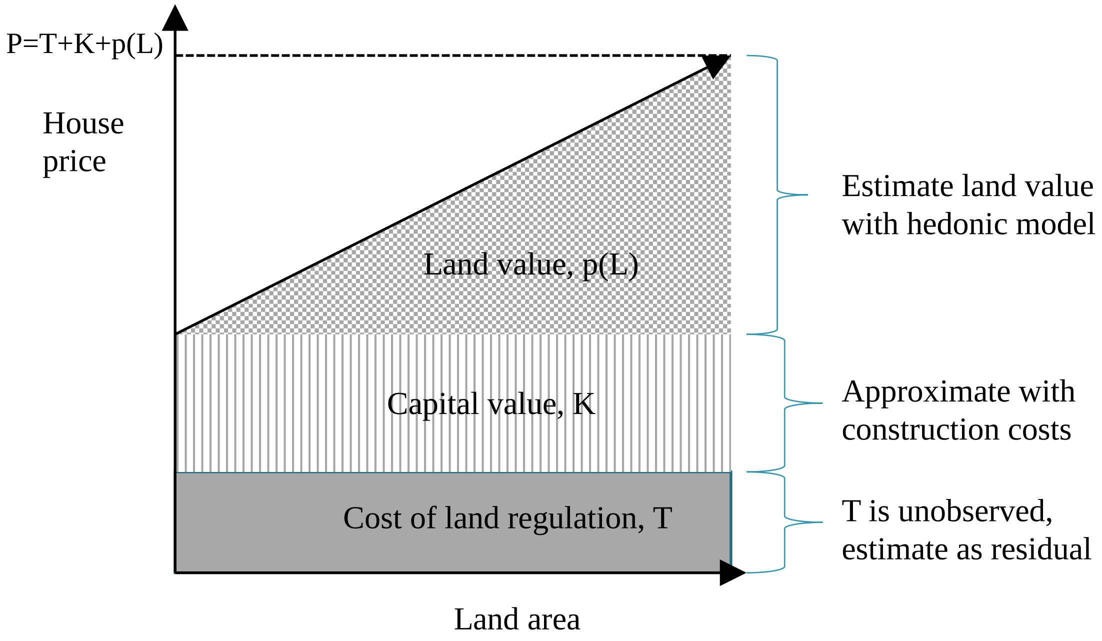
where $P(L)$ is the price of the house as a function of land L, the capital value of the house K, and any land use regulation costs, T. Glaeser and Gyourko (2003) observe equation (1) implies:

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

Glaeser and Gyourko (2003) then work at a city-level and subtract the construction cost of an average dwelling (K) from the median house price $P(L)$. That equals $T + p(L)$ so any 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 1 illustrates.

Figure 1: Glaeser and Gyourko (2003) formulation of house prices

Stylised representation



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 the presence of costs of 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.[6]

2.2.2 A worked example

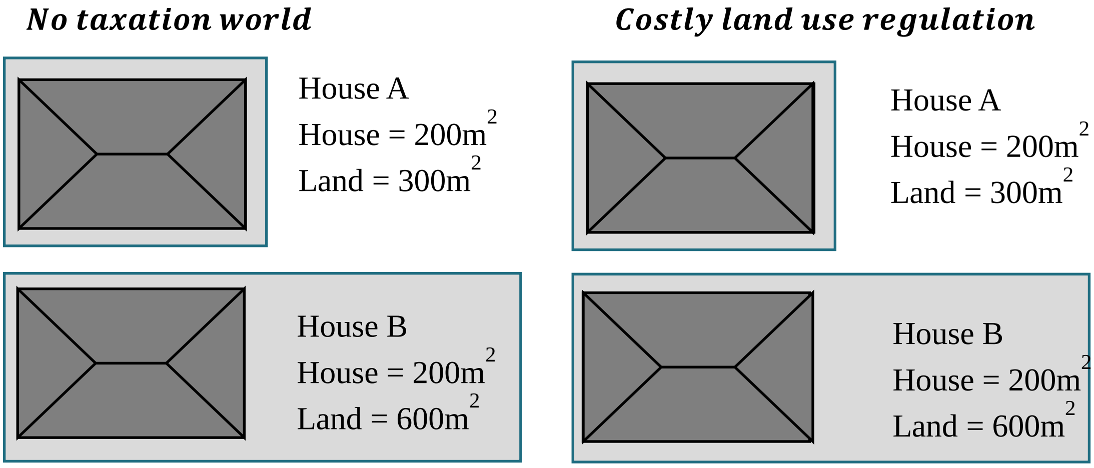
Figure 2 below shows worked examples for houses A and B in a stylised world with no land use taxation and a world with costly land use regulation. House A is 200 square metres on a 300 square metre section while House B is 200 square metres on a 600 square metre section. We assume constructions costs are $2,000 a square metre so

[6] One other method that could be used to compare 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.

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) constructions 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.

Figure 2: Stylised representation of the impact of land use regulation



$$House\ Price:\ P(L) = T + K + p(L)$$

No taxation world

$$House\ A = 0 + \$400{,}000 + \$60{,}000 = \$460{,}000$$

$$House\ B = 0 + \$400{,}000 + \$120{,}000 = \$520{,}000$$

Costly land use regulation world

$$House\ A = \$150{,}000 + \$400{,}000 + \$60{,}000 = \$610{,}000$$

$$House\ B = \$150{,}000 + \$400{,}000 + \$120{,}000 = \$670{,}000$$

2.2.3 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 from Core Logic and Auckland Council that report the house sales, $P(L)$. We first filter out observations that includes removing:

- any house sales that are not residential dwellings
- any house sales with zero land area
- any house sales with a price less than $50,000
- any house sales greater than $10,000,000
- any house sales with a total floor area less than 40 square metres
- any house sales with a total floor area greater than 2,000 square metres.[7]

We then use our New Zealand Building Economist data on the cost of construction per square metre to obtain K for every house sale and then we can compute $P(L) - K$ that provides an estimate of $T + pL$. Our cost data varies by regions and housing type to better match each property.

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

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

We also allow for spatial correlation and equation (3) produces an errors 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 including: building age, the condition of the building, the total floor area, the contour of the property, the existence of a garage and other property improvements to the property.

In addition to splitting our unit record dataset by units of use we also test for complementarities in housing amenity such that large houses may complement large backyards while smaller houses are less likely to contain families and smaller parcels of land might not lower price.

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

Finally, we compare the land prices on the extensive and intensive margins and recreate table 4 on page 30 of Glaeser and Gyourko (2003) at a city level (from Statistics New Zealand's Territory Authority definitions).[8]

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

2.3.1 Theory suggests density reveals supply restrictions

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.[9] Glaeser and Gyourko (2003) 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 the locations identified as high price. 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.

For the case of the US, 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 heterogeneity across cities that Glaeser and Gyourko (2003) plot.

Subsequent regressions control for:

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[8] 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).

[9] 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.

- Richer people that 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 for each city.

None of the regressions show any significant relationship between areas with high house prices and density.

2.3.2 Taking the theory to New Zealand data

Glaeser and Gyourko (2003) work with 40 cities but for New Zealand we are limited to 7. 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 7 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 140 percent (the variable in Glaeser and Gyourko 2003) and the median house price. We also use the log of median family income in 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 marginal costs should accurate reflect the cost of building. Even so they are relatively cautious and advocate only large gaps between marginal costs and prices should indicate the presence of land use and building restrictions.

If there exists 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 the existence of a wedge between prices and the marginal cost of adding additional floors signal 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 that might be 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 the approach is the requirement 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 (likely to be not more than $300/ft.) and the price (that have exceeded $600/ft.). They argue that this wedge reveals the impact of land use regulation.

2.4.1 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 cost builder across different apartment types. Then we use construction costs data from Statistics New Zealand’s capital goods index to rate the apartment cost data across our 5 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 from Auckland and Wellington. Then we construct the total cost of the apartment 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. Rather than adopt this 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.

3. Results

3.1 Method 1: House prices generally outstrip construction costs

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 that 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 include about 55 percent of the population at the 2013 census.

Throughout our results there are many assumptions and rules of thumb that underpin our analysis. These include for example:

- that the construction market is competitive
- that our sales databases are accurate and capture the right housing concept
- that our estimate of construction costs is reasonable for each property
- any costs associated with construction absent from our cost estimates.

For example, 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% of the cost of constructing a new dwelling.[10] Moreover, 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.

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[10] See Beacon (2015) who estimate 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.

That makes us cautious to attribute only large differences between prices and construction costs as indicative of the presence of costly land use regulation. Glaeser and Gyourko (2003) choose to label cities where house prices are 40 percent higher than construction cost as expensive. While our unit record estimates might be expected to deliver a more accurate represent 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 US. So on balance we work with a 40 percent indicator of expensive housing relative to costs.[11]

We chart our key indicator for each of the cities in Figure 3 and include an aggregate measure of all 7 cities in our study. What is immediately striking is that in every period and across every period 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).

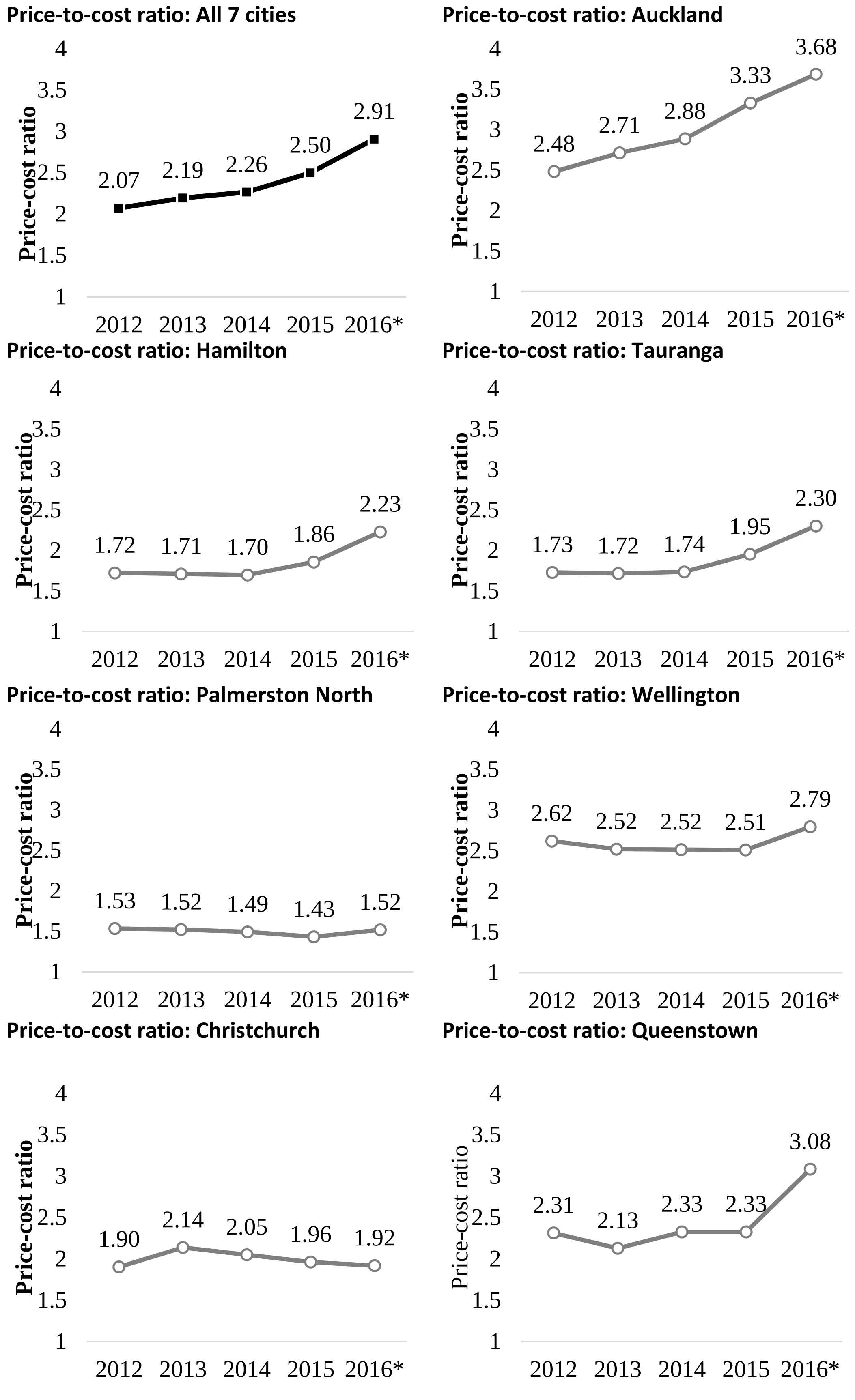
Individual cities also reveal a very large wedge between our measure of construction costs and prices. For example, at the end of our data period, prices are more than double our measures of costs for Hamilton, Tauranga, Queenstown and Wellington while prices are 3.68 times higher than costs for Auckland.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

3.2 Method 2: Land prices suggest costly land use regulation

Our second method for testing for the presence of costly land use regulation compares the extensive price of land (with a house on it) to the value of land without a house using hedonic regression methods. Recall we use the equation in Glaeser and Gyourko (2003) to describe costly land use regulation, T:

[11] Glaeser, Edward L., and Joseph 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.

Figure 3: Our estimates suggest a large gap between prices and costs



$$P(L) - K = T + p(L) \quad (4)$$

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 Core Logic 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. We also calculate the distance to the city centre for every sale as an explanatory variable.

Our hedonic regressions take the standard approach developed in Rosen (1974) and Roback (1982) for hedonic house price regressions – a similar method to that already applied to New Zealand data in Nunns (2013) and Timar et al. (2014). Our regressions on each house sale leverage many indicator of housing quality See Appendix 1 for the results of our hedonic regressions.

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 in its entirety or including the subset of significant indicator variables.

We run linear regressions – as do Glaeser and Gyourko (2003) – that we present in Figure A.1 but tend to favour the log-log specification in Figure A.2.
Column V of Figure 4 shows the mean house price from Core Logic. 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 Core Logic Capital Value estimate. Columns (I) and (II) present estimates of the intensive value of land based on hedonic regressions.

Figure 4: Estimates of the Extensive and intensive price of land for New Zealand cities

City	(I) Hedonic land price *p* per m^2, intensive margin, log model	(II) Hedonic price p per m^2, intensive margin, linear model	(III) Land price as house price - costs, ($p+T/L$) extensive margin	(IV) Core Logic implied land price	(V) Mean house price
Auckland	$52.51‡ (4.638)	*$83.06‡* *(4.071)*	$766.48	$638.55	$949,429
Christchurch	$80.69‡ (4.196)	$66.13‡ (3.005)	$319.36	$259.42	$524,605
Hamilton	$95.24‡ (3.338)	$49.66‡ (1.816)	$266.82	$193.26	$464,053
Palmerston N.	$28.02‡ (1.111)	$26.20‡ (1.265)	$194.06	$103.18	$345,105
Queenstown	59.38‡ (2.744)	$55.85‡ (3.191)	$310.23	$328.35	$787,994
Tauranga	$103.72‡ (4.671)	$82.34‡ (3.483)	$312.61	$233,22	$552,578
Wellington	$44.454‡ (5.679)	$48.24‡ (3.589)	$386.48	$455.40	$652,500

NB. Standard errors are in parentheses beneath the coefficient estimates, the log model estimates 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.

What is most striking is the large differences between the intensive prices that are on average 5-6 times higher than the extensive prices of land. For example, our estimates for Auckland suggest that the cost of an average home on 800 square metres of land is only $32,424 (or 3.5 percent higher) more than the cost of a home on 400 square metres of land According to Glaeser and Gyourko (2003) method, this suggests a substantive impact of the cost of land use regulation, T that we show below in Figure 5.

Figure 5: Estimates of the cost of land use regulation for New Zealand cities

City	(A) Mean House Price	(B) Construction cost estimate	(C) Hedonic land value estimate	(D) 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%

It is worth pausing to consider what is contained within T. In principle T contains anything that drives a wedge between prices and construction costs. This could include a multitude of land use regulations, including height restrictions, minimum lot sizes, minimum parking requirements and heritage restrictions.

The wedge T might also reflect geographic restrictions that make it more difficult to build in some areas than others. Steep terrain in parts of Wellington and Queenstown are likely to play a role whereas Christchurch and Hamilton are less likely to be affected by geographical constraints.[12] But at least in principle, tight geography would increase demand for *both* the intensive and extensive margin. So we are disinclined to attribute a large impact to geographic constraints.

3.3 Method 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 if land use regulation is driving up prices. If local areas can accommodate some demand, then we expect to see population density increase in highly sought-after areas and house prices to also reflect demand in these areas.

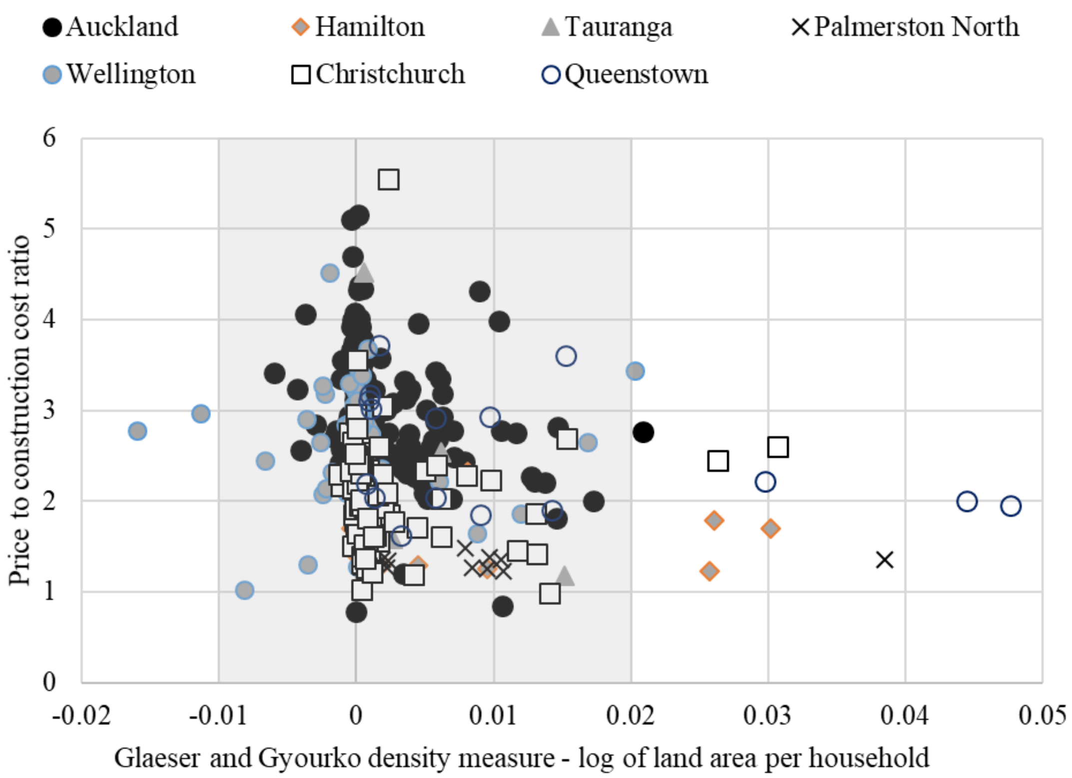
[12] Saiz (2010) documents the role of geography on land prices for US cities.

Areas where land use regulations are particularly restrictive might not accommodate any new residents and 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.

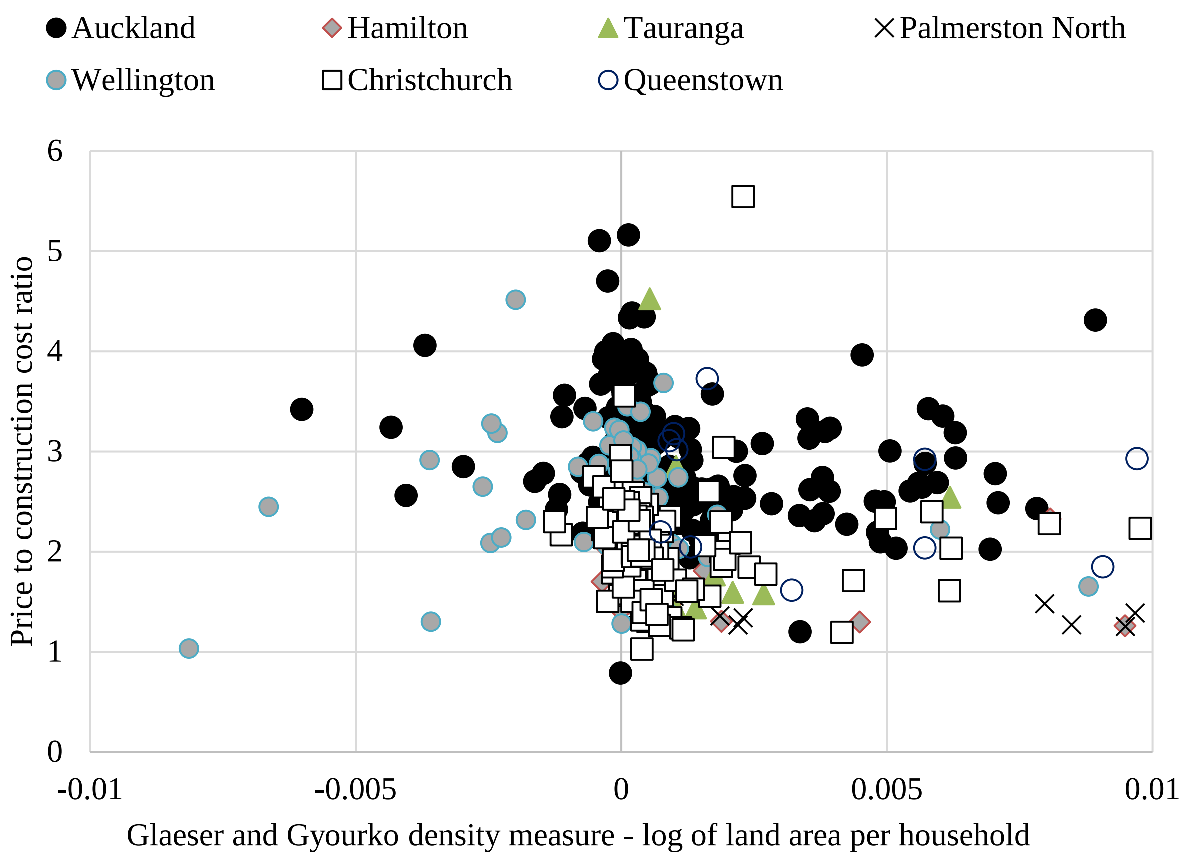
Figure 6 charts our density measure data at the suburb level (using Statistics New Zealand's area unit definitions) against the price-to-cost ratio at the area unit level by each of our key territory authorities. Since we conduct our regressions to test for the relationship between density and prices 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.

Figure 6: Glaeser-Gyourko (2003) density measure vs price-cost ratio by suburb, 2015



At least to us, we cannot see a clear relationship but there can be many factors that drive prices and density.[13] 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 contains low densities (to the right of the chart) some of which are associated with Queenstown-Lakes District that 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 light grey in Figure 6.

Figure 7: Density measure vs price-cost ratio by suburb, 2015 - subsample



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

We report our estimation results for each city and for the four regressions in Figure 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 indicating 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. And we know from Lees (2016) that existing Auckland suburbs outside the downtown area, have accommodated very few new residents between 1996 and 2013. We conclude there is in general only a weak relationship between density and prices, certainly much smaller than if the response to high demand is sufficiently flexible to encourage large inflows.[14,15]

[14] We also considered a subsample restricted to value 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.

[15] We also use an F-test to see if the density relationship is similar across each of our territory authorities, allowing for the intercept terms to vary but enforcing the slope coefficients to be identical across the territory authorities. For each of the four regressions we reject the idea that the density-price relationship is the same – cities respond differently to demand pressures.

Figure 8: Our regression results our mixed – supply response varies by city

City	Log land area per household	Log land area per household	Log land area per household	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	2.2099	2.2475	6.8778	5.6081
	(0.0405)	(0.0373)	(0.0000)	(0.0000)

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 to 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 that looks at dwellings.

Figure 9 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 like the ratio we observe for dwellings of 3.68. There does 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 are 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 (in orange) use construction cost estimates from QV cost builder that do not vary with the height of the apartment. 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 at higher floors are 21 percent higher than the cost of construction at lower levels.

To test the extent to which this might matter, we present results in Figure 9 that add 21 percent to construction costs of multi-storey apartments. These conservative estimates are depicted in grey and show similar profiles to our base case.[16]

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 information for planning purposes, particularly for periods when prices and construction costs move rapidly.

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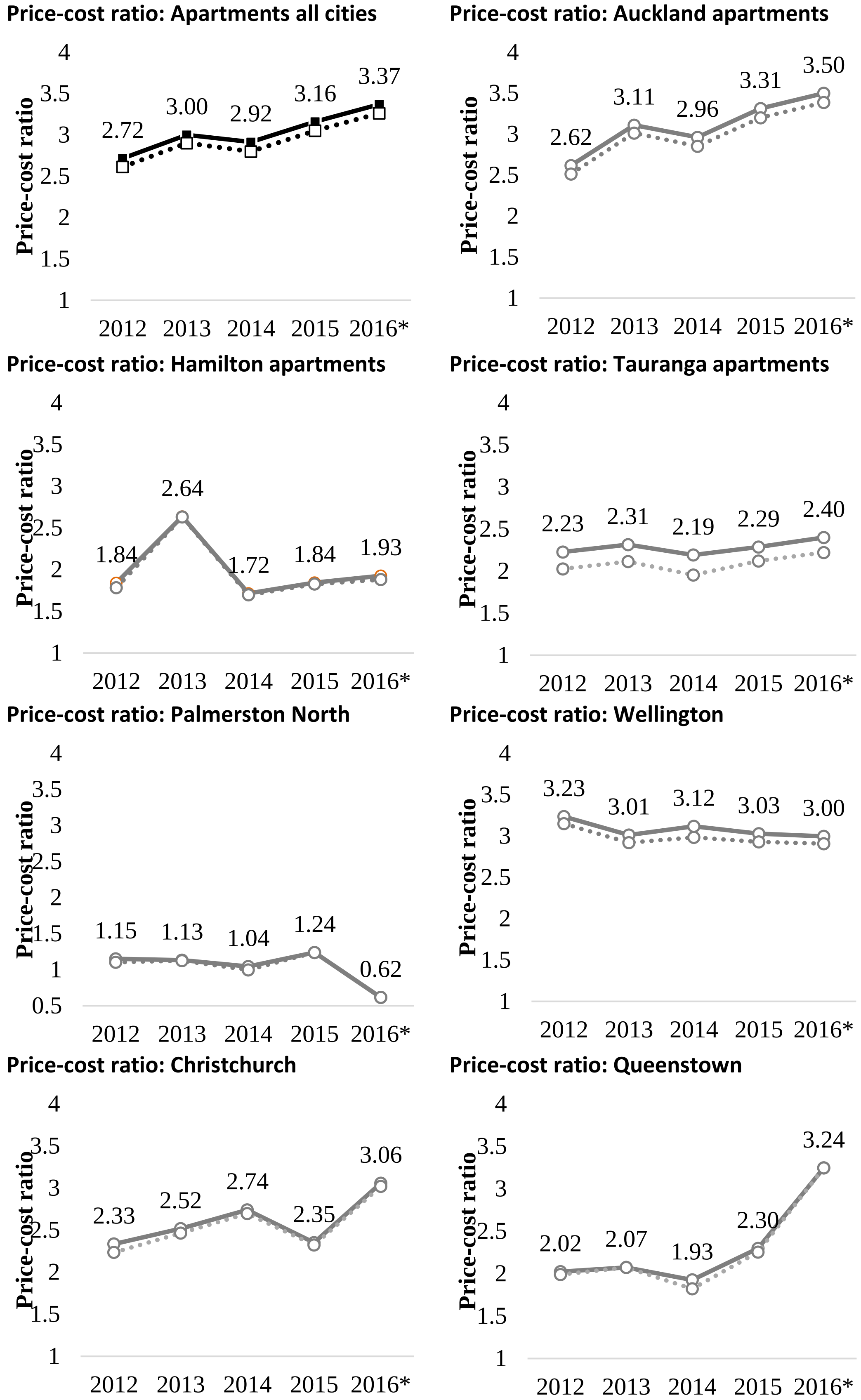
[16] Since some cities contain many townhouses and small apartments not affected by this adjustment, the difference from the baseline estimate to the conservative case is not uniform across the cities we study.

Figure 9: Apartments also suggest a gap between prices and construction costs



NB: Solid line denotes central estimate; dotted line denotes conservative cost estimate

4. Conclusion

The nature of land use regulation – that varies with complexity and intensity across a city – makes measuring the impacts at an aggregate level complex (see Figure 10). The four different methods we use to indicate the extent to which costly land use regulation might be present are all suggestive of potentially large impacts that make housing supply relatively unresponsive to increases in demand. That drives prices higher when confronted with additional demand for highly sought-after locations.

Figure 10: All four of our methods suggest impacts of land regulation on land markets

Method	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 regulation
Method 2	A wedge between intrinsic & extrinsic land prices could be land use regulation	Use hedonics for intensive land prices and then calculate extensive price	Extensive prices are 4-9 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 cities behave differently with no clear effect	Some locations allow growth but restrictions push demand to 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 regulation

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

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

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 like 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. Glaeser and Gyourko (2003)'s policy recommendation seems even more appropriate for many housing markets in New Zealand:

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

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Appendix 1

Figure A1: House sale price hedonic regressions, linear model selected cities, 2012-16.

Explanatory variable	Auckland	Hamilton	Tauranga	Palmerston	Wellington	Christchurch	Queenstown
Intercept	494,000	-280,900	479,100	-326,300	-256,400	-551,000	558,500
	(86,820)	(69,670)	(133,700)	(66,960)	(95,010)	(622,700)	(239,800)
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	292,000	216,700	274,900	369,200	365,200	294,600
		(14,520)	(22,220)	(23,340)	(30,750)	(24,870)	(41,100)
-3	n/a	378,200	282,900	354,600	503,500	457,100	355,400
		(14,370)	(21,480)	(23,240)	(30,490)	(24,800)	(39,590)
-4	n/a	433,000	374,200	405,600	611,200	533,600	479,300
		(14,450)	(21,620)	(23,270)	(30,510)	(24,920)	(39,770)
-5+	n/a	493,800	483,400	470,300	750,200	641,100	650,500
		(14,590)	(22,080)	(23,420)	(30,790)	(25,270)	(41,330)
Floor area per	n/a	3,640	5,737	3,703	7,287	5,403	7,868
bedroom		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	-2,143	8,558	25,800	15,560	13,710	25,880	63,690
	(3,081)	(1,447)	(2,766)	(1,950)	(7,982)	(2,902)	(11,810)
-Weatherboard	0	9,808	7,937	14,400	15,280	28,870	31,470
		(1,801)	(4,384)	(2,274)	(7,560)	(4,075)	(13,090)
Build condition							
-Fair	-51,230	-40370	-40510	-26280		2,361	
	(9,486)	(12270)	(38,970)	(35940)		(25,140)	
-Good	27,900	-588.7	55,550	29,390		-1,462	
	(3,189)	(10,560)	(34,110)	(35,430)		(23,440)	
-Mixed	-106,300	5,856	20,090	-106,400		-203,300	
	(13,020)	(18,380)	(44,930)	(39,760)		(24,450)	
-Poor	-106,300	-52,280	7,649	-20,460		-79,150	
	(13,020)	(23,600)	(34,490)	(39,310)		(308,30)	
Site contour							
- Easy fall/rise		157,100		-159,700			319,800
		(43,480)		(41,570)			(125,700)
- Level	6,603	151,900		-165,700	29,760		268,900
	(2,502)	(43,490)		(41,460)	(3,464)		(125500)
-Steep rise/fall	-25,660	148,200		-166,100	-39,330		366,600

Explanatory variable	Auckland	Hamilton	Tauranga	Palmerston	Wellington	Christchurch	Queenstown
	(5,260)	(43,630)		(42,480)	(3,910)		(126,500)
Weathertight?	n/a	-3,808	-2606	-4,185	-9,813	-3,901	-5,727
		(845.7)	(1,018)	(1,112)	(1,740)	(871.5)	(3,842)
Distance to CBD		-3,036	11,460		-27,320	-10,280	-10,840
		(1,723)	(1,864)		(3,714)	(1,300)	(1,794)
Half-year							
- 2012H2	26,170	7,186	11,710	5,910	12,780	6,822	57,790
	(4,731)	(1,944)	(4,253)	(2,299)	(5,013)	(2,008)	(12,220)
- 2013H1	71,660	17,910	18,960	9,005	29,070	17,010	28,950
	(4,731)	(2,196)	(4,706)	(2,584)	(5,356)	(2,274)	(13,350)
- 2013H2	116,600	27,510	29,340	12,740	28,370	25,220	79,990
	(4,749)	(2,045)	(4,373)	(2,402)	(5,198)	(2,116)	(12,690)
- 2014H1	146,900	33,650	54,110	16,170	49,820	31,970	101,800
	(4,841)	(2,506)	(5,031)	(2,956)	(6,053)	(2,594)	(14,070)
- 2014H2	195,600	51,270	74,890	20,030	36,060	50,610	139,700
	(4,744)	(2,211)	(4,507)	(2,603)	(5,616)	(2,289)	(13,470)
- 2015H1	288,600	58,440	96,590	19,320	56,910	57,740	196,500
	(4,628)	(2,617)	(5,408)	(3,178)	(6,933)	(2,705)	(14,690)
- 2015H2	371,200	113,900	158,200	34,850	73,660	113,000	227,600
	(4,726)	(2,188)	(4,637)	(2,744)	(6,144)	(2,258)	(14,150)
- 2016H1	434,500	201,900	267,000	55,520	150,400	200,100	440,600
	(4,894)	(2,658)	(5,510)	(2,980)	(7,030)	(2,750)	(15,760)
Build decade							
- 1900s		-445,200	0	10,170	-103,200	-415700	875,600
		(45,580)	(0)	(16,890)	(28,770)	(46,810)	(270,900)
- 1910s		-428,400	0	10,790	-110,800	-411,900	779,400
		(45,240)	(0)	(16,450)	(28,790)	(46,070)	(258,400)
- 1920s	-160,900	-464,600	2,435,000	24,980	-126,700	-425,200	981,400
	(8,780)	(45,150)	(1,039,000)	(16,220)	(28,730)	(45,910)	(255,600)
- 1930s	-220,400	-479,000	2,472,000	33,930	-152,300	-430,100	964,800
	(10,620)	(45,430)	(1,043,000)	(16,460)	(29,210)	(46,240)	(250,300)
- 1940s	-341,100	-469,000	2399000	11,340	-208,700	-431,800	678,700
	(9,711)	(45,690)	(1,048,000)	(16,520)	(29,540)	(46,330)	(253,200)
- 1950s	-450,400	-486,400	2,406,000	8,332	-212,600	-452,400	896,100
	(8,200)	(45,870)	(1,053,000)	(16,470)	(29,720)	(46,560)	(242,300)
- 1960s	-519,200	-487,500	2,426,000	20,210	-248,800	-461,400	910,000
	(7,959)	(46,100)	(1,058,000)	(16,560)	(30,020)	(46,800)	(242,900)

Explanatory variable	Auckland	Hamilton	Tauranga	Palmerston	Wellington	Christchurch	Queenstown
- 1970s	-558,800	-490,500	2,397,000	14,050	-28,8300	-467,700	8,171,00
	(8,158)	(46,320)	(1,063,000)	(16,720)	(30,560)	(47,020)	(243,800)
- 1980s	-556,600	-485,000	2,427,000	19,510	-257,900		796,200
	(8,466)	(46,580)	(1,068,000)	(16,930)	(31,170)		(245,100)
- 1990s	-565,500	-468,900	2,430,000	52,770	-259,500		808,900
	(8,441)	(46,892)	(1,074,000)	(17,210)	(32,110)		(246,500)
- 2000s	-537,400	-450,200	2,480,000	89,630	-195,700		879,900
	(8,420)	(47080)	(1,078,000)	(17,280)	(32,470)		(247,400)
- 2010s	-610,400	-510,200	2,342,000	39,960	-357,800		684,200
	(8,499)	(47,330)	(1,083,000)	(17,420)	(33,110)		(248,200)
Quality							
- A	164,800						
	(6,458)						
- B	54,120						
	(5,478)						
- No workshop	-58,380						
	(3,334)						
- No deck	-7,069						
	(2,495)						
Improvements	139,400						
	(3,777)						
Internal garages							
- 1	24,260						
	(4,036)						
- 2	-167,800						
	(4,627)						
- 3	-252,300						
	(10,350)						
- 4	-274,100						
	(26,620)						
- 5	-584,300						
	(63,850)						
More garage dummies	-433.5						
View dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AU dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Figure A2: House sale price hedonic regressions, log-log model selected NZ cities, 2012-16

Explanatory Variable	Auckland	Hamilton	Tauranga	Palmerston North	Wellington	Christchurch	Queenstown
Intercept	12.4784	11.4500	11.7800	10.5200	12.1100	10.0200	11.568
	(0.0985)	(0.1680)	(0.2367)	(0.1690)	(0.2393)	(0.0850)	(0.2440)
Land area	0.1332	0.1395	0.1759	0.1420	0.0474	0.1589	0.1060
	(0.0037)	(0.0056)	(0.0079)	(0.0060)	(0.0066)	(0.0083)	(0.0086)
Bedrooms							
-2		-0.0441	-0.1907	0.2410	0.1409	0.6391	0.3500
		(0.0483)	(0.0456)	(0.0680)	(0.0515)	(0.0460)	(0.0509)
-3		0.0527	-0.2048	0.2830	0.2356	0.8202	0.5173
		(0.0538)	(0.0571)	(0.0750)	(0.0570)	(0.0459)	(0.0491)
-4		0.0715	-0.2028	0.2590	0.2943	0.9684	0.6985
		(0.0589)	(0.0571)	(0.0820)	(0.0630)	(0.0462)	(0.0493)
-5+		0.0734	-0.2101	0.2330	0.3439	1.0940	0.8289
		(0.0638)	(0.0635)	(0.0880)	(0.0694)	(0.0469)	(0.0512)
Build decade							
- 1900s		-0.6092		-0.0250	-0.0299	0.0187	1.2431
		(0.1037)		(0.0419)	(0.0429)	(0.0258)	(0.3315)
- 1910s		-0.5923		0.0219	-0.0159	0.0201	1.1131
		(0.1029)		(0.0409)	(0.0430)	(0.0247)	(0.3167)
- 1920s	-0.1617	-0.6298	10.1500	0.0669	-0.0438	0.0550	1.4305
	(0.0097)	(0.1027)	(1.7590)	(0.0403)	(0.0427)	(0.0254)	(0.3135)
- 1930s	-0.2777	-0.6553	10.1300	0.0923	-0.0794	0.0702	1.3930
	(0.0117)	(0.1034)	(1.7650)	(0.0408)	(0.0432)	(0.0263)	(0.3068)
- 1940s	-0.4075	-0.6609	10.1800	0.0187	-0.1420	-0.0316	1.0740
	(0.0107)	(0.1040)	(1.7740)	(0.0410)	(0.0435)	(0.0259)	(0.3100)
- 1950s	-0.5415	-0.6988	10.1700	0.0055	-0.1614	-0.0127	1.2397
	(0.0090)	(0.1044)	(1.7820)	(0.0409)	(0.0436)	(0.0253)	(0.2970)
- 1960s	-0.6269	-0.7008	10.2200	0.0522	-0.1947	0.0335	1.1696
	(0.0088)	(0.1049)	(1.7910)	(0.0411)	(0.0437)	(0.0257)	(0.2973)
- 1970s	-0.6830	-0.6934	10.2000	0.0368	-0.2295	0.0163	1.0986
	(0.0092)	(0.1054)	(1.7990)	(0.0415)	(0.0442)	(0.0263)	(0.2984)
- 1980s	-0.6808	-0.6788	10.2600	0.0623	-0.1798	0.0392	1.0932
	(0.0093)	(0.1060)	(1.8080)	(0.0420)	(0.0447)	(0.0270)	(0.2999)
- 1990s	-0.6458	-0.6292	10.3200	0.1390	-0.1620	0.0979	1.1034
	(0.0093)	(0.1067)	(1.8180)	(0.0427)	(0.0456)	(0.0277)	(0.3016)
- 2000s	-0.5510	-0.6066	10.4500	0.2045	-0.0655	0.1902	1.1897
	(0.0093)	(0.1072)	(1.8260)	(0.0429)	(0.0457)	(0.0269)	(0.3028)
- 2010s	-0.5773	-0.8086	10.0500	0.0145	-0.3848	-0.1795	0.6635
	(0.0094)	(0.1077)	(1.8330)	(0.0432)	(0.0462)	(0.0265)	(0.3038)
Construction							
– Other	0.0489	-0.0047	0.0087	0.0203	0.0069	0.0165	0.0446
	(0.0034)	(0.0033)	(0.0047)	(0.0049)	(0.0111)	(0.0054)	(0.0145)
Weatherboard	0.0592	0.0017	-0.0141	0.0226	0.0367	0.0280	-0.0111
	(0.0037)	(0.0041)	(0.0074)	(0.0057)	(0.0106)	(0.0075)	(0.0160)

Explanatory Variable	Auckland	Hamilton	Tauranga	Palmerston North	Wellington	Christchurch	Queenstown
Building con.							
- Average	-0.0390	-0.0333	-0.0584	0.0260		-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		0.0300	0.1532
	(0.0035)	(0.0240)	(0.0573)	(0.0879)		(0.0434)	(0.1303)
- Mixed		0.0233	-0.1183	-0.2230		-0.5223	0.1051
		(0.0418)	(0.0755)	(0.0988)		(0.0452)	(0.1820)
- Poor	-0.0679	-0.3116	-0.0874	-0.2188		-0.2735	0.3743
	(0.0105)	(0.0537)	(0.0579)	(0.0975)		(0.0570)	(0.2700)
Watertight indicator		-0.0046	-0.0500	-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	0.0200		0.0735		-0.0055
		(0.0107)	(0.0086)		(0.0128)		(0.0015)
Distance to CBD^2		0.0033	0.0001		-0.0040		
		(0.0011)	(0.0005)		(0.0008)		
Half-year							
- 2012H2	0.0402	0.0148	0.0176	0.0375	0.0220	0.0576	0.0473
	(0.0052)	(0.0044)	(0.0072)	(0.0060)	(0.0070)	(0.0064)	(0.0149)
- 2013H1	0.1132	0.0443	0.0393	0.0241	0.0411	0.1002	0.0519
	(0.0051)	(0.0050)	(0.0079)	(0.0057)	(0.0075)	(0.0080)	(0.0163)
- 2013H2	0.1830	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)	(0.0060)	(0.0084)	(0.0112)	(0.0173)
- 2014H2	0.2965	0.1232	0.1537	0.0600	0.0563	0.2977	0.2350
	(0.0052)	(0.0050)	(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)	(0.0060)	(0.0091)	(0.0079)	(0.0097)	(0.0121)	(0.0180)
- 2015H2	0.5088	0.2712	0.3360	0.0973	0.1351	0.4286	0.3590
	(0.0052	(0.0050)	(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)
r^2-adjusted	0.6079	0.6618	0.5753	0.7085	0.6167	0.5124	0.5527