

# THE IMPACT OF LAND-USE REGULATION ON HOUSING SUPPLY IN CANADA

Kenneth P. Green, Josef Filipowicz, Steve Lafleur and Ian Herzog





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## Executive Summary

As Canadians continue to converge on urban centres and concerns about the affordability of housing grow, it is crucial to understand why the country's major housing markets have seen such dramatic growth in prices. This study presents evidence that the regulation of residential development restricts the housing supply, encouraging the growth of prices and distorting local economies.

Growing demand for homes in a region is generally followed by growing home prices and a growing housing stock, but the balance between these two outcomes depends on the structure of the housing supply. Markets with a responsive housing supply tend to address demand with the construction of new homes, while less responsive supply leads to a rise in prices. This study's empirical analysis suggests that costly and challenging land-use regulations have made the housing supply less responsive to demand in Canada's urban centers.

The study compares growth of housing stock between 2006 and 2011 with five measures of land-use regulation—approval timelines, timeline uncertainty, council and community impacts, costs and fees, and the prevalence of rezoning—as well as a summary index of these measures. More regulated districts tend to grow less, even after accounting for a range of other factors like geographical constraints and transportation. In particular, increasing the average approval timeline for residential development by six months is associated with a decrease in growth of 3.7 percentage points—equivalent to halving growth of the average neighbourhood in our data.

Direct estimates of regulation's effect on the housing supply suggest that long and uncertain project-approval timelines are particularly detrimental to supply's responsiveness to demand. In fact, the data suggest that moving from the average city's approval timelines or perceived timeline uncertainty to a higher level (one standard deviation above average) is sufficient to mute completely the responsiveness of the housing supply to demand in desirable neighbourhoods. Opposition from council and community groups also substantially reduces the housing supply's ability to respond to growing demand. On the other hand, high costs and fees and how frequently municipalities require rezoning appear to have less direct effect on the housing market's tendency to respond to demand with new supply.

The study concludes by assessing how growth might have been distributed across each of metropolitan Toronto, Vancouver, and Calgary if regulation did not affect where housing gets built. Best estimates suggest that differences in municipal land-use regulations within these regions encouraged growth to occur farther

from metropolitan cores, increasing urban sprawl. This effect is particularly stark in Greater Calgary, where less stringent regulation in Rocky View County (which surrounds Calgary) would have driven new home building closer to the region's core—instead growth has leapfrogged over Rocky View to more distant municipalities. Under harmonized regulations, Greater Toronto would have had additional growth along the central Yonge Street corridor, which has transit access to Canada's largest downtown. Finally, the study estimates that, if the city of Vancouver were regulated similarly to its suburbs, it might have seen additional growth in its highly desirable downtown and west-side neighbourhoods.

The negative relationship between regulation and the growth of housing stock found in this study has important implications for policy makers. First, greater regulation is associated with lower growth in an average neighbourhood even after accounting for differences in labour-market conditions, access to transportation, key demographics, and the availability of land. Finding this relationship across similar neighbourhoods in nearby municipalities shows that it is robust, and difficult to explain by other factors. Second, the relationship is a standard feature of modern housing markets: prior work has found a negative correlation between growth and regulation across the United States and this study demonstrates the same trend in a broad cross-section of Canadian cities. These results suggest that having the right regulatory framework is crucial for encouraging the supply of available and affordable housing in Canada's growing metropolitan areas.



# 1 Introduction

Canada's metropolitan areas are critical to the national economy. They represent almost three quarters of Canadian gross domestic product and have grown in population by almost 15% from 2004 to 2014, compared to the national rate of population growth of just over 11% (Statistics Canada, 2015a; 2015b). As cities continue drawing newcomers, it is essential that the housing stock grow. Potential consequences of a stagnant housing stock include rising home prices and foregone economic activity (Saks, 2008). Of course, some urban constraints are natural, such as geographic features including mountains and bodies of water. But regulatory features such as restrictive zoning and a costly approval process for building permits also impose constraints to new housing development. In this study, we examine the impact of residential land-use regulation on housing growth in Canada's largest metropolitan areas.

Firms and workers see many benefits from a location in major metropolitan areas. Big cities offer large talent pools, networks of interconnected firms sharing suppliers and ideas, and diverse markets where unique businesses can thrive (Rosenthal and Strange, 2004). These factors tend to increase both productivity and competition, leading to higher wages for workers of all skill levels (Statistics Canada, 2012; Moretti, 2004a). These dynamics attach substantial benefits to allowing more people to move to a city, who in turn add to the city's economic potential.

The benefits of cities largely depend on their openness to newcomers, which in turn depends on the availability of housing. Where the number of new homes supplied is less responsive to demand, home prices and rents tend to rise, dampening the benefits of higher incomes and productivity in an urban center (Saks, 2008). Public policy plays a role in this dynamic. There is evidence from the United States that regulation creates a wedge between home prices and physical construction costs, especially in highly productive urban areas like Manhattan and Silicon Valley (Glaeser and Gyourko, 2003).

A growing body of research documents regulation's role in determining outcomes in American housing markets. Californian cities with more stringent land-use regulations tend to see higher home prices, and less new home construction (Quigley and Raphael, 2005; Jackson, 2016). A similar connection between regulation and decreased construction was found in Greater Boston (Glaeser and Ward, 2009). These findings underline the costs of land-use regulation, which include uncertainty and delays in obtaining development approval, especially in economically productive regions.

In this publication, we describe the economic impacts of urban constraints and land-use regulations in Canadian cities. Using data describing regulatory processes in a cross-section of Canadian municipalities, we find that more highly regulated cities tend to have less growth in housing stock. We then compare census tracts within municipalities to adjust for local factors influencing growth, and find a robust negative relationship between regulation and the housing supply. Our analysis has some minor limitations [1] but our findings have profound implications for local policy makers. Local housing supply appears to contract substantially with increases in approval timelines for residential development, timeline uncertainty, regulatory costs and fees, and council and community opposition to new homes, but the prevalence of rezoning appears to have relatively little impact on growth. Further analysis shows that long and uncertain approval processes make the amount of housing supplied less responsive to demand.

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[1] It is important to note that we make no attempt to measure regulation's benefits. Surely, land-use regulations are intended to correct externalities, manage infrastructure, and generally serve community interests, but these effects are beyond the scope of our work, and have proved difficult to quantify (Turner, Haughwout, and van der Klaauw, 2014). We partially address this shortcoming by focusing on measures of regulation that are less likely to directly benefit communities: specifically, approval timelines and their uncertainty. We also acknowledge that unexpected demand for growth might overwhelm a poorly equipped city planning department, eroding the expediency with which development applications are processed. This possibility might complicate the relationship between regulation and growth, and is among many aspects of this relationship that unfortunately lie outside the scope of our current work.

## 2 Housing in Urban Economies

The extent to which growing demand drives up home prices depends on the housing supply. Housing prices will grow when building costs [2] increase with city size, or when geographic and policy constraints make buildable land, short commutes, or nice views more scarce.

In Canada's largest urban centers, home prices reflect land availability, building costs, neighbourhood features, and demand within the region. Within a metropolitan region, differences in housing prices can often be explained by differences in quality, transportation costs, and amenities (see Glaeser and Ward, 2009 for an example in greater Boston). If homebuilders could respond to growing demand by continuously building identical homes, competition among sellers would force both resale and new home prices nearer to costs. This intuition tends to describe reality accurately in many parts of the United States, although homes in a number of American metropolitan areas—particularly those in California—are known frequently to exceed physical construction costs by a wide margin (Glaeser and Gyourko, 2003).

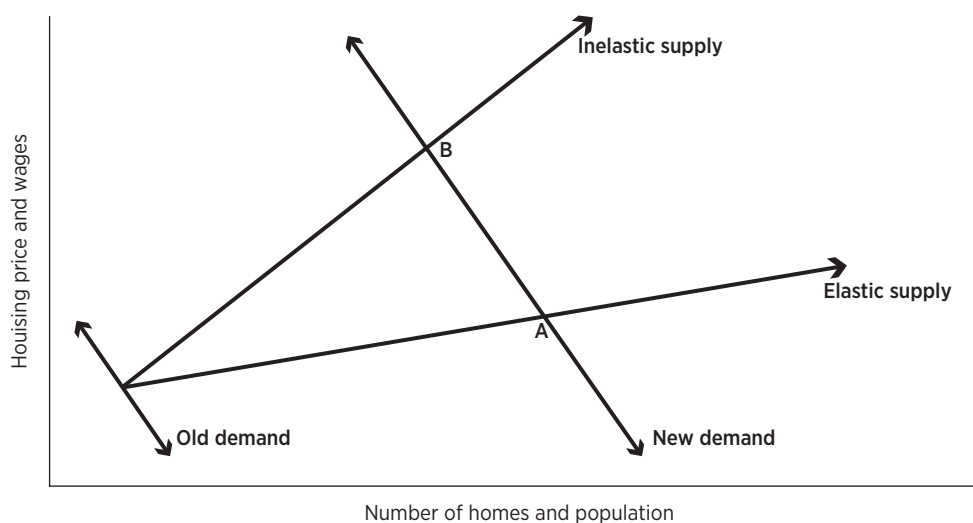
The local housing supply's ability to respond to price increases with the provision of new homes is typically summarized by a measure known as the price elasticity of the housing supply. Elastic housing supply refers to markets where any change in housing prices results in a swift increase in construction; this scenario best describes places without severe physical or policy constraints making new homes difficult to bring to market. Conversely, inelastic supply refers to markets where new construction is less responsive to price changes, a common feature of municipalities facing physical barriers or prohibitive land-use regulations.

**Figure 1** (taken from Glaeser, Gyourko, and Saks, 2006) outlines the implications of altering the elasticity of the housing supply in a region with growing housing demand. With an elastic housing supply, developers respond to growing demand by offering a steady stream of new homes. The result is limited growth in housing prices as demand increases (point A, figure 1). If the housing supply is inelastic, a lack of new building results in housing prices being bid up as demand shifts. The clearest examples of inelastic supply leading to rapid appreciation in housing prices are found in high productivity (and, by proxy, high demand) urban

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[2] In this context, building costs refer to the marginal cost of providing housing of a consistent quality. These costs are a function of many factors, including the costs of land, financing, construction materials, and labour.

Figure 1: The nature of housing supply and the impacts of demand shocks



Source: Glaeser, Gyourko, and Saks, 2006: 31. Reproduced by permission.

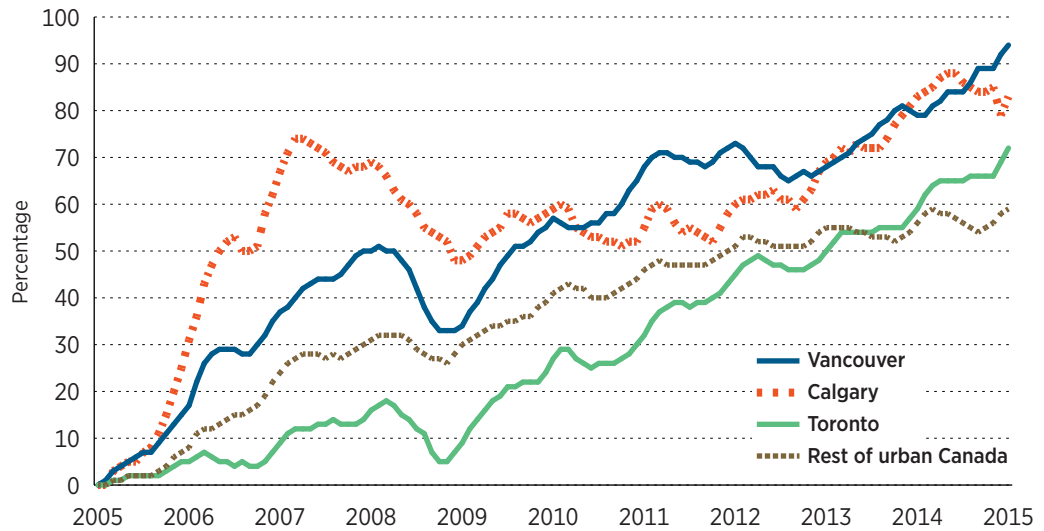
regions such as New York and Silicon Valley, which create many high-wage jobs but have highly constrained housing markets. In such markets, growth in wages is largely offset by increasing housing costs [3] (point B, figure 1).

Similarly, housing in many of Canada's major cities is in high demand, and recent growth in house prices suggests that this demand has met a relatively inelastic supply. Figure 2 shows that the growth in house prices in each of Toronto, Vancouver, and Calgary exceeded that in Canada's other major metropolitan areas between 2005 and 2015. Only Toronto's housing prices grew slower than the rest of urban Canada in the first half of this period, but price growth increased in Toronto after 2009.

Young and educated people are especially likely to migrate to urban areas (Statistics Canada, 2009) and tend to achieve a substantial earnings premium as a result (Statistics Canada, 2012). Toronto offers a particularly productive labour market. Metropolitan Toronto generates a larger earnings premium than other large Canadian urban areas, and young degree holders accounted for a substantial portion of net migration to Toronto in the mid-2000s (Statistics Canada, 2012). While there is less research focusing on other urban areas, there is good reason to believe that those with growing housing prices are in high demand. For example,

[3] In fact, Hornbeck and Moretti (2015) find that improvements in manufacturing productivity tend to increase both wages and housing costs most in cities with the least elastic housing supply, but the impact on real wages (which are adjusted for housing costs) is relatively constant across the United States.

Figure 2: Growth (%) of housing prices in Canada's metropolitan areas, 2005–2015



Note: The eight-city composite index shown here as 'Rest of urban Canada' combines price growth in Victoria, Edmonton, Quebec, Winnipeg, Ottawa-Gatineau, Halifax, Hamilton, and Montreal. Weights are adopted from Teranet's 11-city composite index, which is weighted based on total metropolitan dwelling value in the 2006 census.

Sources: Teranet, 2016; authors' calculations.

Vancouver's natural amenities and mild climate make it particularly desirable to many, and the city attracts significant interest from foreign property investors (Yan, 2015). These observations are consistent with the theory illustrated in figure 1: Canada's largest urban areas are generally productive, or offer desirable amenities, driving growing housing demand that has been met with a relatively inelastic supply.

Housing supply elasticities vary substantially across cities. Albert Saiz (2010) constructed estimates of long-run housing-supply elasticities for American metropolitan areas, highlighting the importance of geography in shaping regional growth. At the metropolitan level, physical and regulatory barriers are key factors determining the housing supply. The amount of land left virtually undevelopable by steep slopes, water cover, and wetlands is inversely related to a region's housing supply elasticity. Government policies that restrict urbanization or add costs to residential development are also associated with an inelastic housing supply.

### 3 Measuring Land-Use Regulation and the Housing Supply

To assess how land-use regulation affects the housing supply empirically, we have collected a novel data set describing regulation, physical constraints, urban amenities, and demographic characteristics of census tracts [4] conforming to municipal boundaries in largest metropolitan areas. Census tracts generally fall within municipal boundaries, so the extent of our sample is decided by the availability of regulation data. At a minimum, our summary index of regulation covers 48 municipalities (containing 2,828 tracts), while our most widespread measures of regulation—rezoning prevalence, approval timelines, and timeline uncertainty—cover 68, 65, and 63 municipalities respectively. [5] In this section, we describe our measures of regulation and the housing supply; descriptions of other data used in this report are in [Appendix A](#).

Our primary outcome variable is the percentage change in the housing stock from 2006 to 2011. Since housing stock data are obtained from the short-form census, 2006 to 2011 is the most recent period over which stock growth can be calculated. We use short-form census data to construct total dwelling counts for 2011 (the most comprehensive measure of the housing stock available) by 2006 census-tract boundaries [6] and restrict our sample to tracts that were populated

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[4] Census tracts are neighbourhood pieces of metropolitan centers that Statistics Canada defines in consultation with local experts. Statistics Canada publishes detailed statistical profiles of census tracts using data from each census.

[5] Empirical analysis of each measure of regulation is based on a slightly different sample defined by data availability. All empirical results in section 4 are presented alongside simple summary statistics of the sample from which they are drawn. The sample of places where the composite regulation index is measured is the intersection of the samples covered by all other regulation measures, hence the relatively limited geographic extent of the regulation index.

[6] Census tracts generally have consistent boundaries, but some tracts are divided into several smaller tracts over time. We use correspondence tables and GIS maps to adjust 2011 dwelling counts to match 2006 census-tract boundaries so that stock growth can be calculated accurately. Additionally, Statistics Canada makes 2006 population counts publicly available for 2011 census-tract boundaries. We use these data to test for the possibility of error in measuring growth due to errors adjusting census-tract boundaries. To avoid measurement error, we dropped 30 tracts for which our new 2006 population estimates were off by more than 100 people.

in 2006. [7] Finally, to ensure that our results are unaffected by outliers, we drop tracts in the top 0.5% of the growth distribution. [8] Growth of housing stock at the city level and physical constraints (which are described in the Appendix A) are aggregated up from census tracts to ensure consistent city boundaries over time.

Our measure of land-use regulation is derived from a 2014 survey of homebuilders and residential developers (Green, Herzog, and Filipowicz, 2015a, 2015b, 2015c). Survey respondents were asked to describe all municipalities they have worked in over the past ten years, with most respondents filling out the survey for multiple municipalities. The resulting data are municipal averages of responses to questions about residential development’s approval timelines, timeline uncertainty, compliance costs and fees, council and community opposition to development, and rezoning frequency (table 1 describes these data in detail). We produce a summary index of regulation, equal to the standardized sum of these five individual measures of regulation, scaled to have a mean of zero and standard deviation of one across the 48 cities in our sample. [9]

**Table 1: Measures of residential land-use regulation**

Approval timelines	Time from the filing date of the first stage of the approval process to the day construction is allowed to commence for typical residential development (months).
Cost and fees	Regulatory compliance costs and fees accrued per dwelling unit built (thousands of dollars).
Council and community	The effect of local council and community groups on residential development (1 to 5 scale where 1 = encourages development and 5 = would not pursue development due to this factor).
Timeline uncertainty	The effect of uncertainty in approval timelines on residential development (1 to 5 scale where 1 = encourages development and 5 = would not pursue development due to this factor).
Rezoning prevalence	The percentage of residential development projects that require rezoning approval (0% to 100%).

Source: Green, Herzog, Filipowicz, 2015a, 2015b, 2015c.

[7] We require that tracts have a non-zero private dwelling stock in 2006: 19 of 4,495 matched tracts were dropped because they were uninhabited in 2006.

[8] In total, 16 outliers were trimmed. The housing stock in each of these outliers grew by more than 130% between 2006 and 2011. There were no equivalent outliers showing negative growth.

[9] While the index of regulation employed in this study is constructed using similar methods to those presented by Green, Herzog, and Filipowicz (2015a, 2015b, 2015c), there are some differences that arise from computing a standardized sum across Canada rather than within regions as was previously done.



Our data can be thought of as describing the short-term growth in housing stock in census tracts in Canada’s largest urban areas, demographic and physical characteristics of these tracts that predict this growth, and the regulatory burdens of the municipalities in which the tracts lie. The extent of the data is limited by our measures of land-use regulation. Our summary index of regulation covers 48 municipalities, including 18 out of Canada’s 25 largest, representing almost two thirds of Canada’s urban population, and over 40% of the national population in 2006. Finally, we assign census tracts to municipal boundaries and restrict our sample to tracts that have at least 90% of their land area within a single municipality. [10] **Table 2** gives summary statistics of growth in dwelling stock, broken down by our regulation index, in tracts for which all five measures of regulation are available.

**Table 2: Dwelling stock growth in census tracts by municipal land use regulation**

	Less regulated	Average regulation	More regulated	Full sample
mean	6.86%	6.99%	5.59%	6.37%
standard deviation	15.43	14.86	14.35	14.83
number of tracts	996	704	1,159	2,859

Note: Less regulated refers to the 16 cities in the bottom third of the regulation distribution (reg < -0.44), average regulation refers to the middle third of the distribution, and more regulated refers to the 16 cities in the top third of the regulation distribution (reg ≥ 0.42).

Source: Statistics Canada, 2006a, 2011b; authors’ calculations.

It is also important to note that our measures of land-use regulation were produced in 2014, while the latest census only measures growth from 2006 to 2011. However, the survey of regulations directed respondents to consider their recent experience with project types [11] that they had pursued within ten years. Since

[10] City boundaries are defined by census subdivisions in the 2011 census. 2006 census tracts are matched to 2011 census subdivisions using Graphical Information System (GIS) data provided by Statistics Canada. In the entire universe of 2006 census tracts (not just those within our study area), roughly 1% of tracts do not have 90% of their land area within a single city and 97% of tracts have less than 1% of their land area outside of their assigned city (91% of tracts conform perfectly to city boundaries). There are three greater Calgary municipalities—Chestermere, Okotoks, and Strathmore—for which we have collected regulation data that are omitted from our sample since they cannot be captured by 2006 census tracts.

[11] Project types include single-family and multiple-dwelling development.

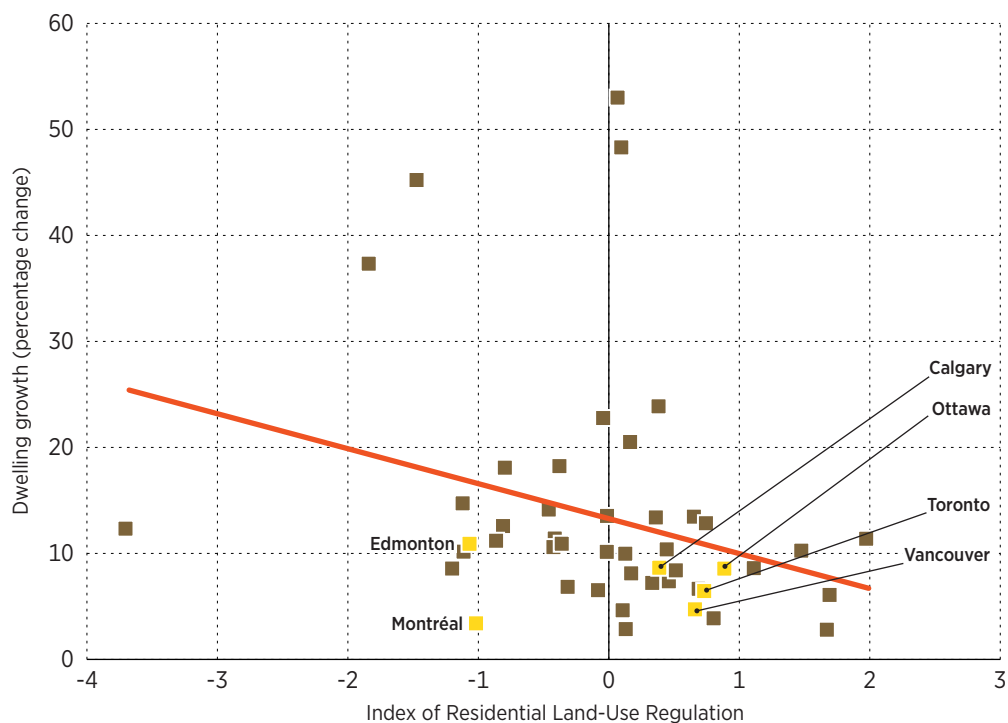


all cities in our regulation data are described by multiple survey respondents, the resulting measures of regulation data most likely capture experiences with regulators that occurred between 2004 and 2014, with more weight on latter years. In practice, measuring regulation and growth at different times tends not to create empirical inconsistencies. For example, Saiz (2010) uses regulation data collected in 2005 to explain housing supply elasticities, which he estimates using US census data spanning the period from 1970 to 2000.

## 4 Evidence of Regulation's Impact on the Housing Supply

In Canada, the fastest growing municipalities tend to be those with the least demanding land-use regulations. **Figure 3** presents the relationship between growth in dwelling stock and the summary index of regulation. These data reveal that land-use regulations vary substantially across Canada, and that cities with the lowest regulatory costs tend to have the most rapid growth in dwelling stock. Indeed, the linear trend [12] between growth and regulation pairs an average of three percentage-point slower growth with each point of increase in the regulation index.

**Figure 3: Growth of dwelling stock (percentage change from 2006 to 2011) and regulation**



Note: Growth in dwelling stock is aggregated up from tract level data. This ensures consistency in geographical boundaries.

Sources: Green, Herzog, Filipowicz, 2015a, 2015b, 2015c; Statistics Canada, 2006a, 2006b, 2011a, 2011c, 2011e; authors' calculations.

[12] The linear trend shown in figure 3 was produced by ordinary least squares, has an R-squared of 0.076, and a slope of  $-3.06$  with a standard error of 1.58.

**Table 3: Regulation's average effect on dwelling growth**

Dependent variable: dwelling stock growth (2006 to 2011)

Measure of regulation	(1) Regulation index	(2) Costs and fees	(3) Approval timelines	(4) Timeline uncertainty	(5) Council and community	(6) Rezoning prevalence
Effect on dwelling growth	-2.501*** (0.917)	-0.179*** (0.0595)	-0.610*** (0.186)	-3.443** (1.391)	-3.336** (1.278)	-0.00625 (0.0507)
R <sup>2</sup>	0.193	0.197	0.191	0.193	0.193	0.182
Number of census tracts	2828	2933	3034	3018	2961	3029
Number of cities	48	57	65	63	58	68
Mean of stock growth	6.37	6.51	6.60	6.54	6.48	6.66
Standard deviation of stock growth	14.87	14.85	14.90	14.89	14.79	14.94
Mean of regulation	0	30.89	13.55	2.810	2.750	59.62
Standard deviation of regulation	1	15.81	5.130	0.590	0.580	18.11

Notes: Each column corresponds to an OLS regression described by equation [1] in Appendix B with standard errors clustered by municipality in parenthesis. All regressions include CMA fixed effects, home ownership rate, share of working-age population with post-secondary education,  $\ln(\text{land area})$ , indicators for more than 5% of tract area physically undevelopable, indicators for rapid transit within 3 km interacted with above median transit use for both local and commuter transit  $\ln(\text{dwelling density})$ ,  $\ln(\text{dist to CBD})$ ,  $\ln(\text{dist to CBD})^2$ , share of population older than 40, and speaking non-official language at home. \*  $p < 0.10$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

Source: Green, Herzog, Filipowicz, 2015a, 2015b, 2015c; Statistics Canada, 2006a, 2006b, 2011a, 2011c, 2011e; Natural Resources Canada, 2016; authors' calculations. Transit stations were located using General Transit Feed Specification files from the websites of TransLink (for the Greater Vancouver), Calgary Transit, Edmonton Transit System, Toronto Transit Commission, Metrolinx (for the Greater Toronto), OC Transpo (for Ottawa), *Société de transport de Montréal*, and *Agence métropolitaine de transport* (for Greater Montreal).

To estimate regulation's average effect on growth more accurately, we disaggregate our sample into census tracts and run linear regressions of growth on regulation and a suite of tract-level controls (described in [Appendix B](#)). In total, we have run six regressions, each using a different measure of regulation and the same set of controls (the number of observations underlying each estimate depends on the number of cities in which each measure of regulation is measured). [Table 3](#) presents our estimates of regulation's average effect on dwelling stock growth, holding constant other factors affecting the supply and demand for housing (each column represents a distinct regression of growth on a regulation measure and controls). First, we associate an average of 2.5 percentage points less dwelling growth with an increase of one standard deviation in our composite measure of regulation; this decline represents more than a third of the growth seen at the sample average. Disaggregating our measure of regulation, we see that approval timelines are a particularly important determinant of dwelling

growth. A six-month increase in approval timelines is associated with a decrease of 3.7 percentage points in growth—well over half of the sample average growth.

We continue by constructing a simplified model of the housing supply, based on the theory outlined in section 3. To this end, we develop a reduced form of the supply function for housing, which resembles that used by Glaeser, Gyourko, and Saks (2006). Like that study, we use the proportion of the adult population in a census tract with at least a bachelor's degree in 2006 as a neighbourhood-level predictor of housing demand. We diverge from Glaeser, Gyourko, and Saks (2006) by focusing on differences in growth among small areas within a labour market. Glaeser and Saiz (2004) argue that variation in educational achievement at a hyper-local level predicts housing demand by reflecting cultural amenities associated with neighbourhoods in which educated people live. In short, the supply model allows our measure of demand to interact with regulation to produce our most reliable estimates of regulation's impact on the housing supply (this model is discussed in detail in Appendix B).

Column 1 of [table 4](#) indicates that an increase of ten percentage points in the share of adults with post-secondary education leads to an increase of 0.67 of a percentage point in dwelling stock growth when the regulation index is set at its average. Further, this model suggests that, when the regulation index increases by one standard deviation, the same increase in demand drives only a 0.10 percentage-point increase in the the growth of housing stock. Columns 3 and 4 suggest that an increase of one standard deviation in the length of approval timelines or their uncertainty almost completely mutes the responsiveness of the supply to demand proxied by a concentration of highly educated residents. A similar shift in council and community opposition reduces our estimate of supply responsiveness to a fifth of its size in the average tract. Supply responsiveness with strong council and community opposition is statistically indistinguishable from zero at standard levels of confidence. Finally, rezoning prevalence and costs and fees have no notable effects on supply responsiveness.

Interestingly, the supply model suggests that regulatory costs and fees have a negligible impact on the housing supply's response to demand, despite the negative relationship between growth and regulatory costs demonstrated in [table 3](#). This null effect might be explained by a tendency for the monetary costs that developers incur to directly benefit neighbourhoods—particularly those with high educational attainment—increasing housing demand and counteracting the negative impact on supply responsiveness. [\[13\]](#)

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[\[13\]](#) If regulatory costs and fees fund useful amenities or infrastructure, the increased costs to developers may be partially offset by increased willingness to pay among highly educated people. This explanation is reconcilable with the prior finding that tracts in cities with higher

**Table 4: The effect of regulation on housing supply responsiveness**

Dependent variable: dwelling stock growth (2006 to 2011)

Measure of regulation:	(1) Regulation index	(2) Costs and fees	(3) Approval timelines	(4) Timeline uncertainty	(5) Council and community	(6) Rezoning prevalence
Bachelor's degree or more (% of adults)	0.0674* (0.0369)	0.0594** (0.0224)	0.0924** (0.0373)	0.0927*** (0.0313)	0.0927*** (0.0284)	0.0579** (0.0230)
Regulation * bachelor's degree or more	-0.0580* (0.0319)	0.000390 (0.00186)	-0.0190** (0.00804)	-0.165*** (0.0371)	-0.129*** (0.0376)	-0.000317 (0.00172)
Supply responsiveness with regulation one standard deviation above average	.0095 (.035)	.0656** (.0305)	-.0053 (.031)	-.0047 (.0267)	.0181 (.0303)	.0521 (.0363)
R <sup>2</sup>	0.130	0.134	0.128	0.137	0.136	0.126
Number of census tracts	2828	2933	3034	3018	2961	3029
Number of cities	48	57	65	63	58	68

Notes: Each column corresponds to an OLS regression described by equation [2] in Appendix B with standard errors clustered by municipality in parenthesis. All regressions include CMA fixed effects, home ownership rate, share of adults with post-secondary education,  $\ln(\text{land area})$ ,  $\ln(\text{dwelling density})$ , indicators for more than 5% of tract area physically undevelopable, indicators for rapid transit within 3 km interacted with above median transit use for both local and commuter transit,  $\ln(\text{metres to centrepoint})$ , and  $\ln(\text{metres to centrepoint})^2$ . Supply responsiveness with regulation at one standard deviation above average is calculated as the sum of coefficients shown, with the regulation coefficient multiplied by regulation's cross-city standard deviation (all measures of regulation are centered to have zero mean). Rounding may prevent coefficients shown from adding up to supply responsiveness estimates. \*  $p < 0.10$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

Source: Green, Herzog, Filipowicz, 2015a, 2015b, 2015c; Statistics Canada, 2006a, 2006b, 2011a, 2011c, 2011e; Natural Resources Canada, 2016; authors' calculations. Transit stations were located using General Transit Feed Specification files from the websites of TransLink (for the Greater Vancouver), Calgary Transit, Edmonton Transit System, Toronto Transit Commission, Metrolinx (for the Greater Toronto), OC Transpo (for Ottawa), *Société de transport de Montréal*, and *Agence métropolitaine de transport* (for Greater Montreal).

**Appendix C** discusses our results further, and demonstrates that they are robust to allowing the responsiveness of the housing supply to depend on geography as well as regulation.

costs and fees tend to grow less, holding other factors equal (see table 4). New households that are attracted to a neighbourhood by amenities associated with well-educated neighbours may place a particularly high value on public amenities provided through developer fees. Further, if these newcomers are also well educated, they may be more likely to have rational expectations about lower property taxes that can follow if developers incur costs that the city would otherwise absorb. Since these proposed explanations are specific to demand associated with education levels in the existing neighbourhood, they may not affect results presented in table 3.

## 5 Regulation's Impact on Housing Supply and Urban Growth

Our econometric results suggest that many places in Canada would have seen substantial increases in the growth of dwelling stock over the late 2000s if land-use regulations were looser and less costly. To clarify the implications of these results, we use regression estimates to simulate how growth would have shifted within Canada's three largest metropolitan areas if regulations were harmonized such that each municipality's regulation index took its region's median value.

We use the coefficient on the regulation-index-to-education interaction term of our housing supply model (column 1 of table 4 in section 4) to estimate counterfactual census-tract growth under regionally harmonized regulations. In this model, each tract's predicted growth from 2006 to 2011 depends on its initial educational attainment, and its level on the composite regulation index. Combining the coefficient on the regulation-education interaction term with census-tract data on education, initial housing stock, and regulation (which only varies across cities) gives a unique estimate of 2011 housing stock under different levels of regulation in each tract. We use these estimates to produce counterfactual growth rates for cities and to map the distribution of regulation's effect on growth across census tracts.

**Table 5** shows the growth impact of harmonizing regulations in the Toronto Census Metropolitan Area (CMA) to match its median regulation municipality, Vaughan. In this alternative scenario, Oakville and King Township, two of the region's most heavily regulated municipalities, are expected to accommodate substantial additional growth. Meanwhile, the expected effect on municipalities that would see increased regulations in the harmonized scenario is relatively muted in the Toronto CMA—no city is predicted to lose more than one percentage point of growth by moving to the region's median regulations.

**Figure 4** presents estimates of the effect on metropolitan Toronto's census tracts from harmonizing regulations. The supply model predicts that several places on the urban fringe would have grown less had their regulations increased to match Vaughan. Several tracts in Brampton near the border with Mississauga—which is more central, but also more regulated—are expected to have grown substantially less under harmonized regulations. Further, the supply model implies that several tracts in Oakville and central Toronto, particularly along or near Yonge Street, would have grown more under harmonized regulations.

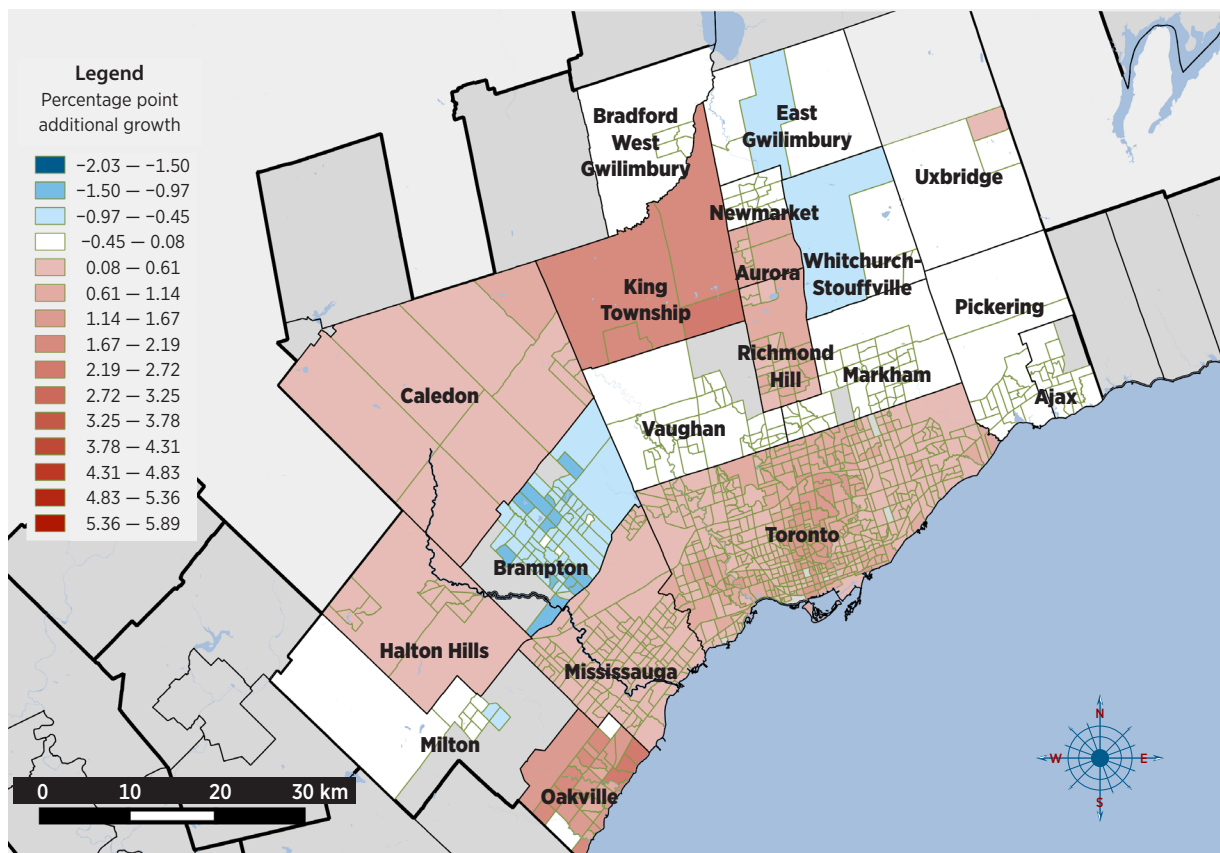
**Table 5: Estimated effect of harmonizing regulations on the growth of housing stock in the Toronto Census Metropolitan Area (CMA)**

Municipality		Municipality		Municipality	
Brampton	-0.9%	Newmarket	-0.3%	Halton Hills	+0.4%
Bradford West Gwillimbury	-0.3%	Markham	-0.0%	Toronto	+0.7%
East Gwillimbury	-0.4%	Vaughan	0.0%	Aurora	+0.7%
Whitchurch Stouffville	-0.4%	Uxbridge	+0.1%	Caledon	+0.5%
Milton	-0.4%	Mississauga	+0.2%	Oakville	+1.6%
Pickering	-0.3%	Richmond Hill	+0.6%	King Township	+2.0%
Ajax	-0.2%				

Notes: Percentage-point change in dwelling stock growth rates predicted from harmonizing the index of regulation to its value in Vaughan. Growth model estimates use the coefficient on regulation presented in column 1 of table 3 and supply model estimates use column 1 of table 4.

Sources: Green, Herzog, Filipowicz, 2015a, 2015b, 2015c; Statistics Canada, 2006a, 2006b, 2011a, 2011c, 2011e; Natural Resources Canada, 2016; authors' calculations. Transit stations were located using General Transit Feed Specification files from the websites of Toronto Transit Commission and Metrolinx (for the Greater Toronto).

**Figure 4: Estimated effect of harmonizing regulations on housing stock growth in the Toronto Census Metropolitan Area (CMA)**



Sources: Green, Herzog, Filipowicz, 2015a, 2015b, 2015c; Statistics Canada, 2006a, 2006b, 2011a, 2011c, 2011e; Natural Resources Canada, 2016; authors' calculations. Transit stations were located using General Transit Feed Specification files from the websites of Toronto Transit Commission and Metrolinx (for Greater Toronto).



**Table 6** shows the impact on growth of harmonizing regulations in the Vancouver CMA to match the regional median in Langley Township. Our model implies a particularly strong impact of regulation on growth in this region. Indeed, if the core municipality of Vancouver had Langley’s level of regulation, it is predicted that it would gain more growth than any municipality in the Toronto CMA from harmonizing regulations to its median level. Conversely, the fast-growing neighbouring city of Burnaby would not have seen as much growth over the same period in this scenario. The North Shore suburbs, which sit adjacent to the region’s core, are also expected to have seen substantially faster growth under harmonized regulations.

**Figure 5** presents estimates of the effect on metropolitan Vancouver’s census tracts from harmonizing regulations. The supply model predicts that harmonizing to less stringent regulations would encourage substantial additional growth in Vancouver’s west side and downtown core. Parts of the District of North Vancouver that hug the North Shore Mountains are also generally predicted to grow far more under harmonized regulations. Meanwhile, several tracts in parts of Burnaby that are farthest from the region’s core are expected to grow less if the city’s regulatory landscape matched its neighbours’.

Finally, **table 7** and **figure 6** present the impact on growth of harmonizing regulations in the Calgary CMA to match their regional median midway between Airdrie and Calgary proper. We predict that Airdrie and Cochrane, which sit several kilometers outside of the Calgary city limits, would have grown less under harmonized regulations. Within Calgary, our model’s results imply that several tracts close to the downtown core would have grown more if Calgary’s regulations matched its neighbours’. Further, our model predicts that, in the absence of its more intense regulations, areas of Rocky View County would have seen substantially more growth, likely producing a more compact region with less development “leapfrogging” to Airdrie and Cochrane.

To interpret predictions generated by our model, it is important to recall that it only captures housing demand in established neighbourhoods. The concentration of higher education is a reasonable measure of housing demand in urban areas, particularly at the census-tract level, but it is clearly not the only factor affecting demand. Labour market potential might drive housing demand in new neighbourhoods at the urban fringe, where developers can offer larger homes to families. Initially rural areas, these places would generally not house concentrated human capital. Therefore, it is important to recognize that our supply model would not capture the growing housing demand that the places experienced, as it was not driven by pre-existing demographics. This scenario likely applies to outer suburbs of Vancouver and Toronto.



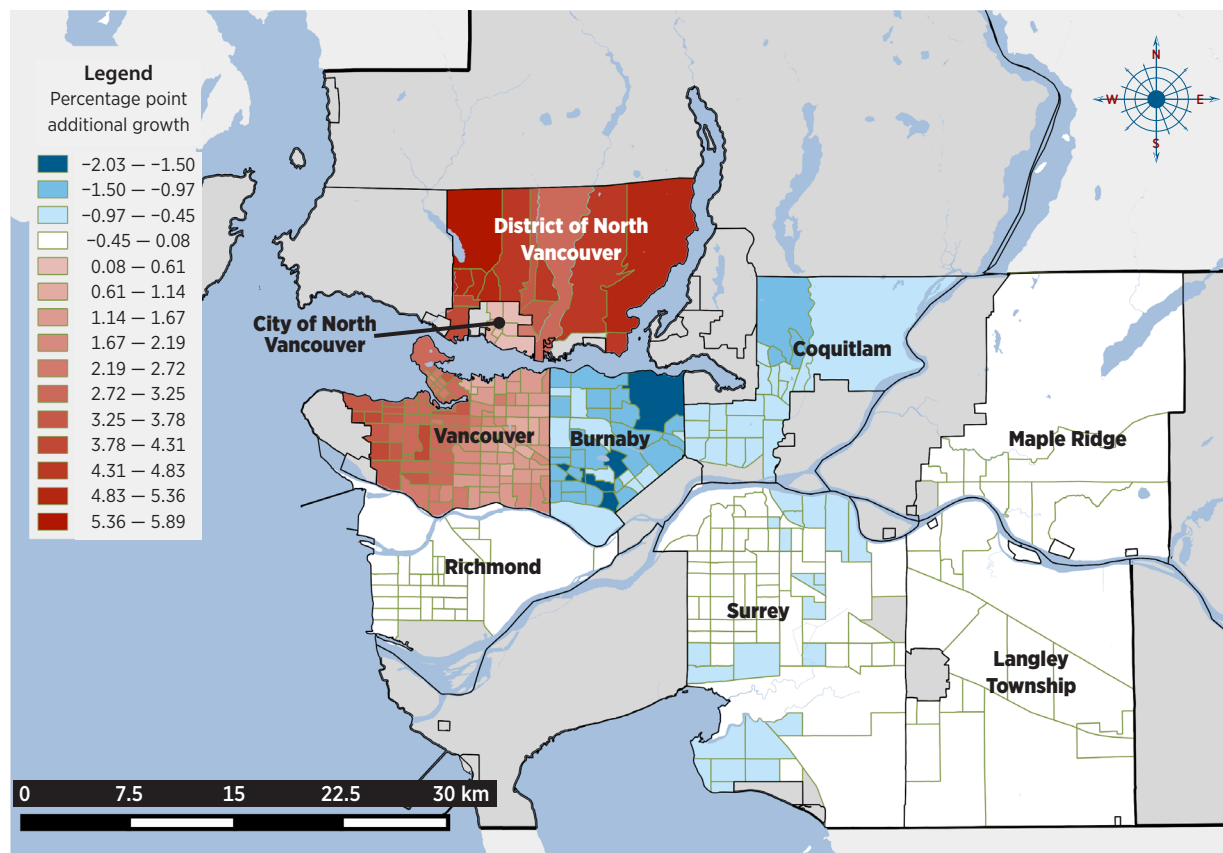
**Table 6: Estimated effect of harmonizing regulations on the growth of housing stock in the Vancouver Census Metropolitan Area (CMA)**

Municipality		Municipality		Municipality	
Burnaby	-1.2%	Richmond	-0.0%	City of North Vancouver	+0.6%
Coquitlam	-0.7%	Langley Township	0.0%	Vancouver	+2.3%
Surrey	-0.4%	Maple Ridge	+0.0%	District of North Vancouver	+4.4%

Notes: Percentage-point change in dwelling stock growth rates predicted from harmonizing the index of regulation to its value in Langley Township. Growth model estimates use the coefficient on regulation presented in column 1 of table 4 and supply model estimates use column 1 of table 5.

Source: Green, Herzog, Filipowicz, 2015a, 2015b, 2015c; Statistics Canada, 2006a, 2006b, 2011a, 2011c, 2011e; Natural Resources Canada, 2016; authors' calculations. Transit stations were located using General Transit Feed Specification files from the website of TransLink (for the Greater Vancouver).

**Figure 5: Estimated effect of harmonizing regulations on housing stock growth in the Vancouver Census Metropolitan Area (CMA)**



Sources: Green, Herzog, Filipowicz, 2015a, 2015b, 2015c; Statistics Canada, 2006a, 2006b, 2011a, 2011c, 2011e; Natural Resources Canada, 2016; authors' calculations. Transit stations were located using General Transit Feed Specification files from the website of TransLink (for the Greater Vancouver).

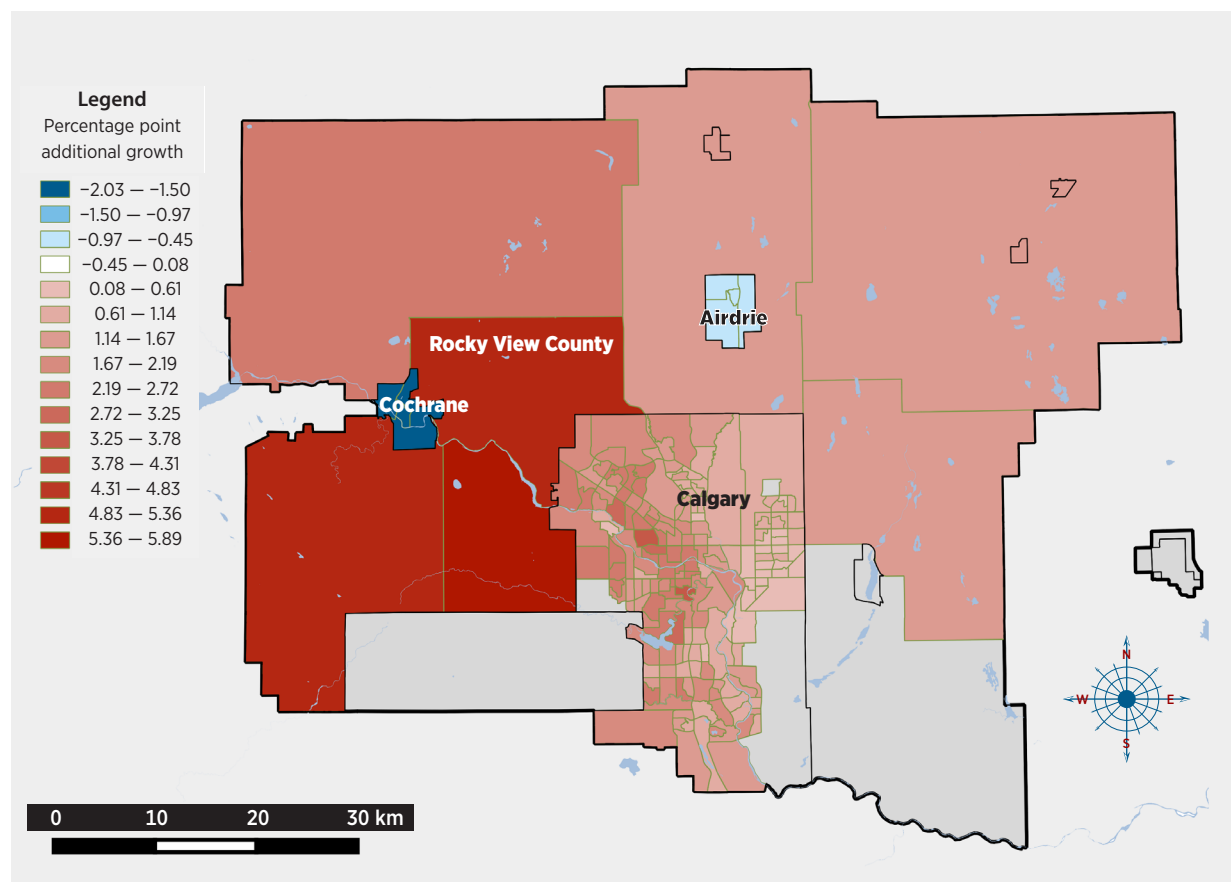
**Table 7: Estimated effect of harmonizing regulations on the growth of housing stock in the Calgary Census Metropolitan Area (CMA)**

Municipality		Municipality		Municipality	
Cochrane	-1.7%	Calgary	+1.6%	Rocky View County	+3.3%
Airdrie	0.8%	Rocky View County	+3.3%		

Notes: Percentage-point change in dwelling stock growth rates predicted from harmonizing the index of regulation to the midpoint of its values in Airdrie and Calgary. Growth model estimates use the coefficient on regulation presented in column 1 of table 4 and supply model estimates use column 1 of table 5.

Source: Green, Herzog, Filipowicz, 2015a, 2015b, 2015c; Statistics Canada, 2006a, 2006b, 2011a, 2011c, 2011e; Natural Resources Canada, 2016; authors' calculations. Transit stations were located using General Transit Feed Specification files from the website of Calgary Transit.

**Figure 6: Estimated effect of harmonizing regulations on housing stock growth in the Calgary Census Metropolitan Area (CMA)**



Sources: Green, Herzog, Filipowicz, 2015a, 2015b, 2015c; Statistics Canada, 2006a, 2006b, 2011a, 2011c, 2011e; Natural Resources Canada, 2016; authors' calculations. Transit stations were located using General Transit Feed Specification files from the website of Calgary Transit.

In general, our results show that land-use regulations in urban Canada limited the housing supply in the mid- and late 2000s. Our estimates imply that harmonizing regulations within Canada's largest metropolitan areas would have led to more contiguous urban forms with less sprawl (particularly in greater Vancouver and Calgary), more growth in highly desirable central neighbourhoods, and more growth in places with natural amenities or high incomes such as Oakville and the District of North Vancouver. In addition, our model suggests that reducing Vancouver's regulatory burden would have generated substantial additional residential development on the city's west side, where growing housing prices have generated substantial attention. [\[14\]](#)

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[\[14\]](#) Typical local newspaper headlines discussing rising home prices in Vancouver include specific examples of single-detached residences in the city's western neighbourhoods, like Kitsilano and Point Grey (McLellan, 2016, February 25; *The Province*, 2016, February 15).

## 6 Conclusion

As Canadians continue to converge on urban centres and concerns about the affordability of housing grow, it is crucial to understand why the country's major housing markets have seen such dramatic growth in prices. The sum of available evidence suggests that restrictions on housing supply play a role in this trend. Growing demand for living in a region is generally followed by growing prices and a growing housing stock, but the balance between these two outcomes depends on the structure of the housing supply. Markets with a responsive housing supply tend to respond to demand with new homes, while less responsive supply leads to growth in prices. Our findings suggest that costly and challenging land-use regulations make the housing supply less responsive to demand.

We find that each aspect of land-use regulation has a distinct impact on the housing supply. Our analysis suggests that long and uncertain project-approval timelines are particularly detrimental to the responsiveness of a local housing supply. In fact, the data suggest that increasing either the length of approval timelines or their perceived uncertainty by one standard deviation above average is sufficient to completely mute the responsiveness of the housing supply to demand in desirable neighbourhoods. Opposition from council and community groups also substantially reduces the housing supply's ability to respond to growing demand.

Meanwhile, high costs and fees are associated with low growth of the housing stock, but this effect is unrelated to a conventional measure of housing demand. This infers that developer fees should only fund amenities and infrastructure that are clearly necessary and serve new development directly: a misuse of developer fees can adversely affect incentives to build new housing. Finally, there is no consistent relationship between the growth of dwelling stock and how frequently municipalities require rezoning for new housing. This highlights that outcomes of regulation—such as monetary costs, delays, uncertainties, and limits to building—are more important for the housing supply than specific institutions within the community planning process.

It is important to note that we have made no attempt to measure regulation's benefits. Surely, land-use regulations are intended to correct externalities, manage infrastructure, and generally serve community interests, but these effects are beyond the scope of our work, and have proved difficult to quantify (Turner, Haughwout, and van der Klaauw, 2014). We partially address this shortcoming by focusing on measures of regulation that are less likely to directly benefit

communities: specifically, approval timelines and their uncertainty. We also acknowledge that unexpected demand for growth might overwhelm a poorly equipped city planning department, eroding the expediency with which development applications are processed. This possibility might complicate the relationship between regulation and growth, and is among many aspects of this relationship that unfortunately lie outside the scope of our current work.

In general, our results infer that costly regulations in a city might reduce the total amount of housing in a region, while shifting homebuilding across municipalities within a region. For some projects, long and uncertain approval timelines can have a substantial impact on urban form as it nudges building towards places where regulatory costs are low. As a result, new homes are located not solely based on where construction is practicable and homes are desirable, but also where regulations are less costly.

The negative relationship between regulation and the growth of housing stock found in this study has important implications for policy makers. First, greater regulation is associated with less growth in an average census tract even after accounting for differences in labour-market conditions, access to transportation, key demographics, and availability of land. Finding this relationship across similar neighbourhoods in nearby municipalities shows that it is robust, and difficult to explain by other factors. Second, the relationship is a standard stylized fact of modern housing markets; prior research has found a negative correlation between growth and regulation across the United States and we see the same trend in a broad cross-section of Canadian cities. In this sense, our results suggest that having the right regulatory framework is crucial for supporting housing availability and affordability in Canada's growing metropolitan areas.

## Appendix A: Description of Data

The data used in this report are derived from the 2006 and 2011 short-form censuses, the 2006 long-form census, the Fraser Institute's Survey of Residential Land-Use Regulation, and several Geographical Information Systems (GIS) databases. The spatial extent of our analysis is largely determined by coverage of the Survey of Residential Land-Use Regulation, which was administered in 2014 and collected information about land-use regulation in Canadian municipalities from real estate professionals (Green, Herzog, and Filipowicz, 2015a, 2015b, 2015c). The census metropolitan areas and census agglomerations from which the census tracts used in this study were drawn are listed in [table A1](#).

All regressions in this paper include a quadratic in the natural logarithm of the straight line distance (in meters) from census-tract centroids (the geographic centre of each tract) to their nearest metropolitan centre points. These centre points represent the heart of Canada's six largest metropolitan areas (those with over one million residents) and were determined primarily by qualitative indicators. Tracts in areas that were not sufficiently urban to be assigned centre points have the logarithm of distance from the nearest centre point coded as zero. Since all regressions in this paper include metropolitan fixed effects, this amounts to assuming that large urban areas are relatively monocentric and that growth in less urban areas is not dependent on proximity to a central business district.

Centre points are defined based on transportation nodes located near central business districts (Union Station in Toronto, Waterfront Station in Vancouver, and Central Station in Montreal) when possible. In Edmonton and Calgary, major central shopping centres anchoring large commercial towers and rapid transit stations were selected. Parliament Hill is used as Ottawa's centre point because of its central location with respect to the cities of Ottawa and Gatineau, proximity to the region's central business district, and broad accessibility to transit. Exact centre point locations are found in [table A1](#).

In addition, all regressions include dummy variables indicating tracts whose centroid fell within three kilometers of a rapid transit (including light rail and bus rapid transit) or a commuter rail station in 2006 and had transit use above our sample median according to the 2006 long-form census. Transit stations were located using General Transit Feed Specification files from the websites of TransLink (for the Greater Vancouver), Calgary Transit, Edmonton Transit System, Toronto Transit Commission, Metrolinx (for the Greater Toronto), OC Transpo (for Ottawa), *Société de transport de Montréal*, and *Agence métropolitaine de transport* (for Greater Montreal).

Table A1: Metropolitan areas studied and their centrepoints

CMA/CA	Centrepoint Location Name	Centrepoint Geographical Coordinates	
		Longitude	Latitude
Toronto			
Hamilton			
Barrie	Union Station	-79.380614	43.64519
Oshawa			
Montréal			
Joliette	Central Station	-73.566014	45.500241
Vancouver			
Abbotsford	Waterfront Station	-123.111865	49.285667
Ottawa	Parliament Hill	-75.699615	45.424766
Calgary	Core Shopping Centre	-114.070943	51.046244
Edmonton	Edmonton City Centre	-113.492959	53.543572
Québec	No centrepoint	—	—
Red Deer	No centrepoint	—	—
Kelowna	No centrepoint	—	—
Chilliwack	No centrepoint	—	—
Granby	No centrepoint	—	—

A variable measuring undevelopable land in census tracts is used in several econometric specifications presented in this paper. The impact of geographic constraints on the housing supply is conceptually similar to the impact of regulation—both can be thought of as making land more difficult to develop into housing. Saiz (2010) found that increasing a metropolitan area’s undevelopable land cover (land at a grade steeper than a 15% or covered by water) substantially reduces its supply elasticity. Our measure of undevelopable land cover is similar to that used by Saiz (2010). However, our unit of observation is far smaller than a metropolitan area. Many tracts in our sample lack undevelopable land; this is particularly true of small, centrally located tracts. For this reason, we use an indicator for tracts with more than 5% of their land area left undevelopable by physical constraints. [\[13\]](#)

[\[13\]](#) We do not use the median share of undevelopable land because the median tract does not contain any land made undevelopable by physical constraints. In our subsample where the full regulation index is measured, 11% of tracts have more than 5% of land undevelopable.

Land covered by water or at a grade steeper than 15% was identified using data from Statistics Canada and Natural Resources Canada databases (Natural Resources Canada, 2016). Steep land was identified using Natural Resources Canada's Geospatial Data Extraction tool, through which raster files were extracted at a resolution of 0.75 arc seconds. Water cover was identified using Statistics Canada's Lakes and Rivers polygon (which includes over 225,000 lakes and river GIS polygons). A census-tract base file that excludes oceans, the Great Lakes, and the St. Lawrence, was then used to determine the percentage of land in each tract left undevelopable by these physical boundaries.



## Appendix B: Econometric Methods

In this appendix, we describe the details of the econometric analysis in this report. We formally present our model specifications, give a detailed breakdown of all variables used, and discuss our use of educational attainment as an indicator of housing demand.

### The average effect of regulation

The average effects of regulation, presented in table 3 (section 4), are the coefficients on regulation from ordinary least squares regressions of the form:

$$growth_{icm} = \alpha_m + \beta_1 reg_{cm} + X'_{icm}\delta + \varepsilon_{icm} \quad [1]$$

where  $growth_{icm}$  refers to the percentage change in the total number of dwellings in a census tract from 2006 to 2011. Further,  $\alpha_m$  is a fixed effect for the metropolitan area containing tract  $i$  and  $reg_{cm}$  is a measure of regulation in the municipality containing tract  $i$ . The residual,  $\varepsilon_{icm}$ , is assumed to be uncorrelated with regulation, but it will certainly cluster at the city level, where our measures of regulation are assigned. Thus the model's parameters are estimated using Ordinary Least Squares (OLS) and statistical inferences are made based on municipally clustered standard errors. The tract level covariates contained  $X_{icm}$  in (which are all measured in 2006) are as follows:

- the share of residents age 25 or older with post-secondary degrees;
- the share of residents aged 40 or older;
- the share of residents speaking non-official languages at home;
- natural logarithm of land area;
- natural logarithm dwelling density;
- homeownership rate;
- a quadratic function in log distance from the closest metropolitan centre point. These centre points represent the core of each of Canada's six largest urban areas; their exact locations and selection criteria are given in Appendix A.

- an indicator of tracts within three kilometres of local rapid-transit stops interacted with an indicator for tracts with greater than median transit ridership;
- an indicator of tracts within three kilometres of commuter-rail stops interacted with an indicator for tracts with greater than median transit ridership. [14]

### The supply model

Our second econometric model, which gives the results shown in table 4 (section 4), is a reduced-form housing-supply function. This model is useful for estimating a reduced-form counterpart to the price elasticity of supply, which we refer to as supply responsiveness. The supply model is estimated by OLS with clustered standard errors and is specified as:

$$growth_{icm} = \tilde{\alpha}_m + \theta_0 edu_{icm} + \theta_1 reg_{cm} * edu_{icm} + C'_{icm} \tilde{\omega} + \tilde{\varepsilon}_{icm} \quad [2]$$

As described earlier,  $growth_{icm}$  is the percentage change in the number of dwellings in a census tract,  $\tilde{\alpha}_m$  is a fixed effect for the metropolitan area containing tract  $i$ ,  $edu_{icm}$  is the share of residents age 25 or older with post-secondary degrees, and  $reg_{cm}$  is a measure of regulation in the municipality containing tract  $i$ . Finally,  $C_{icm}$  is a vector of covariates that might shift the housing supply curve. The supply model's controls include all covariates listed above except those describing the shares of residents aged 40 or older, with post-secondary degrees, and speaking non-official languages at home. These age and language controls are omitted from this specification to facilitate estimation of the impact of year 2006 human capital ( $edu_{icm}$ ), our demand proxy of interest.

In the supply model, the responsiveness of supply to demand (predicted by education) depends on regulation in each city such that:

$$supply\ response_{icm} = \theta_0 + \theta_1 reg_{cm} \quad [3]$$

We center measures of regulation around zero so that the coefficient on education ( $\theta_0$  in equations 2 and 3) gives the supply responsiveness in a city with the average level of regulation. More importantly, the coefficient on the interaction

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[14] In its *Glossary of Transit Terminology*, the American Public Transportation Association defines commuter rail as: "Railroad local and regional passenger train operations between a central city, its suburbs and/or another central city. It may be either locomotive-hauled or self-propelled, and is characterized by multi-trip tickets, specific station-to-station fares, railroad employment practices and usually only one or two stations in the central business district. Also known as 'suburban rail'" (1994): 22).

between regulation and education ( $\theta_1$  in equations 2 and 3) gives regulation's effect on the responsiveness of the housing supply. As a robustness check, we run additional regressions where equation 2 is amended to include an interaction between education and an indicator for tracts with at least 5% of their land left undevelopable by physical barriers. This amounts to allowing the responsiveness of supply to depend on both regulation and undevelopable land such that:

$$\text{supply response}_{icm} = \theta_0 + \theta_1 \text{reg}_{cm} + \theta_2 (\text{undevelopable land} > 5\%)_{icm} \quad [4]$$

It is useful to examine carefully our decision to use a measure of educational attainment as our primary indicator of housing demand in the supply model. While this measure does not capture housing demand in previously empty tracts—leaving us unable to properly examine housing market dynamics in some of Canada's more recently developed suburbs—educational attainment is a useful proxy for housing demand in urban areas.

There is a great deal of research connecting a city's growth to the educational achievements of its population. Indeed, the idea that a high density of skills should drive urban growth is well established: cities with a more highly educated population are often more productive, and tend to be in high demand (Glaeser and Shapiro, 2003; Moretti, 2004b). In his seminal text, Alfred Marshall (1890) introduced the idea that firms are more productive in cities with thick markets of highly skilled workers, who in turn benefit as competition between potential employers causes productivity gains to be reflected in wages. More recently, Acemoglu (1996) proposed that firms that can expect a sustained ability to employ highly skilled workers have a greater incentive to invest in other aspects of their business, accumulating capital that makes all workers more productive, including the less skilled. The local service industry also benefits from this dynamic: well-educated individuals with diverse tastes are willing to pay for a variety of premium amenities. The resulting diversity in goods, services, and amenities available in a place can further increase demand for housing. Further, high levels of education are related to low crime rates, although the greatest impact on crime appears to come from completing high school (Lochner, 2007). Finally, Rosenthal and Strange (2008) suggest that these sorts of spillovers from human capital attenuate with distance, inferring that substantial sub-regional variation in housing demand can be captured by our tract-level measure of education.

In our sample of census tracts, it is clear that growing housing demand is generally not evenly distributed across a metropolitan area. Instead, the initial impact of a positive labour-productivity shock (an example explored in section 2

of this paper) would be strongest in neighbourhoods that newcomers find most attractive. If this shift in labour demand attracts highly educated individuals to a region, it is reasonable to expect that housing demand will grow most in neighbourhoods that already housed clusters of highly educated people. Hence, a concentration of highly educated people in a census tract is a predictor of housing demand, while tracts with less human capital are less likely to be in demand.

## Appendix C: Robustness of Econometric Results

In this section, we provide additional details and robustness checks of the econometric analysis in this paper. **Tables C1a** and **C1b** present the coefficients on control variables from regressions discussed in section 3. Metropolitan fixed effects were included as dummy variables in all regressions but are not shown in these tables.

**Table C1c** presents results of a regression that tests the robustness of the supply model to allowing the supply responsiveness to depend on geography as well as regulation. To that end, we include an indicator of tracts where at least 5% of the land is under water or on a steep slope interacted with our measure of demand. In this specification, it is clear that tracts with more varied terrain see less growth in response to demand, but the impact of regulation is largely unchanged. Our estimates of regulation's impact on the housing supply are generally robust to accounting fully for geography's effect in this model.

It is important to note that our sample contains tracts whose dwelling stock contracted between 2006 and 2011: this is true for 16.8% of the 2,828 tracts in our sample of cities where the full regulation index is measured. Further, a logistic regression of whether each tract contracted on our regulation index, CMA fixed effects, and control variables (shown in the first column of **table C2**) shows that contracting tracts tend to sit in more regulated municipalities—an unsurprising result. This is in part because old and unmaintained homes depreciate and eventually become uninhabitable, leaving the housing stock. Depreciating homes would generally be replaced with new ones but regulation may erode developers' incentives or ability to redevelop certain neighbourhoods.

It is also possible that costly regulations concentrate in cities that have rezoned land from residential to commercial or other uses, or that consolidations have occurred between lots to make way for lower density residential uses (for example, combining two single-detached home lots to build a single, larger dwelling). If either of these latter two explanations is true, our estimates of regulation's effect on growth would be biased, although the direction and magnitude of this possible bias are unclear.

Restricting our attention to growing tracts does not substantially alter our results. To test this, we censor growth to be non-negative and produce Tobit estimates of regulation's effect on growth (with controls described in appendix B). The second column of **table C2** shows that our estimate of regulation's effect on growth retains its sign and statistical precision when we focus on growing tracts.

Table C1a: OLS regressions of growth on regulation and controls

Dependent variable: dwelling stock growth (2006 to 2011)

Measure of regulation	(1) Regulation index	(2) Costs and fees	(3) Approval timelines	(4) Timeline uncertainty	(5) Council and community	(6) Rezoning prevalence
Regulation	-2.501*** (0.917)	-0.179*** (0.0595)	-0.610*** (0.186)	-3.443** (1.391)	-3.336** (1.278)	-0.00625 (0.0507)
ln(dwelling density)	1.960** (0.860)	2.014** (0.853)	1.588* (0.837)	1.832** (0.855)	1.790** (0.859)	1.958** (0.871)
ln(land area)	5.407*** (1.205)	5.311*** (1.154)	4.810*** (1.122)	5.216*** (1.138)	5.235*** (1.149)	5.164*** (1.158)
Undevelopable land > 5%	-1.393** (0.663)	-1.495** (0.672)	-0.691 (0.784)	-0.255 (0.829)	-0.823 (0.793)	-0.824 (0.835)
Home ownership rate (% of households)	0.0912*** (0.0204)	0.0878*** (0.0192)	0.0828*** (0.0191)	0.0828*** (0.0193)	0.0817*** (0.0195)	0.0758*** (0.0197)
Bachelor's degree or more (% of adults)	0.0640* (0.0329)	0.0685** (0.0320)	0.0678** (0.0314)	0.0588* (0.0309)	0.0613* (0.0308)	0.0576* (0.0298)
40 years old and over (% of people)	-0.461*** (0.0731)	-0.468*** (0.0679)	-0.473*** (0.0688)	-0.458*** (0.0677)	-0.456*** (0.0696)	-0.456*** (0.0663)
Non-official language spoken at home (% of households)	0.0537* (0.0316)	0.0543 (0.0340)	0.0596* (0.0338)	0.0537 (0.0325)	0.0496 (0.0304)	0.0441 (0.0321)
Local RT station within 3 KM and transit use above median	1.684*** (0.596)	1.521*** (0.547)	1.483** (0.627)	1.978*** (0.692)	2.061*** (0.661)	1.628** (0.725)
Commuter RT station within 3 KM and transit use above median	0.752 (1.156)	0.348 (1.055)	0.243 (1.032)	0.452 (1.060)	0.511 (1.093)	0.571 (1.038)
ln(Distance to nearest centrepoin)	-31.60*** (11.29)	-34.90*** (11.37)	-36.16*** (11.74)	-33.90*** (11.48)	-31.61*** (11.25)	-32.38*** (11.77)
ln(Distance to nearest centrepoin) <sup>2</sup>	1.655*** (0.595)	1.866*** (0.595)	1.936*** (0.619)	1.803*** (0.602)	1.665*** (0.589)	1.742*** (0.617)
R <sup>2</sup>	0.193	0.197	0.191	0.193	0.193	0.182
Number of census tracts	2,828	2,933	3,034	3,018	2,961	3,029
Number of cities	48	57	65	63	58	68

Notes: Standard errors clustered by municipality in paranthesis. All regressions include CMA dummy variables.

\* p&lt;0.10, \*\* p&lt;0.05, \*\*\* p&lt;0.01

Sources: Green, Herzog, Filipowicz, 2015a, 2015b, 2015c; Statistics Canada, 2006a, 2006b, 2011a, 2011b, 2001d; Natural Resources Canada, 2016; authors' calculations. Transit stations were located using General Transit Feed Specification files from the websites of TransLink (for the Greater Vancouver), Calgary Transit, Edmonton Transit System, Toronto Transit Commission, Metrolinx (for the Greater Toronto), OC Transpo (for Ottawa), *Société de transport de Montréal*, and *Agence métropolitaine de transport* (for Greater Montreal).

Table C1b: OLS regressions corresponding to the supply model

Dependent variable: dwelling stock growth (2006 to 2011)

Measure of regulation	(1) Regulation index	(2) Costs and fees	(3) Approval timelines	(4) Timeline uncertainty	(5) Council and community	(6) Rezoning prevalence
Bachelor's degree or higher (% of adults)	0.0674* (0.0369)	0.0594** (0.0224)	0.0924** (0.0373)	0.0927*** (0.0313)	0.0927*** (0.0284)	0.0579** (0.0230)
Regulation * bachelor's degree or higher	-0.0580* (0.0319)	0.000390 (0.00186)	-0.0190** (0.00804)	-0.165*** (0.0371)	-0.129*** (0.0376)	-0.000317 (0.00172)
ln(dwelling density)	3.135** (1.340)	3.036** (1.378)	2.769** (1.256)	2.876** (1.258)	2.806** (1.270)	2.929** (1.305)
ln(land area)	6.123*** (1.636)	5.975*** (1.633)	5.581*** (1.502)	5.989*** (1.510)	5.903*** (1.518)	5.902*** (1.555)
Undevelopable land > 5%	0.207 (1.357)	0.450 (1.372)	1.011 (1.491)	1.745 (1.479)	1.377 (1.548)	0.829 (1.539)
Home ownership rate (% of households)	0.0652*** (0.0219)	0.0609*** (0.0204)	0.0615*** (0.0194)	0.0605*** (0.0197)	0.0585*** (0.0197)	0.0564*** (0.0188)
Local RT station within 3 KM and transit use above median	1.337* (0.670)	1.031 (0.788)	1.263* (0.633)	1.543** (0.598)	1.766*** (0.631)	1.179 (0.741)
Commuter RT station within 3 KM and transit use above median	0.861 (0.927)	0.853 (0.810)	0.648 (0.838)	0.812 (0.922)	0.848 (0.907)	0.964 (0.842)
ln(Distance to nearest centrepoint)	-38.92** (14.76)	-42.40*** (14.58)	-40.56*** (14.34)	-39.65*** (13.80)	-38.77*** (13.80)	-38.01** (14.48)
ln(Distance to nearest centrepoint) <sup>2</sup>	2.103** (0.785)	2.311*** (0.767)	2.215*** (0.759)	2.140*** (0.729)	2.089*** (0.729)	2.067*** (0.765)
R <sup>2</sup>	0.130	0.134	0.128	0.137	0.136	0.126
Number of census tracts	2,828	2,933	3,034	3,018	2,961	3,029
Number of cities	48	57	65	63	58	68

Notes: Standard errors clustered by municipality in parenthesis. All regressions include CMA dummy variables.

\* p&lt;0.10, \*\* p&lt;0.05, \*\*\* p&lt;0.01

Sources: Green, Herzog, Filipowicz, 2015a, 2015b, 2015c; Statistics Canada, 2006a, 2006b, 2011a, 2011b, 2001d; Natural Resources Canada, 2016; authors' calculations. Transit stations were located using General Transit Feed Specification files from the websites of TransLink (for the Greater Vancouver), Calgary Transit, Edmonton Transit System, Toronto Transit Commission, Metrolinx (for the Greater Toronto), OC Transpo (for Ottawa), *Société de transport de Montréal*, and *Agence métropolitaine de transport* (for Greater Montreal).

Table C1c: Effect of allowing supply responsiveness to depend on undevelopable land

Dependent variable: dwelling stock growth (2006 to 2011)

Measure of regulation	(1) Regulation index	(2) Costs and fees	(3) Approval timelines	(4) Timeline uncertainty	(5) Council and community	(6) Rezoning prevalence
Bachelor's degree or higher (% of adults)	0.0779** (0.0370)	0.0709*** (0.0226)	0.104*** (0.0377)	0.106*** (0.0321)	0.106*** (0.0290)	0.0696*** (0.0229)
Regulation * bachelor's degree or higher	-0.0568* (0.0322)	0.000432 (0.00184)	-0.0183** (0.00811)	-0.162*** (0.0385)	-0.128*** (0.0378)	0.0000393 (0.00174)
Undevelopable land > 5% * bachelor's degree or higher	-0.0840*** (0.0271)	-0.0936*** (0.0287)	-0.0917*** (0.0286)	-0.106*** (0.0295)	-0.107*** (0.0291)	-0.0962*** (0.0299)
ln(dwelling density)	3.158** (1.338)	3.060** (1.375)	2.790** (1.253)	2.898** (1.254)	2.838** (1.266)	2.954** (1.300)
ln(land area)	6.141*** (1.628)	5.997*** (1.623)	5.604*** (1.493)	6.019*** (1.499)	5.932*** (1.505)	5.926*** (1.544)
Undevelopable land > 5%	0.207 (1.357)	0.450 (1.372)	1.011 (1.491)	1.745 (1.479)	1.377 (1.548)	0.829 (1.539)
Home ownership rate (% of households)	0.0661*** (0.0221)	0.0621*** (0.0206)	0.0624*** (0.0194)	0.0616*** (0.0199)	0.0599*** (0.0200)	0.0578*** (0.0189)
Local RT station within 3 KM and transit use above median	1.324* (0.675)	1.027 (0.786)	1.231* (0.624)	1.509** (0.582)	1.755*** (0.622)	1.125 (0.741)
Commuter RT station within 3 KM and transit use above median	0.789 (0.911)	0.777 (0.793)	0.575 (0.823)	0.722 (0.901)	0.754 (0.887)	0.871 (0.824)
ln(Distance to nearest centrepoin)	-38.88** (14.55)	-42.35*** (14.32)	-40.18*** (14.15)	-39.42*** (13.58)	-38.66*** (13.54)	-37.76** (14.30)
ln(Distance to nearest centrepoin) <sup>2</sup>	2.099*** (0.773)	2.305*** (0.753)	2.191*** (0.749)	2.123*** (0.716)	2.080*** (0.715)	2.049*** (0.756)
R <sup>2</sup>	0.131	0.135	0.129	0.138	0.137	0.127
Number of census tracts	2,828	2,933	3,034	3,018	2,961	3,029
Number of cities	48	57	65	63	58	68

Notes: Standard errors clustered by municipality in paranthesis. All regressions include CMA dummy variables.

\* p&lt;0.10, \*\* p&lt;0.05, \*\*\* p&lt;0.01

Sources: Green, Herzog, Filipowicz, 2015a, 2015b, 2015c; Statistics Canada, 2006a, 2006b, 2011a, 2011b, 2001d; Natural Resources Canada, 2016; authors' calculations. Transit stations were located using General Transit Feed Specification files from the websites of TransLink (for the Greater Vancouver), Calgary Transit, Edmonton Transit System, Toronto Transit Commission, Metrolinx (for the Greater Toronto), OC Transpo (for Ottawa), *Société de transport de Montréal*, and *Agence métropolitaine de transport* (for Greater Montreal).



Table C2: The impact of contracting tracts on the growth-regulation relationship

Dependent variables:	(1) Dwelling stock growth < 0	(2) Dwelling stock growth
Estimator:	Logit MLE	Tobit MLE, censored if growth < 0
Regulation	0.296** (0.115)	-2.757*** (0.976)
ln(dwelling density)	-0.522*** (0.159)	1.498* (0.886)
ln(land area)	-0.606*** (0.157)	5.476*** (1.140)
Undevelopable land > 5%	0.0412 (0.170)	-1.839** (0.764)
Home ownership rate (% of households)	-0.0238*** (0.00457)	0.109*** (0.0220)
Bachelor's degree or more (% of adults)	0.0123 (0.00913)	0.0406 (0.0341)
40 years old and over (% of people)	0.0660*** (0.00764)	-0.524*** (0.0772)
Non-official language spoken at home (% of households)	-0.00490 (0.00509)	0.0669* (0.0352)
Local RT station within 3 KM and transit use above median	0.209 (0.137)	1.534*** (0.585)
Commuter RT station within 3 KM and transit use above median	0.235*** (0.0672)	0.935 (1.230)
ln(Distance to nearest metro centrepoint)	1.042 (1.285)	-33.83*** (12.24)
ln(Distance to nearest metro centrepoint) <sup>2</sup>	-0.0530 (0.0769)	1.750*** (0.654)
Number of census tracts	2,815	2,828
Number of cities	47	48

Notes: Standard errors clustered by municipality in paranthesis. All regressions include CMA dummy variables.

\* p<0.10, \*\* p<0.05, \*\*\* p<0.01

Sources: Green, Herzog, Filipowicz, 2015a, 2015b, 2015c; Statistics Canada, 2006a, 2006b, 2011a, 2011b, 2001d; Natural Resources Canada, 2016; authors' calculations. Transit stations were located using General Transit Feed Specification files from the websites of TransLink (for the Greater Vancouver), Calgary Transit, Edmonton Transit System, Toronto Transit Commission, Metrolinx (for the Greater Toronto), OC Transpo (for Ottawa), *Société de transport de Montréal*, and *Agence métropolitaine de transport* (for Greater Montreal).

## References

Acemoglu, Daron (1996). A Microfoundation for Social Increasing Returns in Human Capital Accumulation. *Quarterly Journal of Economics* 111, 3: 779–804. <<http://economics.mit.edu/files/3803>>, as of May 17, 2016.

American Public Transit Association (1994). *Glossary of Transit Terminology*. American Public Transit Association. <[http://www.apta.com/resources/reportsandpublications/Documents/Transit\\_Glossary\\_1994.pdf](http://www.apta.com/resources/reportsandpublications/Documents/Transit_Glossary_1994.pdf)>.

Glaeser, Edward L., and Joseph Gyourko (2003). The Impact of Building Restrictions on Housing Affordability. *FRBNY Economic Policy Review*, June: 21–39. <<https://www.newyorkfed.org/medialibrary/media/research/epr/03v09n2/0306glae.pdf>>.

Glaeser, Edward L., Joseph Gyourko, and Raven E. Saks (2006). *Urban Growth and Housing Supply*. Discussion Paper Number 2062. Harvard Institute of Economic Research. <<http://scholar.harvard.edu/glaeser/publications/urban-growth-and-housing-supply>>.

Glaeser, Edward L., and Jesse M. Shapiro (2003). Urban Growth in the 1990s: Is City Living Back? *Journal of Regional Science* 43, 1: 139–165.

Glaeser, Edward L., and Bryce A. Ward (2009). The Causes and Consequences of Land Use Regulation: Evidence from Greater Boston. *Journal of Urban Economics* 65, 3: 265–278.

Glaeser, Edward L., and Albert Saiz (2004). The Rise of the Skilled City. *Brookings-Wharton Papers on Urban Affairs* 2004, 1: 47–105. Available at: <<https://muse.jhu.edu/article/170968/pdf>>.

Green, Kenneth P., Ian Herzog, and Josef Filipowicz (2015a). *New Homes and Red Tape: Residential Land-Use Regulation in BC's Lower Mainland*. Fraser Institute. <<https://www.fraserinstitute.org/research/new-homes-and-red-tape-residential-land-use-regulation-bc-lower-mainland>>.

Green, Kenneth P., Ian Herzog, and Josef Filipowicz (2015b). *New Homes and Red Tape: Residential Land-Use Regulation in Alberta's Calgary-Edmonton Corridor*. Fraser Institute. <<https://www.fraserinstitute.org/studies/new-homes-and-red-tape-residential-land-use-regulation-albertas-calgary-edmonton-corridor>>.

Green, Kenneth P., Ian Herzog and Josef Filipowicz (2015c). *New Homes and Red Tape: Residential Land-Use Regulation in Ontario's Greater Golden Horseshoe*. Fraser Institute. <<https://www.fraserinstitute.org/studies/new-homes-and-red-tape-residential-land-use-regulation-in-ontarios-greater-golden-horseshoe>>

Hornbeck, Richard, and Enrico Moretti (2015). Who Benefits from Productivity Growth? The Local and Aggregate Impacts of Local TFP Shocks on Wages, Rents, and Inequality. May (Preliminary Draft). University of Chicago Booth School of Business. <[http://faculty.chicagobooth.edu/richard.hornbeck/research/papers/TFP\\_hm\\_may2015.pdf](http://faculty.chicagobooth.edu/richard.hornbeck/research/papers/TFP_hm_may2015.pdf)>.

Jackson, Kristoffer (2016). Do Land Use Regulations Stifle Residential Development? Evidence from California Cities. *Journal of Urban Economics* 91: 45–56.

Lochner, Lance (2007). *Education and Crime*. Department of Economics, University of Western Ontario. <[https://www.researchgate.net/profile/Lance\\_Lochner/publication/228394576\\_Education\\_and\\_crime/links/0deec51a8e1ca547fd000000.pdf](https://www.researchgate.net/profile/Lance_Lochner/publication/228394576_Education_and_crime/links/0deec51a8e1ca547fd000000.pdf)>, as of June 22, 2016.

Marshall, Alfred (1890). *Principles of Economics*. Macmillan.

Mayer, Christopher J., and C. Tsurriel Somerville (2000). Land Use Regulation and New Construction. *Regional Science and Urban Economics* 30, 6: 639–662.

McLellan, Wendy (2016, February 25). Kitsilano House Sells for \$735,000 over Asking Price in Record-Breaking \$4.23-Million Deal. *The Province*. <<http://blogs.theprovince.com/2016/02/25/kitsilano-house-sells-for-735000-over-asking-in-record-breaking-4-23-million-deal/>>.

Moretti, Enrico (2004a). Estimating the Social Return to Higher Education: Evidence from Longitudinal and Repeated Cross-Sectional Data. *Journal of Econometrics* 121, 1: 175–212.

Moretti, Enrico (2004b). Human Capital Externalities in Cities. *Handbook of Regional and Urban Economics* 4: 2,243–2,291.

Natural Resources Canada (2016). Geospatial Data Extraction. <<http://geogratis.gc.ca/site/eng/extraction>>, as of January 26, 2016.

*The Province* (2016, February 15). That Tiny Point Grey Home — and Its Land — Sells for \$80,000 over \$2.398-Million Asking Price. *The Province*. <<http://www.theprovince.com/That+tiny+Point+Grey+home+land+sells+over+million+asking+price/11721091/story.html>>.

Quigley, John M., and Steven Raphael (2005). Regulation and the High Cost of Housing in California. *American Economic Review* 95, 2: 323–328.

Rosenthal, Stuart S., and William C. Strange (2004). Evidence on the Nature and Sources of Agglomeration Economies. *Handbook of Regional and Urban Economics* 4: 2,119–2,171.

Rosenthal, Stuart S., and William C. Strange (2008). The Attenuation of Human Capital Spillovers. *Journal of Urban Economics* 64, 2: 373–389.

Saiz, Albert (2010). The Geographic Determinants of Housing Supply. *Quarterly Journal of Economics* 125, 3: 1,253–1,296.

Saks, Raven E. (2008). Job Creation and Housing Construction: Constraints on Metropolitan Area Employment Growth. *Journal of Urban Economics* 64, 1: 178–195.

Turner, Matthew A., Andrew Haughwout, and Wilbert van der Klaauw (2014). Land Use Regulation and Welfare. *Econometrica* 82, 4: 1,341–1,403.

Teranet (2016). *House Price Index*. <<http://www.housepriceindex.ca/default.aspx?langue=EN>>, as of February 26, 2016.

Yan, Andy (2015). *Ownership Patterns of Single Family Home Sales on Selected West Side Neighborhoods in the City of Vancouver: A Case Study*. Bing Thom Architects. <<http://www.btaworks.com/2015/11/02/ownership-patterns-of-single-family-home-sales-on-selected-west-side-neighborhoods-in-the-city-of-vancouver-a-case-study/>>.

## Resources from Statistics Canada

Statistics Canada (2006a). *Census Tracts*. Cartographic Boundary File, 2006 Census - Boundary files. <<https://www12.statcan.gc.ca/census-recensement/2011/geo/bound-limit/bound-limit-2006-eng.cfm>>, as of March 23, 2016.

Statistics Canada (2006b). *Census Subdivisions*. Cartographic Boundary File, 2006 Census - Boundary files. <<https://www12.statcan.gc.ca/census-recensement/2011/geo/bound-limit/bound-limit-2006-eng.cfm>>, as of March 23, 2016.

Statistics Canada (2006c). *Community Profile: Census Tracts, 2006 Census*. Catalogue no. 92-597-XWE.

Statistics Canada (2006c). *GeoSuite, 2006 Census*. Catalogue no. 92-150-X.

Statistics Canada (2009). *A Socio-Demographic Profile of Migrants in Canada According to the 2006 Census*. Catalogue no. 91-209-X. <<http://www.statcan.gc.ca/pub/91-209-x/2004000/part2/p2-eng.htm>>.

Statistics Canada (2011a). *Census Metropolitan Areas and Census Agglomerations*. Cartographic Boundary File, 2011 Census - Boundary files. <<https://www12.statcan.gc.ca/census-recensement/2011/geo/bound-limit/bound-limit-2011-eng.cfm>>, as of March 23, 2016.

Statistics Canada (2011b). *Census Subdivisions*. Cartographic Boundary File, 2011 Census - Boundary files. <<https://www12.statcan.gc.ca/census-recensement/2011/geo/bound-limit/bound-limit-2011-eng.cfm>>.

Statistics Canada (2011c). *Coastal Waters (polygons)*. Cartographic Boundary File, 2011 Census - Boundary files. <<https://www12.statcan.gc.ca/census-recensement/2011/geo/bound-limit/bound-limit-2011-eng.cfm>>, as of March 23, 2016).

Statistics Canada (2011d). *GeoSuite, 2011 Census*. Catalogue no. 92-150-X.

Statistics Canada (2011e). *Lakes and Rivers (Polygons)*. Cartographic Boundary File, 2011 Census - Boundary files. <<https://www12.statcan.gc.ca/census-recensement/2011/geo/bound-limit/bound-limit-2011-eng.cfm>>, as of March 23, 2016.

Statistics Canada (2012). *Cities and Growth: Moving to Toronto - Income Gains Associated with Large Metropolitan Labour Markets*. <<http://www.statcan.gc.ca/pub/11-622-m/11-622-m2012023-eng.htm>>.

Statistics Canada (2014). Metropolitan Gross Domestic Product: Experimental Estimates, 2001 to 2009. <<http://www.statcan.gc.ca/pub/11-626-x/11-626-x2014042-eng.htm>>, as of January 24, 2016.

Statistics Canada (2015a). *Table 051-0001. Estimates of Population, by Age Group and Sex for July 1, Canada, Provinces and Territories*. <<http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=510001>>, as of January 24, 2016.

Statistics Canada (2015b). *Table 051-0056. Estimates of Population by Census Metropolitan Area, Sex and Age Group for July 1, Based on the Standard Geographical Classification (SGC) 2011*. <<http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=0510056&pattern=051-0056..051-0065&tabMode=dataTable&srchLan=-1&p1=-1&p2=31>>, as of January 24, 2016.

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