

Head, Allen; Lloyd-Ellis, Huw

**Working Paper**

## Has house price growth in Canadian cities been excessive?

Queen's Economics Department Working Paper, No. 1331

**Provided in Cooperation with:**

Queen's University, Department of Economics (QED)

*Suggested Citation:* Head, Allen; Lloyd-Ellis, Huw (2014) : Has house price growth in Canadian cities been excessive?, Queen's Economics Department Working Paper, No. 1331, Queen's University, Department of Economics, Kingston (Ontario)

This Version is available at:

<https://hdl.handle.net/10419/122032>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*



Queen's Economics Department Working Paper No. 1331

# Has House Price Growth in Canadian Cities been Excessive?

Allen Head  
Queen's University

Huw Lloyd-Ellis  
Queen's University

Department of Economics  
Queen's University  
94 University Avenue  
Kingston, Ontario, Canada  
K7L 3N6

11-2014

# Has House Price Growth in Canadian Cities been Excessive?

Allen Head

Huw Lloyd-Ellis\*

November 4, 2014

## Abstract

The dramatic rise in Canada's average house price to average rent ratio has induced some commentators to argue that a speculative bubble is under way the collapse of which will have a calamitous effect on the economy. Others have argued, however, that the currently high level of house prices may be rationalized by the low cost of financing, given the decline in interest rates over the last two decades. In this article, we assess these arguments through the lens of a simple asset pricing model applied to city-level data. We quantify the extent to which excess growth in Canadian house prices depends on the nature of the current regime governing *real* interest rates, expectations of rent growth in different cities and variations in property taxes.

*Journal of Economic Literature Classification:* E30, R31, R10

*Keywords:* House prices, interest rates.

---

\*Department of Economics, Queen's University, Kingston, Ontario, Canada, K7L 3N6. Email: lloydell@econ.queensu.ca; heada@econ.queensu.ca. Financial support from the Social Sciences and Humanities Research Council of Canada are gratefully acknowledged. All errors are our own.

# 1 Introduction

In this paper we use a canonical asset pricing framework to consider the extent to which the growth of house prices in major Canadian cities is explained by changes in rents, real interest rates, and property taxes. We are interested specifically in the extent, if any, to which they indicate over-valuation of residential housing. Overall, we find that for the cities we study the extent to which house prices have appreciated in excess of what would be predicted by our basic model depends ultimately on the way participants in the housing market view current low real interest rates: Are they here to stay or a transitory phenomenon? Specifically, we find that if Canada is viewed as having entered a new regime of lower “normal” real interest rates, then our measures of the over-valuation of residential real estate in major Canadian cities are significantly reduced. We also document how our measured excess valuations depend on factors influencing expected rent growth in different cities and on the impact of changes in effective property taxes over time.

Our work is motivated by the observation that, in real terms, Canada’s average price-rent ratio has risen dramatically since the 1990s. We focus specifically on the growth of the price-rent ratio as several factors which drive house *prices* may be expected to have a similar effect on *rents*. For example, increases in either construction or land costs (possibly due to more stringent development regulations in the face of population growth) would tend to increase both purchase prices and rents. Moreover, in many settings (including the model we study) these would have no effect on the price-rent ratio. Similarly, increases in either income or population which drive up house prices will raise rents in equal proportion.

Moreover, growth of the price-rent ratio is commonly advanced as an indicator of the potential extent of over-valuation of owner-occupied housing (e.g. OECD, 2014). *The Economist* publishes an index of the aggregate price-rent ratio relative to its long-run average for a number of countries. For Canada this index is computed relative to its mean over the period 1975 -2013).<sup>1</sup> According to this indicator, the aggregate price-rent ratio in Canada at the end of 2013 was 76% higher than its historical average. Its rapid and sustained rise (by comparison, at its peak in 2006 the average price-rent ratio for the U.S. was 52% above its historical average) has induced some commentators to argue that a speculative bubble is under way; the collapse of which may have a calamitous effect on the Canadian economy (O’Brien, 2013, Roubini, 2013).

---

<sup>1</sup>In this index, the average price is based on a weighted average of resale-price indices from 11 large population centres (see below) and average rent is based on a constant-quality rent index produced by Statistics Canada for use in computing the CPI.

While increases in the price-rent ratio are commonly treated as evidence of housing being overvalued, indexes like that of *The Economist* are subject to a number of criticisms. First, it is not clear that benchmarking relative to the long-run average is appropriate. If prices continually rise relative to rents for an extended period of time, the long-run average will rise as well. If there really were an over-valuation or bubble in the price of owner-occupied housing, this approach would thus yield an underestimate of it. If possible, it might be better to benchmark such an indicator to a period of relative “normality” in housing markets. For example, a period that might be useful for current purposes would be drawn from prior to the last decade. Of course, such “normal” periods may not be easy to identify and the results will always be sensitive to the choice.

Second, questions have been raised recently regarding the appropriateness of the aggregate rent index produced by Statistics Canada. The index appears to have grown at a much slower rate since 1990 than average rents for various types of accommodation measured in survey data by the Canadian Mortgage and Housing Corporation (CMHC). The difference is substantial; as Dunning (2014) notes, the Statistics Canada index grows at 1.4% per year on average, while CMHC reports average rent growth of 2.2%, more than 50% higher. It seems unlikely that such a large difference can be accounted for by improvements in the average quality of rental units. In our work, we use the CMHC rental survey data, which is compiled for relatively large Canadian cities at the Census Metropolitan Area (CMA) level.

The third, and perhaps most important, problem with using simple price-rent ratios as indicators of excess valuation of owned housing is that they do not consider a role for variation in the expected costs of mortgage finance, fluctuations in expected rent growth, or changing property taxes. Recent mortgage rates have been substantially lower (both in nominal and real terms) than during the benchmark decade. And, rent growth varies substantially across cities and over time, reflecting variation in overall housing demand. Finally, although effective property taxes are difficult to compute, it is clear that they can also vary substantially both across cities and over time. For these reasons, we develop a tractable analytical framework that attempts to account for these important factors in an index of the relative valuation of owned to rental housing.

Under a variety of assumptions, the most important determinant, quantitatively, of the price-rent ratio is the real interest rate. A marked decline in real interest rates over the last two decades could, in principle, rationalize substantial increases in price-rent ratios, essentially through the implied low cost of financing household investment in housing. As Glaeser, Gottlieb and Gyourko (2010) point out, however, relatively low interest rates justify

high observed price-rent ratios only if they are expected to persist indefinitely. Indeed, an assumption along these lines was made by Himmelberg, Mayer and Sinai (2005), who argued that rising prices at the start of the recent U.S. housing boom might largely reflect fundamentals. Taking account of mean reversion in interest rates, Glaeser *et al.* (2010) find that this is no longer the case; house prices become much less sensitive to interest rate movements.

In our analysis we also consider mean reversion in interest rates, but take a somewhat different approach from that of Glaeser *et al.* (2010). In particular, we consider the possibility that participants in the housing market may view the interest rate as having shifted between two regimes: a high interest rate regime that obtained in the 1980's and early 1990's, and a *new normal* low interest regime to which the economy has shifted since.

Extrapolating forward using the current, very low real interest rate (as did Himmelberg *et al.*, 2005) for many cities yields predicted house prices in 2013 which are in many cases *higher* than their actual observed values. Accounting instead for reversion of the interest rate to its unconditional mean (as did Glaeser *et al.*, 2010) results, on the other hand, in estimated excess valuations only ten percentage points lower on average than those implied using price-rent ratios with a fixed interest rate. When, however, we account for the possibility that agents view the long-run or "normal" real interest rate to have fallen since the 1980s and 1990s, we estimate the extent of excess valuation to be considerably lower (up to forty percentage points lower on average). Moreover, once we incorporate variation in the effective property tax rate, excess valuations are reduced even further for some cities.

The remainder of the paper is organized as follows. In Section 2, we document and discuss the implications of price-rent ratios for a group of 12 major Canadian cities. Then, in Section 3, we develop a generalized framework based on our canonical model for assessing the extent of excess valuation of owned housing that incorporates interest rate variation, local rent growth variation and property taxes. Sections 4 through 7 use this framework to measure implied excess valuations under different assumptions regarding forecasts of future interest rates and treatment of property taxes. Section 8 discusses the implications of a number of alternative assumptions. In particular, we consider the impacts of adjusting for the effects of the 1995 Quebec referendum, discounts on mortgage rates and changes to the benchmark period. Section 9 offers some conclusions and an appendix provides more details on the data sources and on our calculations.

## 2 City-Level Price-Rent Ratios

The solid lines in Figure 1 document the price-rental ratio for 12 large CMAs relative to the average over the first decade for which data is available (1987-96).<sup>2</sup> Prices here are the average prices of existing homes sold through the MLS and rents are the average rents for two-bedroom apartments published by the CMHC.<sup>3</sup> The benchmark period is somewhat arbitrary, but during it the index fluctuates relatively tightly around one for most cities.<sup>4</sup> The main exceptions are Toronto and Hamilton which experienced much larger fluctuations around the average during that decade.

The first column of Table 1 documents the extent to which price-rent ratios in each city have grown relative to their respective averages during the benchmark period. Although, we are using actual average rents, the simple and population-weighted averages, 71% and 69% respectively, are of a similar order of magnitude to that reported by the *Economist* using the Statistics Canada measure of quality adjusted rent benchmarked to the average over the whole sample. This reflects the fact that price-rent ratios are low during the benchmark decade relative to the average.

Note, however, that for these calculations neither price nor rent data are quality adjusted. Quality-adjusted rent data at the CMA level is not readily available. A resale price index beginning in 1999 has, however, been produced for all twelve cities by Teranet/National Bank. In principle, this index should adjust for some aspects of quality in the housing stock resulting from new additions. The second column of Table 1 documents the excess valuation in 2013 implied by the price-rent ratio using this index of quality-adjusted prices. In all cases but two, measures of the price-rent ratio using the Teranet index imply *lower* excess valuations in 2013.<sup>5</sup> In some cases the difference is large (*e.g.* that of Hamilton).

It is not clear which of the two indexes is most appropriate for our purposes. If, on the one hand, the average quality of the rental stock has grown at the same rate as the housing stock, then the calculation using the MLS price index (*i.e.* column 1) is more meaningful. If, on the other hand, the quality of the rental stock has not grown as fast as that of owner-occupied housing, then the Teranet index (column 2) is more appropriate.

---

<sup>2</sup>Extending the benchmark period by a few years (*e.g.* 1987-2000) makes little difference to the results.

<sup>3</sup>Although average rents for other types of accommodation are available, they tend to move together. We use those for two-bedroom apartments as these appear to be the most common and their rents are the least volatile.

<sup>4</sup>Moreover, the national price-rent ratio over this benchmark decade was very close to the long-run average between 1973 and 2013.

<sup>5</sup>The exceptions are Victoria and Winnipeg.

Figure 1 depicts the price-rent ratios for each city using both indexes, with the ratio computed using the Teranet price index indicated by the dashed lines. For each city, the Teranet indexed is normalized to equal the MLS index in 1999. Because the Teranet index starts for all cities only in 1999, we are effectively assuming here that its average over the benchmark decade is the same as that of the MLS price index.<sup>6</sup> As may be seen, the two indexes move together closely for most cities. There are, however, several exceptions. For Gatineau in particular, the Teranet index has grown much more slowly than the MLS average price index. Unfortunately, interpreting this is complicated by the fact that the Teranet index is actually computed for the combined Ottawa-Gatineau region.<sup>7</sup>

Below we develop a more general framework for assessing excess valuation, and throughout we provide calculations making use of both price indices.

### 3 Analytical Framework

We consider a stochastic version of the model studied by Poterba (1984), and also recently discussed by Glaeser, Gottlieb and Gyourko (2011). Let rental and interest payments be made at the end of each period. For a renter, the expected outlays from renting over the duration of his/her tenancy is the present-discounted value of current and expected future rental payments. We assume that discount rates and rent growth evolve over time according stationary, autoregressive processes. Under these assumptions one can express the present discounted cost of renting in city  $c$  at time  $t$  as

$$Z_{ct}R_{ct} \tag{1}$$

where

$$Z_{ct} = 1 + E_t \left[ \sum_{j=1}^{\infty} D_{t+j} \frac{R_{ct+j}}{R_{ct}} \right], \quad D_{t+j} = \prod_{s=1}^j \left( \frac{1}{1 + r_{t+s}} \right) \tag{2}$$

depends on the forecasted means and variances of future interest,  $r_{t+j}$  and rental growth rates,  $g_{ct+j}$ , conditional on information available at time  $t$ . Throughout most of our analysis we assume that rent growth in city  $c$  follows a first-order autoregressive process given by

$$g_{ct+1} = (1 - \rho_c)\bar{g}_c + \rho_c g_{ct} + e_{ct+1} \quad e_{ct} \sim N(0, \sigma_{ec}^2) \tag{3}$$

---

<sup>6</sup>For some of the cities, but not all, the Teranet index can be computed for earlier years.

<sup>7</sup>Note, however, that average prices have in fact grown at very similar rates in the two regions since 1999.



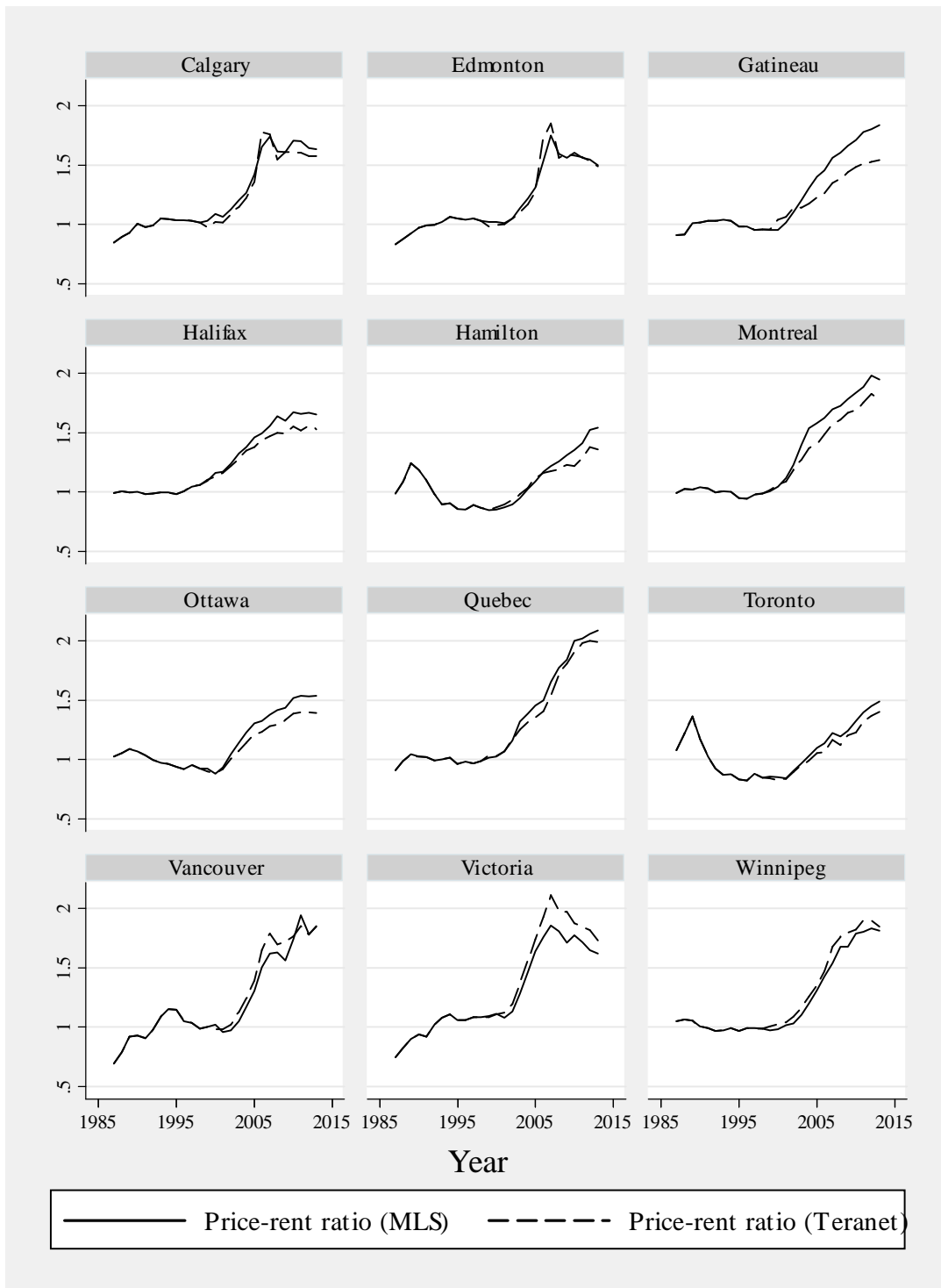


Figure 1: Price-rent ratios relative to benchmark decade

where  $\rho_c \in (0, 1)$  and  $\bar{g}_c$  represents the average or long-run rent growth for city  $c$ . We make alternative assumptions about the evolution of real interest rates below and, in Section 8 we consider alternative specifications of (3).

The present value of the cost of owning a housing with purchase price  $P_{ct}$  is assumed to consist of a down-payment,  $\psi P_{ct}$ , the present discounted value of future mortgage payments, current and future property taxes and current and future maintenance costs. We assume that the real mortgage rate faced by the representative household is a multiple  $\beta$  of the real rate at which they discount the future,  $r_t$ . In contrast to the United States, Canadian mortgage interest payments are not deductible from income taxes.<sup>8</sup>

Computation of property taxes is, in general, complicated. The effective property tax rate depends both on the mill rate and the evolution of property assessments which typically differ significantly from transactions prices and which generally vary across cities and over time. To begin with we simplify the analysis by assuming that the mill rate,  $\tau$ , and the ratio of initial assessment to purchase price,  $\alpha$ , are both constant.<sup>9</sup> We assume also that subsequent property assessments are expected to grow at the same rate,  $g_t$ , as rents. Similarly, maintenance costs are assumed to be a constant proportion  $\delta$  of expected housing value.

Under these assumptions (see Appendix), the cost of owning a representative housing unit may be expressed as

$$P_{ct} [\psi + \beta(1 - \psi) + (\tau\alpha + \delta) Z_{ct}] \quad (4)$$

where  $Z_{ct}$  is defined above. If households are risk-neutral, we have accounted for all the costs of renting and owning correctly, there are no direct utility differences between owning and renting, and we are considering a choice of tenure for the same property, then we should expect the costs of owning to equal those of renting. In practice, of course, the nature of the typical owned house differs from that of typical rented accommodation. Moreover, households may derive utility from home-ownership, even for identical housing. To allow for these factors we will allow for an owner-occupied housing utility premium,  $\theta_{ct}$ .<sup>10</sup> It then follows that the price of a representative owner-occupied house can be expressed as

$$P_{ct} = \frac{\theta_{ct} Z_{ct} R_{ct}}{\psi + \beta(1 - \psi) + (\tau\alpha + \delta) Z_{ct}}. \quad (5)$$

---

<sup>8</sup>There are, however, a number of other effective subsidies to ownership which may play a minor role.

<sup>9</sup>Below we consider the potential implications of effective property tax rates that vary over time.

<sup>10</sup>This premium could also be viewed as a reduced-form way to represent differences in the risk-characteristics and/or differences in the borrowing costs associated with owning and renting.

In what follows we assume that the owned-housing premium is constant over time in a given location,  $\theta_{ct} = \theta_c$ . Of course, the premium could change over time for various reasons. For example, the quality (e.g. size, closeness to amenities) of the typical owned home might rise or fall relative to typical rental accommodation.<sup>11</sup> Alternatively, if there is a pure ownership premium, rising incomes might raise the demand for owned versus rental housing, thereby causing  $\theta_{ct}$  to rise over time and across cities. Unless, however, the relative costs of producing owned versus rental housing change in a secular fashion over time, it is not clear why  $\theta_{ct}$  would have a substantial trend.<sup>12</sup>

In our baseline examples computed below, we fix  $\beta = 1$  which implies that the opportunity cost of the down-payment is equivalent to the mortgage interest rate. This implies that the value of  $\psi$  is irrelevant.<sup>13</sup> In fact as long as these parameters are constant over time, their exact values have only very small effects on our results. We set  $\theta_c$  for each city so that the price-rent ratio implied by the theory (*i.e.* given by (5)) is equal to the average of the observed price-rent ratio during the benchmark decade.<sup>14</sup> Initially, we fix the effective property tax rates at  $\tau\alpha = 0.008$  in every city, reflecting the national average over the sample period. In Section 7, we allow property tax rates to vary across cities and over time. Finally we also set  $\delta = 0.008$ , reflecting the fact that, in the data, property taxes consistently account for about 50% of all non-mortgage costs of home-ownership.

In the calculations below, we compute  $r_t$  using the mortgage rate on a 5 year conventional mortgage published by Statistics Canada. As a number of authors have argued (e.g. Dunning 2014), this rate is likely to be an upper bound on actual mortgage rates, since banks offer discounts based on customer negotiations. In Section 8, we consider the implications of allowing for a fixed discount on the mortgage rate.

## 4 Extrapolative discounting

A simple approach to discounting future rents is to assume that recent real interest rates will persist indefinitely. More precisely, we assume that households discount using a simple moving average of the last four years of real interest rates; effectively assuming that the rate will not change at all over their lifetimes. We use a four-year moving average to capture

---

<sup>11</sup>One could try to adjust for these effects by using "quality-adjusted" rents and prices.

<sup>12</sup>One possibility could be that such a trend arises due to composition effects.

<sup>13</sup>Our results are not very sensitive to the exact value of  $\beta$  as long as it is not too far from 1.

<sup>14</sup>Consequently, the values of  $\theta_c$  vary with each of the cases described below.

the idea that it may take a few years for households to become confident that interest rates will persist near their current levels. The stochastic rent growth process for each city is estimated using (3).<sup>15</sup> The method used to incorporate these estimates into a computation of house prices is described in the Appendix.

Figure 2 compares the observed time path of house prices to that implied by the theoretical model under the assumption that agents use extrapolative discounting, taking the 1987-96 period as a benchmark. Interestingly, for all cities other than the three in Quebec, the price at the end of 2013 implied by the theory is *greater* than the actual price. Thus, this extrapolative approach suggests that there is *no* excess valuation of houses for the cities in our sample other than the ones in Quebec! Worryingly, this result is similar to the conclusion reached by Himmelberg, Mayer and Sinai (2005) in their evaluation of prices in the United States during the housing boom. Such an approach to discounting is, however, inconsistent with rational expectations, given that real interest rates evolve in an autoregressive fashion (see below).

Table 1: Excess valuation by 2013 (% relative to benchmark decade, 1987-96)

CMA	Price-Rent Ratio		Extrapolation		Mean-reverting	
	MLS ave.	Teranet	MLS ave.	Teranet	MLS ave.	Teranet
Calgary	63	58	-32	-34	51	45
Edmonton	50	49	-41	-42	36	35
Gatineau*	83	54	3	-13	72	44
Halifax	65	53	-10	-17	55	43
Hamilton	54	36	-19	-28	45	28
Montreal	95	78	9	0	82	67
Ottawa*	54	39	-19	-26	44	31
Quebec	109	99	16	10	94	85
Toronto	49	40	-23	-27	40	32
Vancouver	84	85	-5	-4	73	73
Victoria	62	73	-15	-10	54	64
Winnipeg	81	84	-17	-15	57	60
Average	71	62	-13	-17	59	51
Weighted	69	60	-13	-17	58	50

\* Teranet index is computed for combined Ottawa-Gatineau region

<sup>15</sup>Because neither the variance nor persistence of rent growth shocks is large for any city, replacing the stochastic processes in (2) with the unconditional means makes little difference.

## 5 Mean-reverting real interest rates

Another (perhaps more rational) view of discounting recognizes that while interest rates experience persistent fluctuations, history suggests that they tend to be mean-reverting. That is, a lower than “normal” rate today may not imply particularly low rates in a few years time. To address this issue we now assume that the real mortgage interest rate follows a simple first-order autoregressive process given by

$$\hat{r}_{t+1} = (1 - \mu)\bar{r} + \mu\hat{r}_t + \varepsilon_{t+1} \quad \varepsilon_t \sim N(0, \sigma_\varepsilon^2) \quad (6)$$

and incorporate this process into our present value calculations.<sup>16</sup> We estimate the parameters of this process,  $\bar{r}$ ,  $\mu$  and  $\sigma_\varepsilon$ , using annual data from 1952-2013 and the results are provide in the first column of Table 2.<sup>17</sup> The method used to incorporate these estimates into a computation of house prices is described in Appendix B.

Table 2: Interest rate process parameter estimates

One Regime			Two Regimes					
$(1 - \mu)\bar{r}$	.014	(.005)	$(1 - \mu_h)\bar{r}_h$	.018	(.011)	$(1 - \mu_l)\bar{r}_l$	.005	(.002)
$\mu$	.706	(.093)	$\mu_h$	.639	(.208)	$\mu_l$	.870	(.034)
$\sigma_\varepsilon$	.018		$\sigma_h$	.024		$\sigma_l$	.006	
$R^2$	.496		$R^2$	.355		$R^2$	.920	

Note: Robust standard errors in parenthesis

The long-dashed lines in Figure 2 depict the implied theoretical price levels compared to the actual prices. Here, we see that when agents’ expectations make use of the observed mean reversion in the historical data, the fact that interest rates are, and have been recently, low has a much smaller impact on present value calculations and, hence, on the predicted path of prices. Perhaps surprisingly, the excess valuation implied by the theory is not all that much lower than it would be if agents ignored variation in the real interest rate altogether (see below). This is because according to the estimated process, the real interest rate converges quite quickly back to it’s estimated long run level of  $\bar{r} = 6\%$ . As the last two columns of Table 1 show, the excess valuations in 2013 implied by this theory are closer (eight to 21 percentage points lower) than those implied by the simple price-rent ratio.

<sup>16</sup>Glaeser et al. (2011) estimate a similar process but allow the variance to be proportional to  $\hat{r}_t$ . When we allow for alternative long-run interest rate regimes (see below), we allow the variance to differ across regimes.

<sup>17</sup>The real interest rate is computed as the mortgage rate at date  $t - 1$  minus the CPI inflation rate between  $t - 1$  and  $t$ .

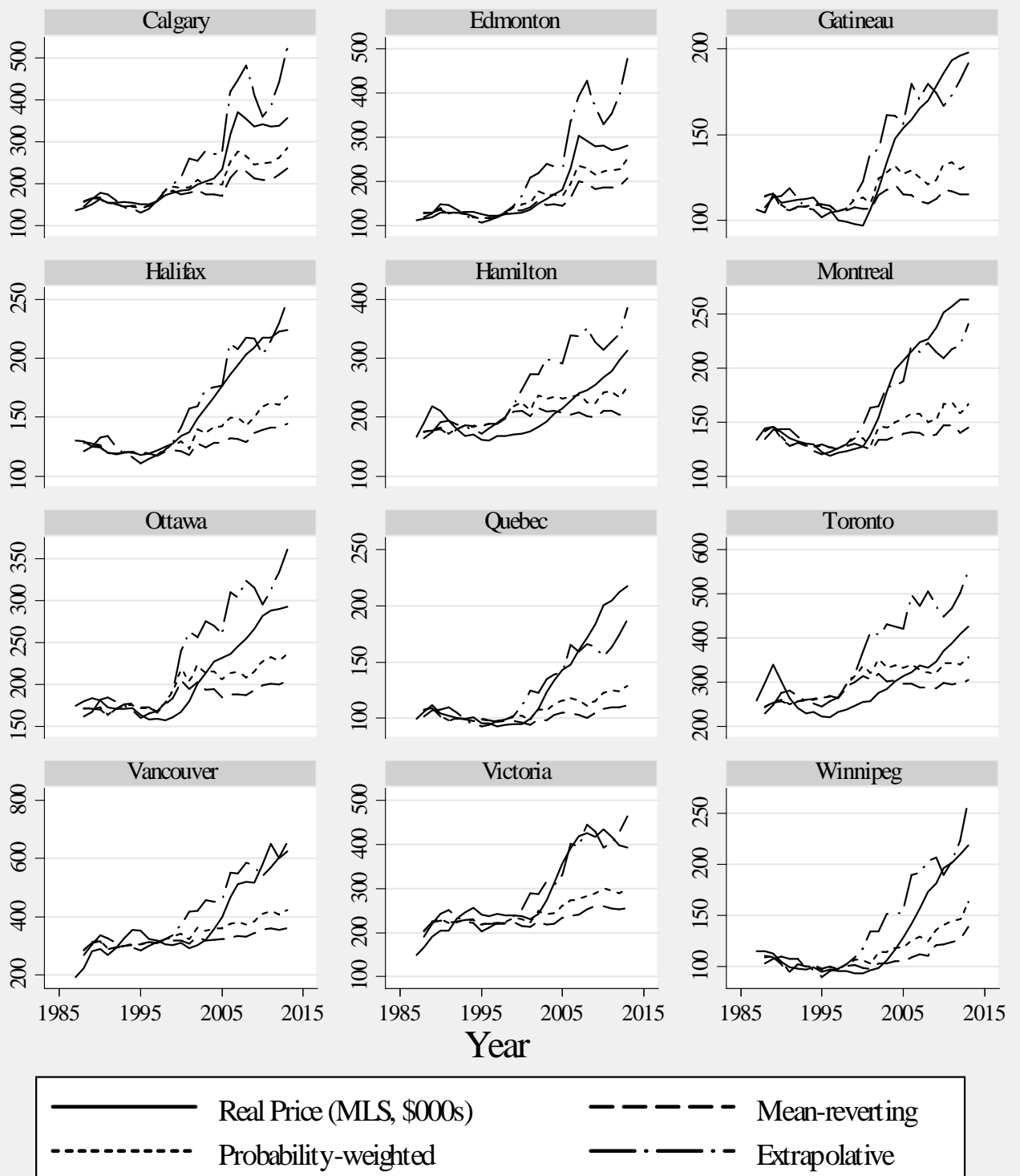


Figure 2: Price predictions under alternative discounting assumptions

## 6 The *new normal*: allowing for alternate real interest regimes

We now consider the possibility that the real interest rate process estimated using historical data in the previous section is no longer relevant, and that rational participants in Canadian real estate markets know this. The real interest rate of an open economy like Canada is closely tied to world-wide real interest rate movements. There are good reasons to believe that global long-run, “normal” real interest rates have, in the last decade, fallen permanently relative to their levels in the 1980s and 1990s. Thus, Canadian mortgage rates may be rationally forecast to remain low. Beaudry and Bergevin (2013), for example, identify several factors that are expected to result in low global real interest rates over the next decade or so. These include slower growth of labour forces and aging populations in developed countries which are expected to reduce investment demand and increase savings, high and rising savings by households in China and other emerging economies and the persistent after-effects of the Great Recession which continues to dampen investment demand and has induced less borrowing and greater saving by US households.

To capture this possibility, we estimate a simple two-regime switching process for the real interest rate in which the likelihood of being in one regime rather than the other depends only on recent observations of the interest rate.<sup>18</sup> The results are provided in the second column of Table 2. All of the estimated parameters ( $\bar{r}_i$ ,  $\mu_i$  and  $\sigma_i$ ) are allowed to vary across the two possible regimes,  $i \in \{l, h\}$ . The estimates imply that the two potential regimes consist of a high long-run real interest rate regime with  $\bar{r}_h \simeq 5\%$  and a low long-run rate regime with  $\bar{r}_l \simeq 3.5\%$ . Figure 3 depicts the estimated probability assigned to being in the low interest rate regime at each date. This procedure generates a probability of being in the low rate regime which varies from a low of 0.08 in 1987 to a value of 0.78 in 2013.

At each date, we assign the estimated probabilities to being in each of the two regimes when calculating present discounted values. In effect this implies that it gradually becomes increasingly likely that the long run rate to which the real interest rate is expected to revert is the lower value (i.e.  $\bar{r}_l = 3.5\%$ ). The short-dashed lines in Figure 2 illustrate the new implied theoretical price compared to the actual price. Now, even though we allow for mean reversion, the theoretical price does increase substantially more than if variation in the interest rate were ignored. But, as shown in the first two columns of Table 3 it still implies significant excess valuation in the actual house price across all the cities by the end

---

<sup>18</sup>Again we use a four-year moving average of past real interest rates.

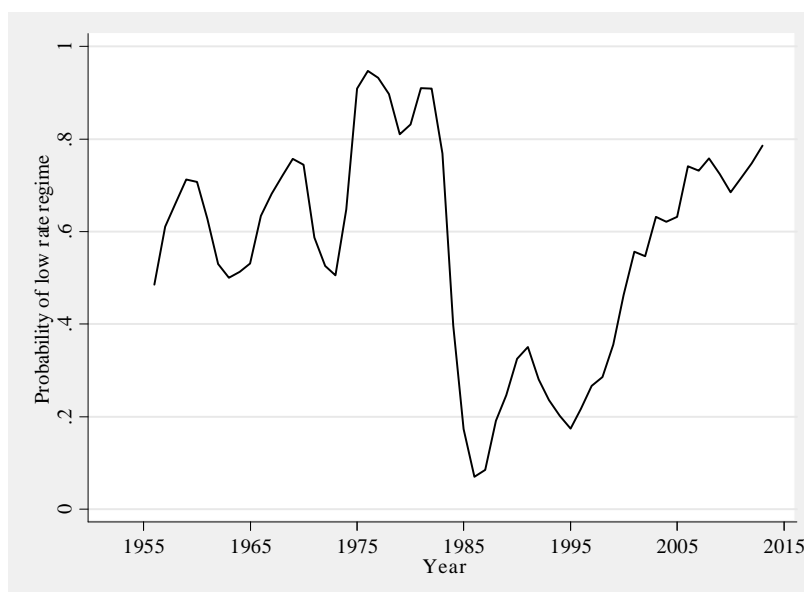


Figure 3: Likelihood of the Economy Being in the Low-Rate Regime

of 2013.

It is possible that our estimates of the probability that the economy has transitioned to the low-rate regime are too low. Suppose that agents have full confidence that the world economy has transitioned permanently to one with a low long-run real interest rate. The middle two columns of Table 3 document the implications of this scenario, by placing probability one on being in the low (3.5%) normal rate regime in 2013. This reduces our estimates of excess valuations substantially, but does not eliminate them. House prices are still high, in the Canadian cities we study, relative to what they would be under extrapolative discounting, owing to the fact that the real interest rate is currently low relative even to the new normal. The population-weighted average of excess valuations is between 28 and 35%, depending on which price index is used.



Table 3: Excess valuation by 2013 (%) with switch to the new “normal”

CMA	Probability-weighted		Full confidence		Variable Taxes		Confidence+Taxes	
	MLS ave.	Teranet	MLS ave.	Teranet	MLS ave.	Teranet	MLS ave.	Teranet
Calgary	25	20	19	14	17	13	11	7
Edmonton	12	11	6	6	5	4	-1	-2
Gatineau*	50	26	44	21	49	25	43	20
Halifax	34	24	28	18	35	25	30	20
Hamilton	24	9	19	5	23	9	18	4
Montreal	58	45	52	39	58	45	52	39
Ottawa*	24	12	18	7	23	11	17	6
Quebec	69	61	62	54	68	60	62	54
Toronto	20	13	14	8	19	12	13	7
Vancouver	48	48	41	42	43	43	36	36
Victoria	31	40	26	34	27	36	21	29
Winnipeg	34	36	28	30	26	28	21	23
Average	36	29	30	23	33	26	27	20
Weighted	35	28	29	23	32	26	27	20

\* Teranet index is computed for combined Ottawa-Gatineau region

## 7 Allowing for property tax variation

Effective property tax rates vary across cities and time both because mill rates,  $\tau_{ct}$ , and property assessment ratios,  $\alpha_{ct}$ , vary. Accounting for effective tax rates which are heterogeneous across cities but time-invariant makes little difference for our calculations. Rather, what matters is the variation across time and how this variation differs across cities. Unfortunately, computing effective property tax rates,  $\tau_{ct}\alpha_{ct}$ , is made difficult by the facts that 1) mill rates are set by individual municipalities and not recorded by any central agency and 2) average assessment values are not published by Statistics Canada.

Here we make use of calculations by Murrell (2008), who estimates average effective property tax rates at the provincial level for three time periods (1981-83, 1997-99 and 2005-07) by computing the ratio of average residential property taxes paid by homeowners to average property values. Murrell finds that, after rising somewhat during the 1980s, effective property tax rates fell in every province between 1999 and 2006. This should not be surprising: even if mill rates rose somewhat, assessed values did not generally rise as rapidly as actual house prices.<sup>19</sup> We replicate Murrell’s calculations for 2010-12 and find that while the tax

<sup>19</sup>Murrell’s results suggest that assessed values were less than half of actual property values by 2005.

rate continued to fall in some cities, it *rose* in most between 2006 and 2011.

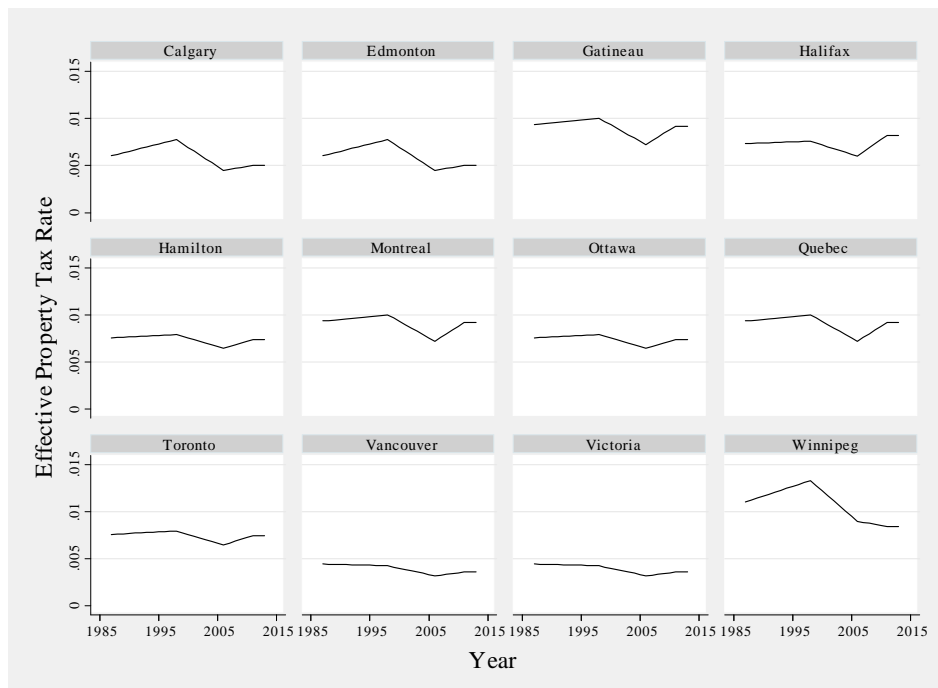


Figure 4: Effective Property Tax Rate (proxy based on Murrell (2008) and authors' calculations)

Here we try to capture the effects of the observed effective tax rate decline in a rather crude fashion. Specifically, we assume the tax rates in 2013 are equal to those estimated for 2010-12. We then linearly interpolate to obtain the rates between 1982, 1999, 2007 and 2011. The implied tax rate time paths for each province are then assumed to be the same for each city in that province. These time paths are illustrated in Figure 4 and when computing present values at each date we assume that the household perceives that they will be constant from that date on.

While these calculations are admittedly simple, note that what matters for the excess valuation calculations is their impact in 2013 relative to the benchmark decade. The last four columns of Table 3 correspond to the first four, but with these effective tax rates incorporated. Figure 5 depicts the actual and predicted price paths when we incorporate variation in tax rates across cities and time. As may be seen, in cities where effective tax rates declined substantially (Calgary, Edmonton, Winnipeg, Vancouver and Victoria) this should have contributed to rising prices in theory and, hence, lowers the implied excess

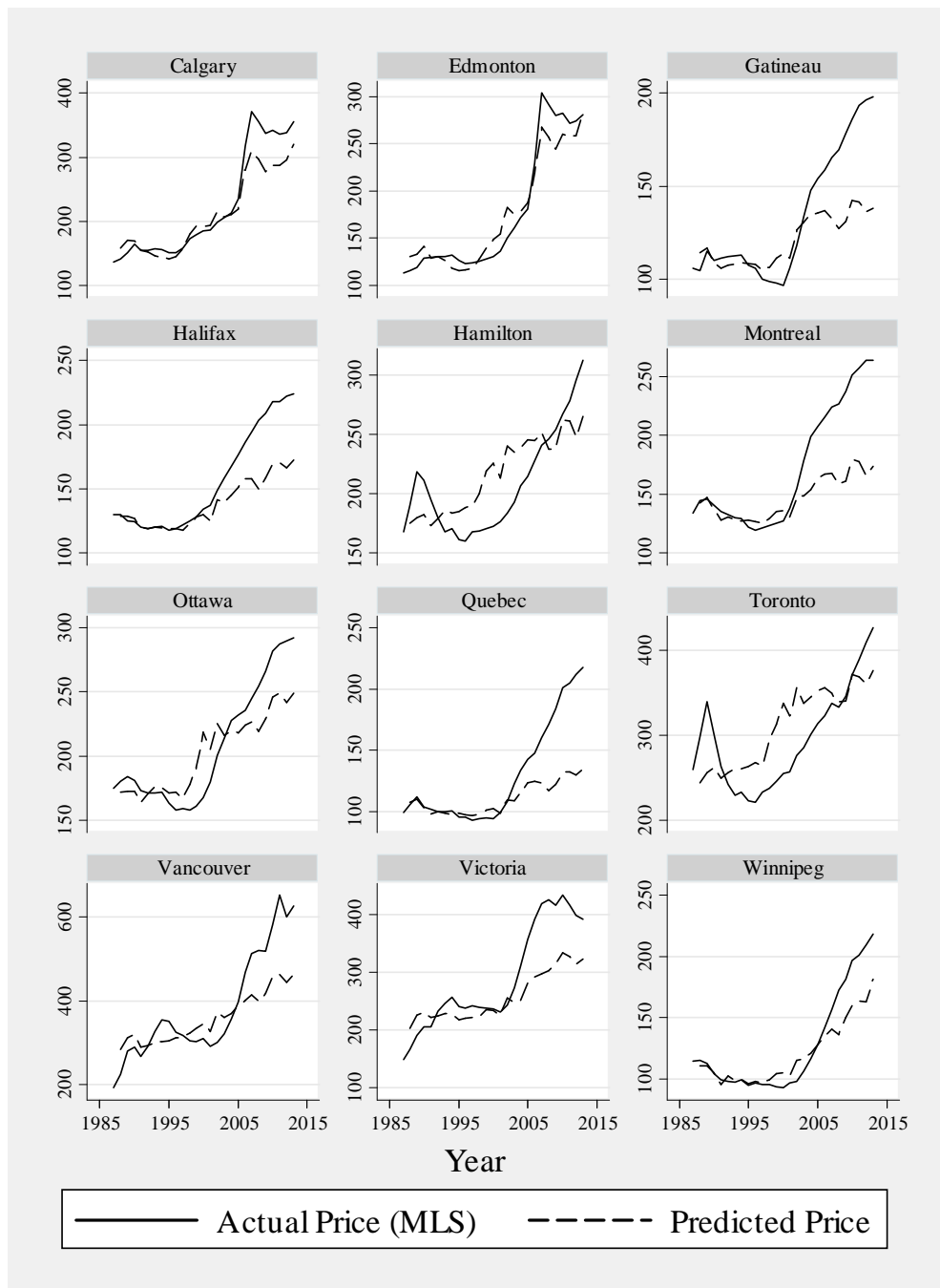


Figure 5: Price predictions under the new normal with taxes incorporated

valuations. Elsewhere there is little effect.

## 8 Alternative assumptions

### 8.1 Accounting for the Likelihood of Quebec Separation

In all of our calculations above, the three cities in Quebec stand out as having experienced excessive price-rent growth relative to that predicted by our model. A cursory glance at real rents over the sample provides one possible reason for this: real rent growth over the sample in these cities was negative on average, whereas in all other cities it was positive. This overall decline masks the fact, illustrated in Figure 6, that real rents declined on average only until the mid-1990s before growing (quite rapidly in Montreal and Quebec City) subsequently. It is not hard to think of reasons why: the potential for separation of Quebec from the rest of Canada was becoming increasingly likely until after the Quebec referendum in 1995. Subsequently, confidence that this would not happen gradually grew so that rent growth became positive.

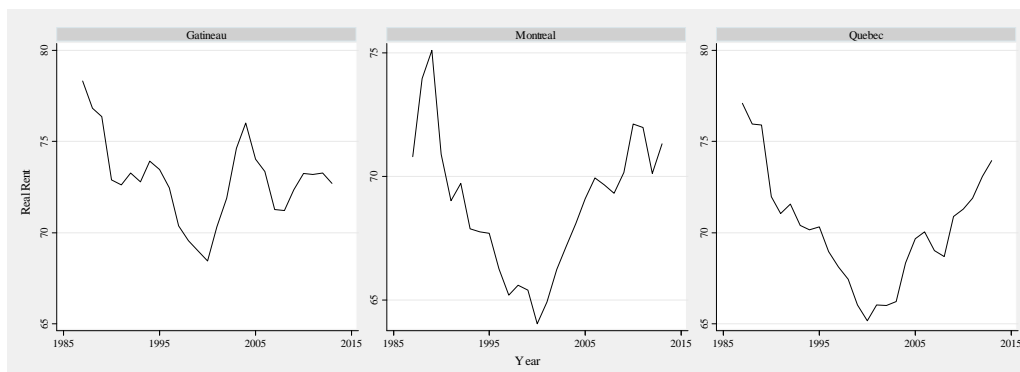


Figure 6: Real Rents in Quebec

Our modelling of rent growth (and hence expected rent growth) in equation (3) is naive in that it does not take into account this major event in recent Canadian history. To capture it in as simple a way as possible we introduce a dummy term in the rent growth equations for the cities in Quebec that allows the unconditional mean to adjust before and after 1996. Consequently, expected long term rent growth is no longer negative after this date and this is reflected in house prices. Table 4 documents the implications for the three cities and the overall averages for all cities. As may be seen the impact is especially significant for Montreal

and Quebec whose excess valuations are cut by 50% or more. The overall simple average for Canada declines by over 6 percentage points and the weighted average by even more (reflecting the large adjustment for Montreal).

Table 4: Excess valuation by 2013 (%) after adjusting rent growth for the Quebec referendum

CMA	Probability-weighted		Full confidence		Variable Taxes		Confidence+Taxes	
	MLS ave.	Teranet	MLS ave.	Teranet	MLS ave.	Teranet	MLS ave.	Teranet
Calgary	25	20	19	14	17	13	11	7
Edmonton	12	11	6	6	5	4	-1	-2
Gatineau*	<b>36</b>	<b>14</b>	<b>30</b>	<b>9</b>	<b>36</b>	<b>25</b>	<b>30</b>	<b>9</b>
Halifax	34	24	28	18	35	25	30	20
Hamilton	24	9	19	5	23	9	18	4
Montreal	<b>23</b>	<b>13</b>	<b>18</b>	<b>8</b>	<b>23</b>	<b>13</b>	<b>18</b>	<b>8</b>
Ottawa*	24	12	18	7	23	11	17	6
Quebec	<b>35</b>	<b>29</b>	<b>30</b>	<b>23</b>	<b>35</b>	<b>29</b>	<b>30</b>	<b>24</b>
Toronto	20	13	14	8	19	12	13	7
Vancouver	48	48	41	42	43	43	36	36
Victoria	31	40	26	34	27	36	21	29
Winnipeg	34	36	28	30	26	28	21	23
Average	<b>29</b>	<b>22</b>	<b>23</b>	<b>17</b>	<b>26</b>	<b>20</b>	<b>20</b>	<b>14</b>
Weighted	<b>26</b>	<b>20</b>	<b>21</b>	<b>15</b>	<b>24</b>	<b>18</b>	<b>18</b>	<b>12</b>

Figures in bold are those that have changed relative to Table 3

## 8.2 Discounted mortgage rate

As noted earlier our use of the 5 year conventional mortgage rate published by Statistics Canada may overstate the true average mortgage rate paid by households since banks offer discounts based on customer negotiations. Unfortunately, there appears to be no data on actual average mortgage rates. In Table 5 we consider the potential consequences of this by assuming that the actual mortgage rate paid is a constant one percentage point lower than the published value. We continue to adjust for the Quebec referendum.

Perhaps not surprisingly, the discounted mortgage causes excess valuations to fall substantially: roughly 50% on average when compared to Table 4. When using the Teranet index, under some assumptions the weighted average of excess valuations may be as low as 6%. These implications depend crucially on the nature of the discount: if we assumed instead that the actual mortgage rates was, say, 20% lower than the posted rate throughout

the period, the excess valuations would not change much. Using a fixed percentage point discount implies a proportionally larger reduction when rates are low than when they are high.

Table 5: Excess valuation by 2013 (%) with discounted mortgage and adjusted for the referendum

CMA	Probability-weighted		Full confidence		Variable Taxes		Confidence+Taxes	
	MLS ave.	Teranet	MLS ave.	Teranet	MLS ave.	Teranet	MLS ave.	Teranet
Calgary	7	3	4	1	3	-1	0	-4
Edmonton	1	1	-1	-2	-3	-4	-6	-6
Gatineau*	21	2	18	-1	23	3	19	0
Halifax	11	2	8	0	13	5	11	2
Hamilton	21	6	17	3	21	6	17	3
Montreal	14	4	11	1	15	5	12	3
Ottawa*	12	2	9	-1	12	2	9	-1
Quebec	23	17	20	13	24	18	21	15
Toronto	17	11	14	7	17	11	14	7
Vancouver	27	27	23	24	24	25	20	21
Victoria	7	14	4	11	5	12	2	8
Winnipeg	16	18	13	15	11	13	8	10
Average	15	9	12	6	14	8	11	5
Weighted	16	10	13	7	15	9	12	6

### 8.3 Alternative benchmark period

It is possible that our choice of the benchmark period (1987-96) may have biased the excess valuations *upwards*. Perhaps owned housing was undervalued in some cities during that period. Note, however, that the national price-rent ratio during this period was actually very close to its value over the period 1973-2013. Nevertheless, in Table 6 we reproduce the results using the average over the whole available sample (1987-2013) as a benchmark.<sup>20</sup> Since the Teranet data does not extend back beyond 1999, these can only be computed for average MLS prices. In this case, the implied weighted average excess valuation lies in a range between 14 and 18% , and the ranking of cities remains unchanged.

<sup>20</sup>We continue to adjust for the Quebec referendum.

Table 6: Excess valuation by 2013 (% relative to average and adjusted for referendum)

CMA	Prob.-weighted MLS ave.	Full confidence MLS ave.	Variable Taxes MLS ave.	Confidence+Taxes MLS ave.
Calgary	8	5	5	2
Edmonton	1	-1	-2	-5
Gatineau	24	20	24	21
Halifax	12	9	14	11
Hamilton	22	19	22	19
Montreal	16	14	18	15
Ottawa	14	11	14	11
Quebec	26	23	27	24
Toronto	19	16	19	16
Vancouver	29	25	27	23
Victoria	8	6	7	4
Winnipeg	17	14	13	10
Average	16	13	16	13
Weighted	18	15	17	14

## 9 Concluding remarks

Alternative assumptions regarding expected future interest rates, expected rent growth and property taxes have large effects on indicators of the relative valuation of owned versus rental housing. We argue that while it is reasonable to allow for mean-reversion in real interest rates, there is substantial evidence that the long-run real interest has fallen significantly relative to its level in the late 1980's and early 1990's. We compute an indicator of the relative valuation that tries to take this possibility into account, as well as variation in rental growth across cities, property taxes, quality improvements and impacts of the 1995 Quebec referendum.

We find that the relative valuation of owned versus rental housing has increased substantially in some cities, though not nearly as much as would be implied by standard indicators of the price-rent ratio. In some cities (*e.g.* Edmonton and Hamilton), accounting for these other factors comes close to rationalizing price movement. In others (especially Quebec City and Vancouver) the excess valuation remains substantial even when we account for these factors. After accounting for interest rate regime change, property taxes and the impacts of the Quebec referendum on rents (Column 3 of Table 4), we find that the implied excess valuations, relative to the benchmark decade, range between 4% (Edmonton) and 43%

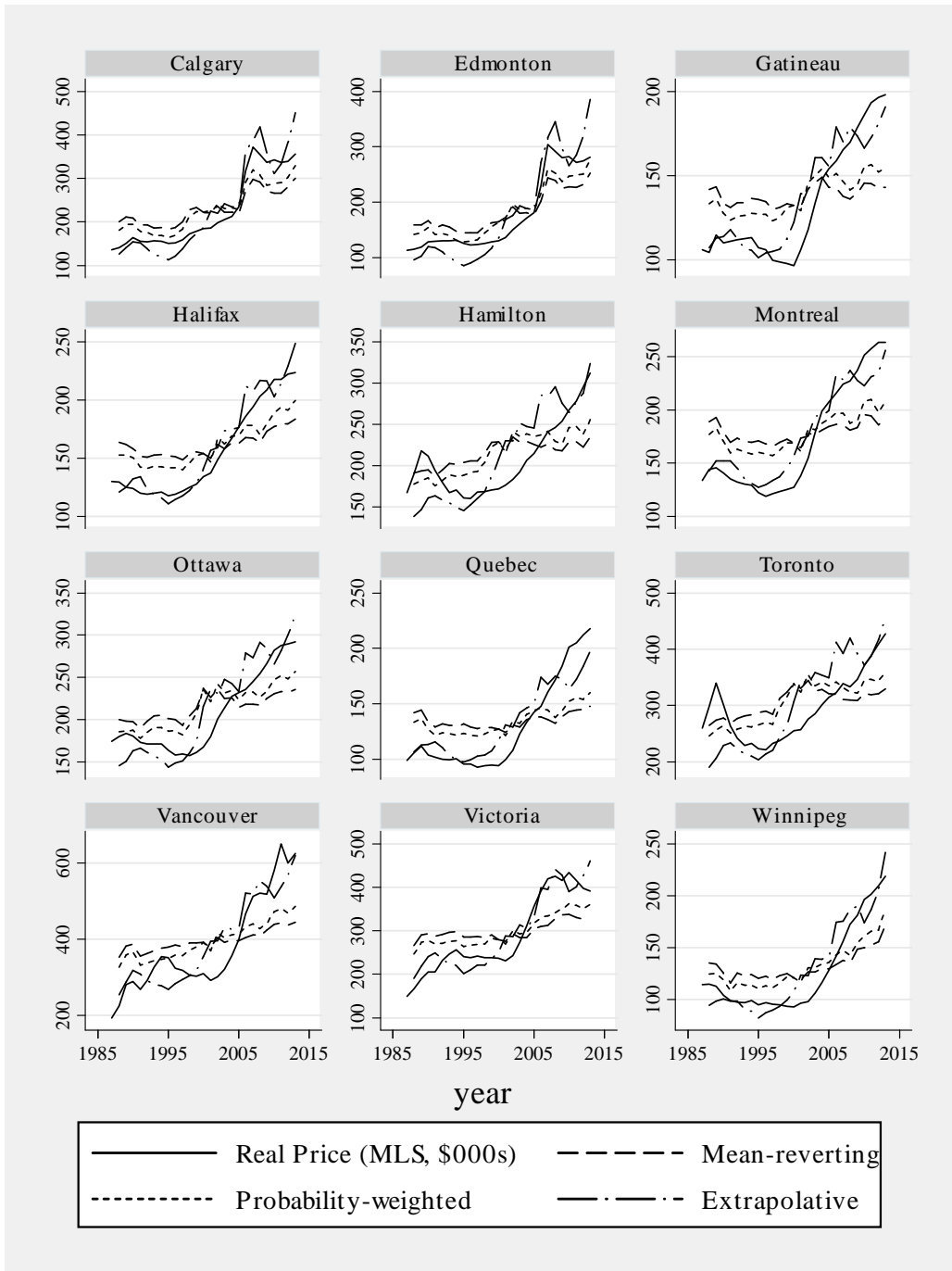


Figure 7: Predicted Prices relative to sample average



(Vancouver) and the weighted average is between 18 and 24%. In all cases our measure of excess valuation is significantly lower than that implied by considering only the growth of the price-rent ratio.

Whether these calculations reflect "over-valuation" of residential housing in Canadian cities depends on whether or not the *ownership premium*,  $\theta_{ct}$ , for residential housing has increased substantially for fundamental reasons. In most cases, not much of this can be accounted for by relative quality improvements, but it is possible that rising real incomes could have increased the households' marginal utility from (and hence desire for) home-ownership. Unless, however, the relative costs of producing owner-occupied (as opposed to rental) housing change in a secular fashion over time, it is not clear why  $\theta_{ct}$  would have a substantial trend. Another possibility is that there have been significant composition effects due to rising incomes or rising inequality.

## 10 Appendices

### Appendix A: Data Sources

**Average city house prices** by city is the MLS<sup>®</sup> Average Residential Price taken from the Canadian Housing Observer  
(<https://www03.cmhc-schl.gc.ca/catalog/productList.cfm?cat=122&lang=en&fr=1414002320325>)

**Teranet-National Bank House price index** by city is taken from the Canadian Housing Observer, Housing Market Indicators  
(<http://www.cmhc-schl.gc.ca/en/corp/about/cahoob/data/index.cfm>)

**Average rents** by city refer to the average rent for two bedroom apartment taken from the Canadian Housing Observer, Housing Market Indicators  
(<http://www.cmhc-schl.gc.ca/en/corp/about/cahoob/data/index.cfm>)

**The mortgage rate** is the CMHC's 5-year conventional mortgage lending rate from Statistics Canada Table 027-0015. This is also described as the "average residential mortgage lending rate: (5 year)" in Statistics Canada Table 176-0043.

**The inflation rate** is the growth rate in the consumer price index from Statistics Canada Table 326-0021.

**Average effective tax rates** by province are based on calculations by Murrell (2008) and data on average property values and average property taxes from Statistics Canada, Survey of Household Spending (Tables 203-0003 and 203-0021)

**Average maintenance and other costs of home-ownership** are also taken from Statistics Canada, Survey of Household Spending (Tables 203-0003 and 203-0021). We find that property taxes consistently account for 50% of the total non-mortgage costs of home-ownership.

## Appendix B: Present Value Calculations

The present value of rental payments in city  $c$  at time  $t$  can be expressed as

$$Z_{ct}R_{ct} = R_{ct} + R_{ct}E_t \sum_{j=1}^{\infty} \exp \left( - \left( \sum_{s=1}^j \hat{r}_{t+s} - \sum_{s=1}^j g_{ct+s} \right) \right)$$

where  $\hat{r}_{t+s} = \ln(1 + r_{t+s})$  and  $g_{ct}$  denotes the growth rate of rents.

The cost of housing is

$$\psi P_{ct} + T_{ct} + E_t \sum_{j=1}^{\infty} \prod_{s=1}^j \left( \frac{1}{1 + r_{t+s}} \right) (\beta r_{t+j} (1 - \psi) P_{ct} + T_{ct+j})$$

This simplifies to<sup>21</sup>

$$(\psi + \beta(1 - \psi)) P_{ct} + T_{ct} + E_t \sum_{j=1}^{\infty} \exp \left( - \sum_{s=1}^j \hat{r}_{t+s} \right) T_{ct+j}$$

Under the assumptions described in the main text, the time  $t + j$  value of property taxes with constant mill rates,  $\tau_c$ , and assessed value to price ratios,  $\alpha_c$ , is given by

$$T_{ct+j} = \tau_c \alpha_c P_{ct} e^{\sum_{s=1}^j g_{ct+s}}$$

It follows that cost of owning is given by (4).

Using (6), the total interest accumulated between  $t$  and  $j$  is

$$X_{t+j}^r = \sum_{s=1}^j \hat{r}_{t+s}$$

is normally distributed with conditional mean

$$\begin{aligned} M_{t,j}^r &= E_t X_{t+j}^r = \sum_{s=1}^j [\bar{r} + \mu^s (\hat{r}_t - \bar{r})] \\ &= j\bar{r} + (\hat{r}_t - \bar{r}) \sum_{s=1}^j \mu^s \\ &= j\bar{r} + \frac{\mu(1 - \mu^j)}{1 - \mu} (\hat{r}_t - \bar{r}) \end{aligned}$$

---

<sup>21</sup>This follows from the fact that

$$\sum_{j=1}^{\infty} \prod_{s=1}^j \left( \frac{1}{1 + r_{t+s}} \right) r_{t+j} = 1.$$

and variance

$$\begin{aligned}
V_{t,j}^r &= \text{Var}_t(X_{t+j}^r) = \text{Var}_t\left(\sum_{s=1}^j \varepsilon_{t+s} \sum_{i=0}^{j-s} (1 + \mu + \dots + \mu^{j-s})\right) \\
&= \text{Var}_t\left(\sum_{s=1}^j \varepsilon_{t+s} \frac{1 - \mu^{j-s+1}}{1 - \mu}\right) = \sigma_\varepsilon^2 \sum_{s=1}^j \left(\frac{1 - \mu^{j-s+1}}{1 - \mu}\right)^2 \\
&= \frac{\sigma_\varepsilon^2}{(1 - \mu)^2} \sum_{s=1}^j \left(1 - 2\mu^{j-s+1} + (\mu^2)^{j-s+1}\right) \\
&= \frac{\sigma_\varepsilon^2}{(1 - \mu)^2} \left(j - 2\mu \sum_{s=1}^j \mu^{j-s} + \mu^2 \sum_{s=1}^j (\mu^2)^{j-s}\right) \\
V_{t,j}^r &= \frac{\sigma_\varepsilon^2}{(1 - \mu)^2} \left(j - 2\mu \left(\frac{1 - \mu^j}{1 - \mu}\right) + \mu^2 \left(\frac{1 - \mu^{2j}}{1 - \mu^2}\right)\right)
\end{aligned}$$

Similarly, using (3), the conditional mean of rent growth between  $t$  and  $j$  is

$$M_{ct,j}^g = j\bar{g}_c + \frac{\rho_c(1 - \rho_c^j)}{1 - \rho_c}(g_{ct} - \bar{g}_c)$$

and its variance is

$$V_{ct,j}^g = \frac{\sigma_{ce}^2}{(1 - \rho_c)^2} \left(j - 2\rho_c \left(\frac{1 - \rho_c^j}{1 - \rho_c}\right) + \rho_c^2 \left(\frac{1 - \rho_c^{2j}}{1 - \rho_c^2}\right)\right)$$

It follows that

$$Z_{ct} = 1 + \sum_{j=1}^{\infty} \exp\left(-\left(M_{t,j}^r + \frac{V_{t,j}^r}{2} - M_{ct,j}^g - \frac{V_{ct,j}^g}{2}\right)\right).$$

At each date, given  $r_t$  and  $g_t$  we solve forward and approximate the sum by truncating it to 1000 periods.

## References

- [1] Beaudry, Paul and Philippe Bergevin (2013), “The New ‘Normal’ for Interest Rates in Canada: The Implications of Long-Term Shifts in Global Savings and Investment,” C.D. Howe Institute E-Brief, May 29, 2013.
- [2] Dunning, Will (2014), “How to dissect a housing bubble,” Report published by Will Dunning Inc., March 12, 2014. <http://www.wdunning.com/docs/Bubble-report-2014-03-12.pdf>
- [3] Glaeser, Edward L., Joshua D. Gottlieb and Joseph Gyourko (2010), “Can Cheap Credit Explain the Housing Boom?,” NBER Working Paper No. 16230.
- [4] Himmelberg, Charles, Christopher Mayer, and Todd Sinai (2005), “Assessing High House Prices: Bubbles, Fundamentals and Misperceptions.” *Journal of Economic Perspectives*, 19(4):67-92, Fall.
- [5] Murrell, David (2008), “Are Property Tax Rates in Atlantic Canada Rising or Falling?” mimeo, University of Fredricton.
- [6] O’Brien, M. (2013), “The Biggest Housing Bubble in the World is in... Canada?,” The Atlantic, [www.theatlantic.com/business/archive/2013/01/the-biggest-housing-bubble-in-the-world-is-in-canada/272499/](http://www.theatlantic.com/business/archive/2013/01/the-biggest-housing-bubble-in-the-world-is-in-canada/272499/).
- [7] OECD (2014), *Economic Surveys: Canada*, OECD Publishing.
- [8] Poterba, James (1984), “Tax Subsidies to Owner-Occupied Housing: An Asset Market Approach,” *Quarterly Journal of Economics*, vol. 99(4), pp. 729-52.
- [9] Roubini, N. (2013), “Housing bubble 2.0 can only end badly”, The Guardian, 2 December.