



# A Structural Model of the Canadian Housing Market: Measuring Overvaluation and Exposure to Consumer Indebtedness

Is the Canadian housing market overvalued? And if so, what factors could trigger a severe house price correction? Motivated by the spectacular rise and fall of house prices south of the border, this paper aims to provide a post-Recession assessment of whether Canada currently faces a US-style housing crash. Using an error-correction model framework, we attempt to measure the divergence of residential house prices from their fundamental values. Bearing in mind present trends in consumer debt levels, we further empirically test for potential drivers of this overvaluation, and quantitatively evaluate the vulnerability of house prices to hikes in the interest rate. We find that current prices are overvalued in the sense that they cannot be justified by previously estimated determinants and have severely deviated from their equilibrium levels. Through further testing, we establish that the level of a household's available income has become an increasingly significant factor in the determination of house prices. Significant erosion of this variable has the potential to trigger a sharp correction in the housing market, however this decline is unlikely to be solely caused by increasing debt obligations.

Madeleine Payne

With Significant Contribution by Professor Mike Kennedy

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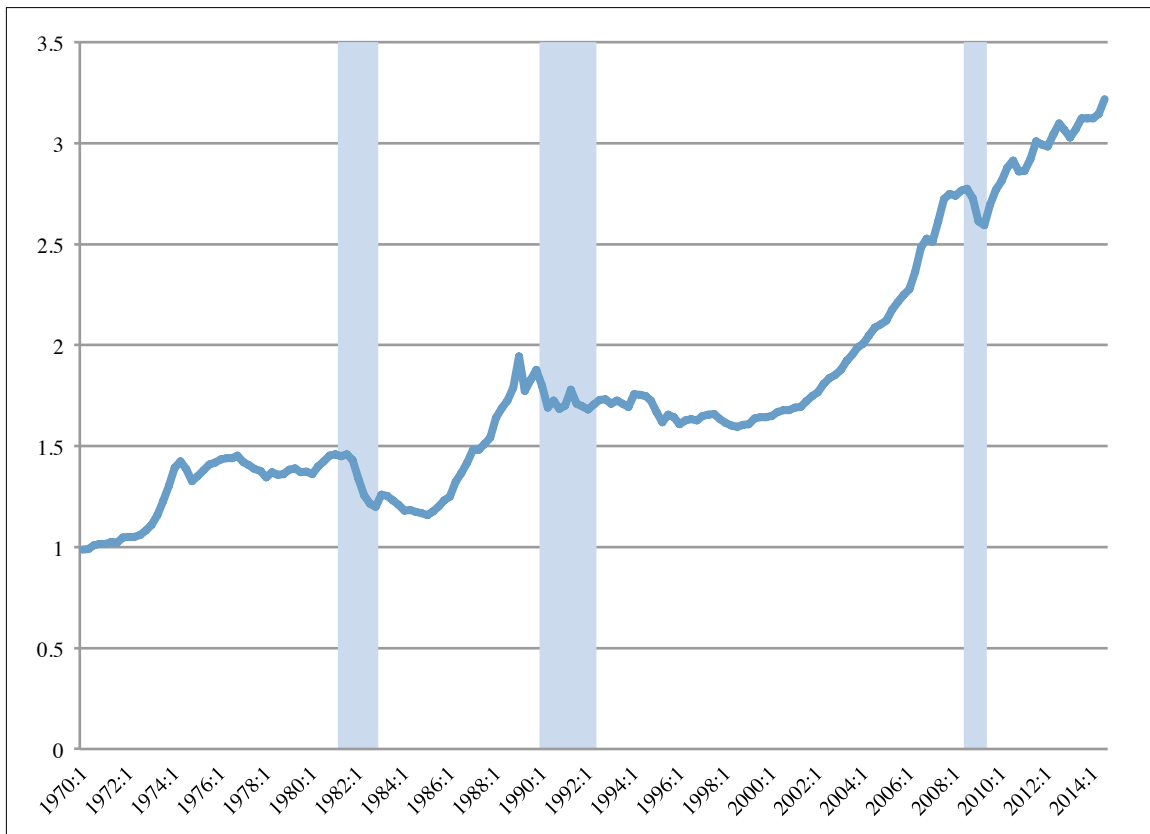
*Is the Canadian housing market overvalued? And if so, what factors could trigger a severe house price correction? Motivated by the spectacular rise and fall of house prices south of the border, this paper aims to provide a post-Recession assessment of whether Canada currently faces a US-style housing crash. Using an error-correction model framework, we attempt to measure the divergence of residential house prices from their fundamental values. Bearing in mind present trends in consumer debt levels, we further empirically test for potential drivers of this overvaluation, and quantitatively evaluate the vulnerability of house prices to hikes in the interest rate. We find that current prices are overvalued in the sense that they cannot be justified by previously estimated determinants and have severely deviated from their equilibrium levels. Through further testing, we establish that the level of a household's available income has become an increasingly significant factor in the determination of house prices. Significant erosion of this variable has the potential to trigger a sharp correction in the housing market, however this decline is unlikely to be solely caused by increasing debt obligations.*

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## Introduction

The swift and steady rise in housing prices observed over the past several years has raised concerns of a speculative bubble, and has lead many to wonder when it will burst. Irrespective of the existence of such a bubble one begs the question; if house prices should indeed experience a sharp correction, how severe will the impact be on the broader economy? And further, can anything be done to cool the red-hot housing market?

Canadian house prices have been rising at unprecedented rates. Real house prices have appreciated by 54% in the last 10 years and 95% in the last 15, vastly outpacing increases in the price level and disposable income over the same period (Figure 1). Further, in contrast to many other countries, Canadian house prices generally remained high throughout the global financial crisis, and never experienced the sharp correction endured by its neighbor to the south.

**Figure 1: Real House Price in Canada (1970=1)**

Source: OECD

Moreover, while house prices have steadily risen and exceeded their pre-crisis peaks, Canadians have taken on more debt. Low interest rates and steady income growth have helped catapult the household debt-to-income ratio to record highs, reaching 165% in the third quarter of 2014 up from just 89% in the prior 15 years (Figure 2). The union of these two phenomena, the inability of highly leveraged households to service their debt leading to a widespread correction in house prices, could have significant implications for the Canadian economy and has been named by Bank of Canada as the most important domestic financial system risk facing the country (Poloz et al., 2014).

Certainly, should this scenario come to pass, the repercussions on the broader economy could be severe and widespread. Housing represents almost 40 percent of the average family's total assets, equivalent to their investments in the stock market, insurance and pension plans combined (Carney, 2011). Thus, housing not only represents a basic human need, but also a substantial financial asset in Canadian portfolios. Given the grave repercussions that could accompany a crash in house prices, we believe that it is vitally important to evaluate the degree of overvaluation in the housing market and attempt to gauge the factors that may contribute to a severe price correction.

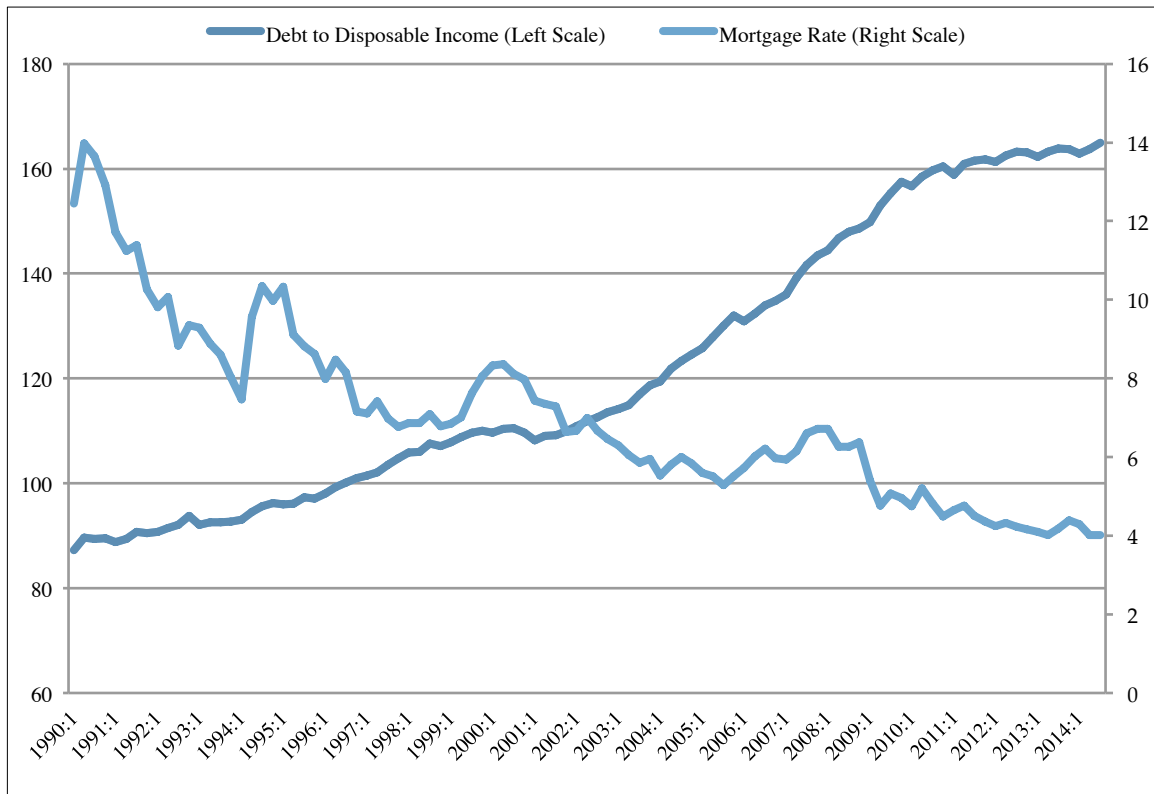
In this paper, we aim to quantify the discrepancy between residential housing prices and their fundamental values as predicted by a dynamic demand and supply model. We supplement this econometric specification with other widely accepted measures of overvalu-

ation, namely, the ratios of price-to-income and price-to-rent. In addition, we assess the susceptibility of housing prices to a hike in the interest rate, and evaluate whether higher rates could indeed trigger a severe correction in the Canadian housing market.

We find that while select simpler indicators do not necessarily suggest a housing bubble, a more sophisticated econometric model does. Indeed, we find that current prices are overvalued in the sense that they cannot be justified by previously estimated determinants and have severely deviated from their equilibrium levels. Through further testing, we establish that the level of a household’s available income has become an increasingly significant factor in the determination of house prices. Significant erosion of this variable has the potential to trigger a sharp correction in the housing market, however this decline is unlikely to be solely caused by increasing debt obligations.

The first section of this paper briefly summarizes the history of housing bubbles in the Canadian context. We then review some of the associated literature that has examined past housing overvaluation and the methodology that was used to come to the authors’ conclusions. Subsequently, we begin to empirically evaluate the existence of a contemporary bubble ourselves with the simple ratios of price-to-income, price-to-rent and finally price-to-interest. The remainder of the paper is devoted to introducing as well as discussing the results and implications of our structural model of Canadian housing prices. In closing, we offer our conclusions and an acknowledgement of the limitations and potential caveats in our analysis.

**Figure 2: Debt to Disposable Income and the Average 5-Year Residential Mortgage Lending Rate**



Source: Statistics Canada

## A Brief History of Canadian Housing Cycles

Prior to speculating the existence of a Canadian housing bubble, we must first define the term. We subscribe to the following definition first coined by Stiglitz (1990) and echoed by McCarthy and Peach (2004):

“If the reason the price is high today is only because investors believe that the selling price will be high tomorrow – when ‘fundamental’ factors do not seem to justify such a price – then a bubble exists.”

Thus, going forward, we will accede that a bubble exists when we observe house prices straying from their *fundamental values*; that is, the values suggested by several underlying determinants.

Generally speaking, the bursting of housing bubbles is a Canadian rarity. As seen in Figure 1, real house prices remained remarkably stable from the end of the last run-up in 1980 until the beginning of the current upsurge in the early 2000s. The only noteworthy declines in real house prices observed in the last 45 years occurred during significant economic recessions, specifically those transpiring in 1981-82, 1990-92 and 2008-09. Since then, however, house prices have risen precipitously to alarming new heights.

The most noteworthy trend seen in Figure 1 is the steep and steady ascent of real house prices since the start of the new millennium. In these past 15 years, real house prices have risen 95% and shown extraordinary resilience through the worldwide economic downturn of 2008. The brief slump that housing markets experienced over what was arguably the worst financial crisis since the Great Depression proved to be transient, as prices quickly recovered and even surpassed their pre-crisis peak.

Ostensibly, the evidence supporting a Canadian housing bubble seems overwhelming. However, these results are far from conclusive. In order to establish whether a true bubble exists, it is essential that we investigate more deeply to determine whether prices are indeed supported by fundamentals, or alternatively, based on irrational behavior and unrealistic expectations of continued price increases.

## Review of The Literature

The error-correction model (ECM) framework employed in this analysis is commonly used to evaluate the degree of overvaluation in housing markets, and there is a large body of literature that adopts this technique. In the following paragraphs, we will summarize the methods and findings of the most relevant ECM text, as well as alternative contributions to Canadian housing market analysis.

In their widely cited paper, McCarthy and Peach (2002) present a reduced-form structural model to examine the response of the U.S. housing market to a monetary policy shock. Using an ECM process to account for slow adjustment in both the demand and supply

sides of their model, they investigate whether the mechanism by which monetary policy influences housing investment has changed over time. Pertinent to the current discussion, in their follow-up work McCarthy and Peach (2004) use the same model they had previously developed to assess the existence of a U.S. housing bubble. They conclude that prices were below what is predicted by their long-run determinants, suggesting that a bubble did not exist.

In the spirit of McCarthy and Peach (2002), Dupuis and Zheng (2010) approach the Canadian housing market question from an alternative standpoint, using an ECM framework to quantify disequilibria in housing *quantity* rather than price. Their model suggests that, based on data over the period from 1961 to 2008, the Canadian housing stock was 2 percent above its equilibrium level at the end of 2008. When applying their model at the provincial level, it was found that there was likely overbuilding by the end of 2008 in Saskatchewan, New Brunswick, British Columbia, Ontario and Quebec.

Demers (2005) evaluates Canadian housing market conditions using both structural and leading-indicator models and estimates the extent to which fundamental factors can explain variations in the housing sector. The analysis concludes that fundamental information can help explain variations in housing investment in both the short and long terms, however it cannot explain the relative price of housing (i.e. the price-to-rent ratio). Furthermore, the paper finds that fundamental factors seem to support the high levels of housing investment seen since the start of the new millennium, suggesting that housing investment was not driven by speculative behavior during this time.

A further contribution to the ECM literature is that of Tsounta (2009), who looks at the fundamental determinants of house prices in five Canadian provinces (Alberta, British Columbia, Ontario, Quebec and Saskatchewan) to assess possible deviations from equilibrium. She finds that by mid-2009, house prices in Western provinces continued to show overvaluation post-boom, while prices in Eastern provinces were close to their fundamental levels. Further, her analysis concludes that the large run-up in Western house prices mostly reflected a catch-up from previously undervalued levels.

Bauer (2014) approaches the issue of house price overvaluation from outside the ECM framework. Rather, he uses a panel logit framework to estimate the likelihood of a house price correction in 18 OECD countries, with a particular focus on Canada. The paper determines that corrections are typically triggered by a sharp tightening of the monetary policy interest rate and estimates that the likelihood of a correction (i.e. a decline in real housing prices of at least 10 percent) occurring in Canada in the next two years is approximately 20 percent. The analysis is unique to the other literature reviewed in that it examines the dynamics of an international cross-section of house prices, rather than examining one country exclusively.

The contribution of this paper to the existing body of literature is, firstly, to pose the Canadian housing bubble question in the current context. It has now been well over half a decade since the onset of the U.S. housing crash and Canada has not yet experienced a major house price correction. To the best of our knowledge, the ECM framework has not

been applied to the Canadian housing market since the analysis contributed by Tsounta (2009). However, since this time, house prices have continued to rise steadily to record new highs, suggesting the topic is well overdue to be broached again. Secondly, there has yet to be analysis undertaken which links housing overvaluation to consumer debt levels. While these phenomena have appeared to move in tandem, literature has yet to test a causal relationship between the two. More precisely, this paper aims not only to answer the question of overvaluation but also to begin to explain the source of the apparent wedge between current prices and their fundamental values.

## Supplemental Evidence of Overvaluation

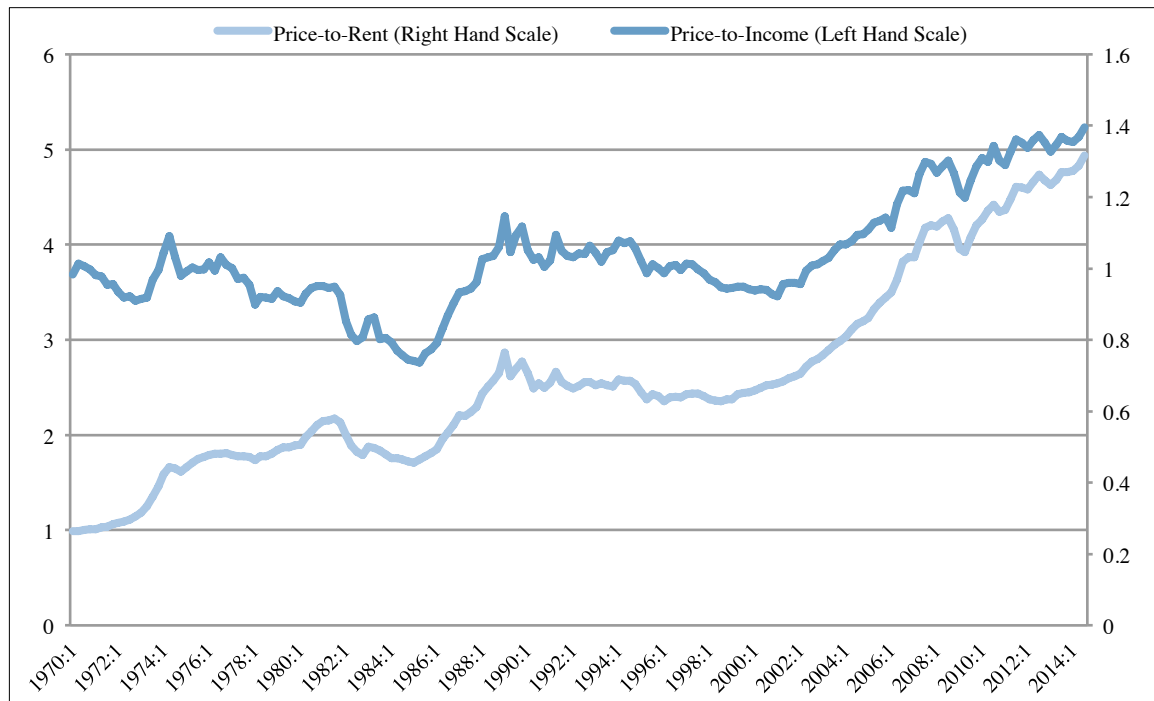
In practice, there are a number of different approaches to measuring the extent of unaffordability and overvaluation in housing markets. The first is based in simple indicators, and the second involves creating and analyzing more elaborate econometric models. While the latter will be examined in the following pages, the former will be the focus of our current discussion. Two such simple measures that have been widely used to assess housing market conditions are the ratios of price-to-income and price-to-rent.

### *The Price-To-Income and Price-To-Rent Ratios*

The ratio of median home price to median household income is frequently employed as a measure of affordability in housing markets. A high price-to-income ratio suggests that households should have more difficulty meeting down payments and mortgage interest payments, making home ownership increasingly out of reach for the average buyer. This, in turn, should reduce demand and exert downward pressure on house prices.

Another common way to evaluate whether house prices are overvalued is to compare them with the rental rates of similar housing units. Put simply, the ratio of price-to-rent can be interpreted as the cost of owning versus renting a house. If this ratio were relatively high, potential buyers would find it in their best interest to rent, as this is the relatively cheaper option. This, in turn, should lead to downward pressure on house prices as individuals choose to substitute rental housing in lieu of home ownership.

Figure 3 illustrates both the price-to-income and price-to-rent ratios observed over the past 45 years in the Canadian housing market, indexed from the year 1970. As we can see, both measures experienced a decade long plateau between the years 1990 and 2000. After the start of the new millennium, however, we witness swift increases in house prices relative to both incomes and rents. The price-to-income ratio sits almost 50% higher today than it did 15 years ago, suggesting that the growth in house prices is vastly outpacing the growth in average incomes. Similarly, the price-to-rent ratio has increased by 100% over the same period, implying the existence of counter-intuitive behavior by homebuyers who should find it in their best interest to rent. Indeed, both Canada's price-to-income and price-to-rent ratios respectively sit among the highest in the OECD in terms of long-term averages (Cheung, 2014). Overall, recent trends observed for both indicative measures suggest that homeownership is becoming increasingly and unsustainably unaffordable.

**Figure 3: Price-to-Income and Price-to-Rent Ratios (1970=1)**

Source: OECD

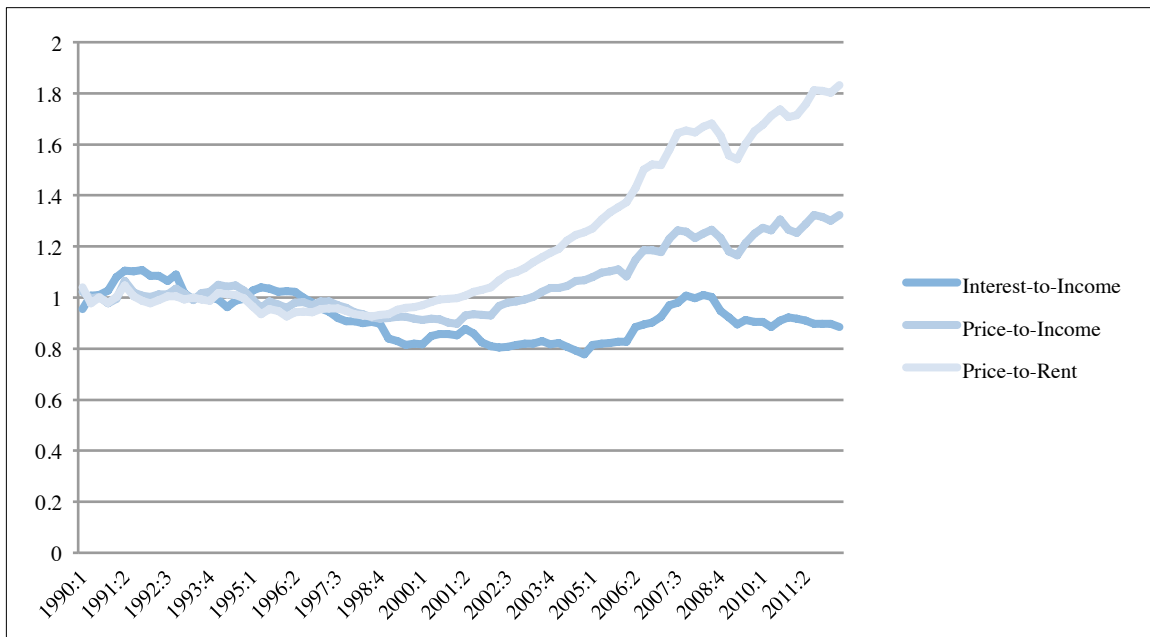
*Limitations and Adjustments*

Both of the two simple ratios presented support the notion that Canadian house prices are overvalued, and poised to fall at some point in the future to return to their fundamental values. However, it should be acknowledged that these measures have flaws that could call into question the conclusions they suggest.

Notably, neither measure takes the prevailing interest rate into consideration despite its clear significance in determining the degree of overvaluation. Interest rates govern the affordability of home ownership, in addition to representing the expected yield on competing investments. The downward trend in mortgage rates witnessed over the past two decades has undoubtedly cut the cost of homeownership and heightened the attractiveness of housing as an investment. Accounting for the effects of interest rates could cast doubt on the severity of housing market overvaluation, assuming that the current low-rate environment persists.

To demonstrate this effect, as per the methods of Girouard et al. (2006), we computed the ratio between average mortgage interest payments at prevailing mortgage rates and average household disposable income. As shown in Figure 4, this ratio has remained relatively stable during the period for which data is available. This is in stark contrast to the price-to-income and price-to-rent ratios that, as discussed above, experienced steep increases in recent years. Accordingly, this alternative measure suggests that the average home remains quite affordable in the sense that, despite increases in prices, households are not devoting more of their income to paying off their mortgage debt obligations. Thus, the evidence of a price bubble in the housing market significantly weakens when interest rates are considered in our simple indicator calculations.



**Figure 4: Price-to-Income, Price-to-Rent and Interest-to-Income Ratios (1970=1)**

Source: OECD, Statistics Canada

## Fundamental Determinants of House Prices

The following section describes the fundamental variables considered to be vital in the determination of house prices. Variable choice has been based in economic intuition and empirically tested to verify each of their respective significance.

### *Determinants of Housing Demand*

One key factor in the determination of housing demand is **demography**, and in particular, the number of people of house-buying age. To be precise, we will argue that increases in housing demand are, in part, spurred by increases in the amount of people aged 25-44. This particular age bracket selected for inclusion is echoed in the analysis of Demers (2005). The explanation behind the inclusion of this variable is intuitive: individuals in this fraction of the population are more likely to be in the stage of life where they are forming households, and have both the desire and the resources to buy a house. Oppositely, individuals outside this range are more likely to sell or rent. Thus, increases in the number of people of house-buying age should increase demand and thereby drive up house prices.

While much of the pertinent literature chose to include real disposable income in their structural models, we instead elected to use **real household discretionary income**<sup>1</sup>. The reasoning behind the inclusion of any sort of income variable is intuitive; as Canadians become wealthier, they are able to afford more expensive down payments and mortgage interest, thus increasing the demand and price of housing. However, it is our belief that

<sup>1</sup> Real discretionary income has been constructed as household disposable income less various expenses (housing, water, electricity and other fuels), less implicit loan charges and then deflated by the CPI.

opting for discretionary rather than disposable income gives a more accurate representation of a household's purchasing power. Many papers including McCarthy and Peach (2002) and Demers (2005) choose to proxy wealth effects using consumption, in line with the permanent income hypothesis. However, data constraints would not allow us to include consumption in our model accurately. Dupuis and Zheng (2010), who opted for the use of real disposable income in their analysis, found no material difference in their results with the substitution of consumption for disposable income.

The **unemployment rate** is included as a key factor in the determination of housing demand for a number of different reasons. For one, the unemployment rate echoes the cyclical variations in economic activity and thus can control for the business cycle (Dupuis and Zheng, 2010). Egebo et al (1990) highlight the ability of the unemployment rate to capture consumer confidence and uncertainty effects. In addition, as argued by Demers (2005), the unemployment rate may also reflect long-term social trends including urbanization, education, and the entry of females into the labour market which have each promoted rising demand for housing. Thus, unemployment should have a negative causal relationship to house prices.

The final determinant of demand we include in our analysis is the prevailing 5-year **real residential mortgage rate**<sup>2</sup>, in line with the methods of Dupuis and Zheng (2010). Interest rates govern the affordability of home ownership, in addition to representing the yield on competing investments; that is, they measure the user cost of capital. In this sense, interest rates measure both the *direct* and *indirect* costs of homeownership. *Directly*, decreases in the mortgage rate should reduce a household's monthly interest payments, making home ownership more affordable for the average household and thus increase the demand for housing. The mortgage rate can also measure the *indirect* cost of homeownership if we assume that it is directly proportional to all other interest rates prevailing in the economy<sup>3</sup>. Accordingly, decreases in the mortgage rate (and all other prevailing interest rates) represent a reduction in the return of alternative investments. Thus, as interest rates decrease, the opportunity cost of homeownership diminishes and demand for housing is likely to increase.

### *Determinants of Housing Supply*

Naturally, investment in new residential construction is contingent on the current level of **housing stock** already existing in the economy. Denoting  $i_t$  as investment in housing (or equivalently, the value of housing starts), the value of current housing stock,  $H_t$ , is considered to obey the following process:  $H_t = H_{t-1} + i_t$ . It should be acknowledged that, in theory, housing stock is more precisely determined by  $H_t = (1 - \delta) H_{t-1} + i_t$ , where  $\delta$  is the rate of depreciation (Sorensen et al., 2005). However, because a reliable depreciation rate could not be found, we estimate housing stock assuming no depreciation.

<sup>2</sup> In this paper, we find the real 5-year residential mortgage rate by subtracting the quarterly change in the CPI from the nominal rate given in the data.

<sup>3</sup> Indeed, the correlation between the 5-year conventional mortgage rate and the corresponding bank rate is 0.96, supporting the merit of this assumption. Correlation between the bank rate and average 5-year residential mortgage rate was calculated from monthly data, stretching from January 1973 to February 2015.

Another intuitive housing supply determinant is that of residential **construction costs**. Regrettably, as evidenced by much of the associated literature, the quality of data for construction costs in many industrialized countries including Canada is considerably poor. The only residential construction index considered appropriate for this research had been terminated in 1990 and thus could not be used in our model of contemporary housing prices. Initially, we attempted to recreate the solution presented by Dupuis and Zheng (2010) to proxy residential construction costs by the construction wage rate. However, a significant causal relationship between wage rates and housing prices could not be found. Instead, we chose to proxy residential construction costs by non-residential construction costs. Indeed, we believe this is a strong substitute, as the correlation between the two indices over the period from 1981 to 1990 was measured to be strong (0.897).

While we discussed previously how **interest rates** determine housing demand, we must also recognize the way in which they govern housing supply. If we continue with our assumption that the rate on a 5-year conventional mortgage is directly proportional to all other interest rates prevailing in the economy, then this rate can measure the cost of borrowing for housing suppliers. Accordingly, interest rates have two separate effects on housing prices, both working in opposite directions. While an increase in the interest rate increases the cost of borrowing for demanders of housing (thereby decreasing price), it also increases the cost of borrowing for suppliers of housing (thereby increasing the price). It is shown later through econometric testing that the demand effect ultimately outweighs the supply effect in the determination of house prices<sup>4</sup>.

A number of other fundamental variables could have been further investigated in this study with respect to their propensity to determine house prices. For instance, through research conducted for the IMF, Cheung (2014) speculated extensively over recent financial innovations and their connection to changing housing dynamics. However, while the improvement of credit availability, the loosening of lending restrictions and sophisticated securitization activities undoubtedly were significant driving forces behind rising house prices, it is difficult to accurately quantify these changes. Similarly difficult to precisely measure is the supply of available land and zoning regulations, for which data is limited. However, according to Dupuis and Zheng (2010), ignoring these variables may not prove to be problematic, since they are unlikely to change rapidly and alter the potential long-run relationship estimated by our model. For the reasons stated above, we chose to exclude these particular factors from our analysis.

## Assessing Overvaluation Using a Structural Model

### *The Model*

As discussed previously, this research subscribes to the following definition of a housing bubble, coined by Stiglitz (1990):

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<sup>4</sup> As shown in Table 1, the coefficient on the Real Mortgage Rate is negative, indicating that an increase in the interest rate ultimately decreases the price of housing.

“If the reason the price is high today is only because investors believe that the selling price will be high tomorrow – when ‘**fundamental**’ factors do not seem to justify such a price – then a bubble exists.”

In this paper, we make use of an econometric model to compute this ‘fundamental’ price, as determined by various demand and supply factors. We then evaluate the severity of overvaluation by comparing the fundamental price predicted by our model to the actual average real house price observed in the market over time. Any significant deviation of real house prices from those predicted by the model suggests that current prices are not justified by fundamentals and thus, a bubble exists.

More precisely, we employ an error-correction model (ECM) framework where the variable of interest, the real house price, is imagined to move in line with a linear combination of fundamental factors over a long period of time. Departure from the path predicted by the fundamentals is taken to be evidence of disequilibrium in the housing market, which is expected to revert back toward a steady state gradually due to significant short-run adjustment costs.

In line with Dupuis in Zheng (2010) and McCarthy and Peach (2004) our structural model takes the following form:

$$\begin{aligned} p_t^{d*} &= \alpha_0 + \alpha_1 H_t + \alpha_2 d_t + \alpha_3 y_t + \alpha_4 r_t + \alpha_5 u_t + \varepsilon_t^d \quad (1) \\ p_t^{s*} &= \gamma_0 + \gamma_1 H_t + \gamma_2 c_t + \gamma_3 r_t + \varepsilon_t^s \quad (2) \end{aligned}$$

where  $p_t^{d*}$  and  $p_t^{s*}$  represent the real price of housing determined by fundamental factors housing stock  $H_t$ , demography  $d_t$ , real discretionary income  $y_t$ , the real residential mortgage rate  $r_t$ , the unemployment rate  $u_t$  and construction costs  $c_t$ , with the  $\varepsilon_t$ 's being error terms.

Within the framework described by equations (1) and (2), we could not find overwhelming evidence of a significant causal relationship between the price of housing and its fundamental determinants on the supply-side. As a result, we elected to exclude these variables from our analysis and, consequently, model Canadian housing prices using only the following inverted demand equation:

$$p_t^{d*} = \alpha_0 + \alpha_1 H_t + \alpha_2 d_t + \alpha_3 y_t + \alpha_4 r_t + \alpha_5 u_t + \varepsilon_t^d$$

### *Methodology*

When tested across the entire estimation period (Q1 1981 to Q3 2014), our model could not come to conclusive results. However, this outcome does not come as a surprise, nor is it harmful to our postulation regarding the existence of a Canadian housing bubble. Indeed, since it is our belief that house prices are no longer justified by fundamental determinants, we should not expect the model to fit the housing price data observed over the recent steep and steady upsurge in prices. That is to say, it is our belief that it is not feasible to estimate a housing price equation over the entire period in question because there is a structural break in the data.

The existence of a structural break in Canadian housing data has been suggested by earlier research, including that performed by Demers (2005) and Dupuis and Zheng (2010). In order to test this assertion, we performed a Chow test with the assumed break occurring in the final quarter of 2002. This test resulted in an F statistic of 3.41, strongly supporting the notion of a structural break at this point in time.

Accordingly, the inverted demand equation is derived from looking at housing data only over the 22-year period that stretches from Q1 1981 to Q4 2002 (when the structural break is thought to occur). Once the coefficients were attained, the equation was applied to the entire period and the fundamental house price was estimated for each quarter.

### Results

Applying the ECM framework to these select explanatory variables over the period from Q1 1981 to Q4 2002, we obtain the following estimates of the inverted demand function, illustrated in Table 1. All coefficients have the correct sign and are statistically significant, with the exception of unemployment. This variable is not statistically significant, however it is still included in order to control for the business cycle. Of particular importance is the significance level of the lagged price variable, which is an essential factor in the ability of the model to prove accurate. The t-statistic of this variable is -3.84, implying very high statistical significance.

**Table 1: Estimates of Demand for Housing Equation**

<i>Variable</i>	<i>Coefficient</i>	<i>Standard Error</i>
(Ln) Lagged Price	-0.1446***	0.0376
(Ln) Real Discretionary Income	0.2370*	0.1331
Unemployment	-0.0019	0.0028
Real Mortgage Rate	-0.0059**	0.0024
(Ln) Demography	.4282***	0.1052
(Ln) Housing Stock	-0.4596***	0.1547
Constant Term	-2.2717**	0.9410

\*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1

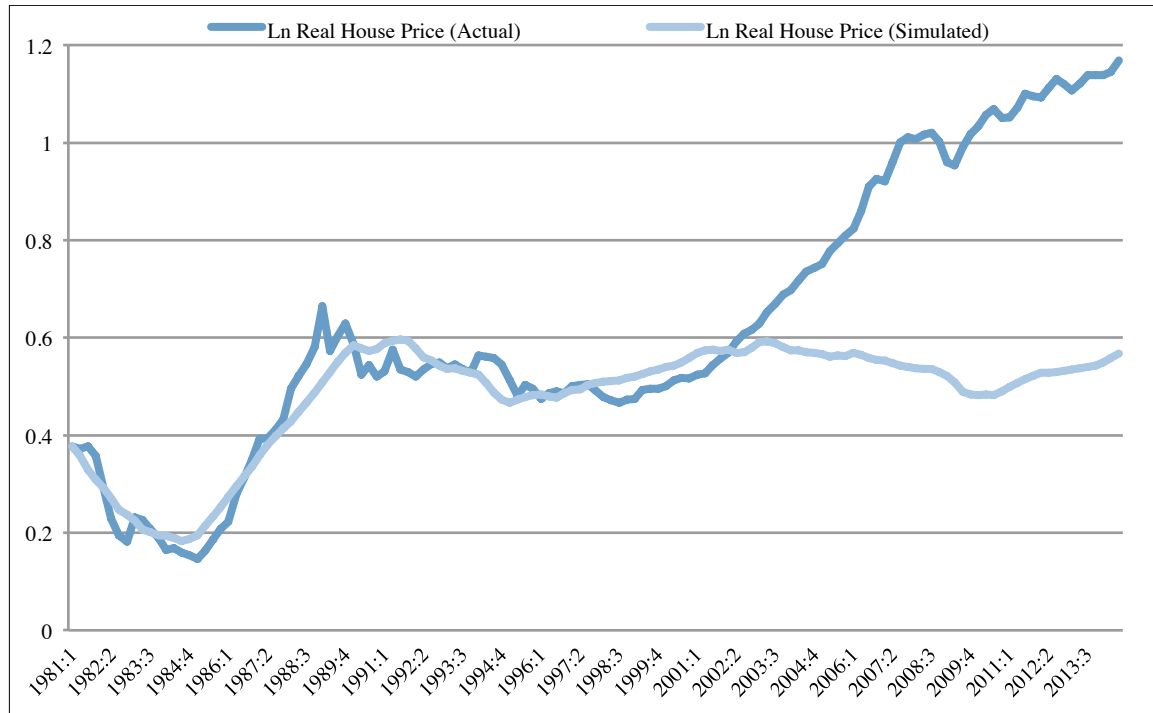
All values reported to the nearest 4 decimal places

Figure 5 illustrates graphically the final results of our estimated equation. As we can see, the model closely follows the actual real house price over the 1981 to 2002 period. However, in the 12 years since this time, a large gap has emerged between actual real house prices and those implied by the model by way of current fundamentals. This departure can be interpreted as overvaluation in the sense that current prices cannot be justified by previously estimated factors. That is, if house prices are presently determined in the same way that they had been in the past, then current prices have significantly deviated from their equilibrium levels.

The reader should also pay particular attention to the first large upswing seen over the estimation period, and the model's response to this price surge. Beginning in the first quarter of 1985, the Canadian housing market experienced a sharp increase in prices, not unlike the one this research centers on. During the four years between 1985 and 1989, prices grew 68% before declining gradually during the 1990-92 economic recession. It

should be emphasized that the estimated equation follows this housing boom closely, thus indicating that it is indeed capable of modeling similar booms and busts. That is, it can be established that the emerging gap between simulated and actual house prices is not a result of a failure of the model to respond to sharp changes in housing dynamics, but rather the product of a deviation of prices from their equilibrium levels.

**Figure 5: Actual vs. Simulated Real House Prices**



### *Contemporary Determinants of House Prices*

The results of our structural model suggest that overvaluation may exist in the Canadian housing market if the assumption holds that house prices are presently determined in the same way that they had been in the past. Where associated literature ceases in their analysis is in the attempt to explain what may be the reasons behind this overvaluation. Indeed, it may be alternatively viewed that prices are now determined in a different way than they had been previously. If this is the case, then the Canadian housing market may, in fact, be in equilibrium, yet still susceptible to any changes in the determining factors.

The question remains: what factors now determine house prices, and further, what could be the potential repercussions of this change? In the spirit of the Chow test performed previously, we estimated our equation again over the entire time period accounting for the structural break in the data. Through trial and error, the two factors deemed to have changed in how they determine house prices over the course of the estimation period were *discretionary income* and *demography*. The resulting estimates of this new inverted demand equation are illustrated in Table 2. As with the previous estimation, certain emphasis should be put on the significance level of the lagged price variable, which has an associated t-statistic of -4.14, implying very high statistical significance.

**Table 2: Estimates of Demand for Housing Equation (Accounting for Structural Break)**

<i>Variable</i>	<i>Coefficient</i>	<i>Standard Error</i>
(Ln) Lagged Price	-0.1362***	0.0329
(Ln) Real Discretionary Income (Pre-Structural Break)	0.1666	0.1095
Unemployment	-0.0029	0.0023
Real Mortgage Rate	-0.0040**	0.0018
(Ln) Demography (Pre-Structural Break)	0.3707***	0.0910
(Ln) Housing Stock	-0.3383*	0.1254
(Ln) Real Discretionary Income (Post-Structural Break)	0.3753***	0.1033
(Ln) Demography (Post-Structural Break)	0.2085*	0.0754
Constant Term	-2.4287**	0.8085

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

All values reported to the nearest 4 decimal places

Particular attention should be paid to the changes in the coefficients on the *real discretionary income* and *demography* variables, both pre- and post-structural break. According to these results, the dynamics of housing demand have changed between the two periods, with certain variables holding more or less weight than they did in the past. More precisely, discretionary income plays a considerably more significant role today than it did in the previous period, while the opposite is true for the role of demography (which plays a less significant role). The remainder of this paper will focus solely on the potential consequences of the increasing weight of income in determining house prices, as we believe it constitutes a significant threat to the Canadian economy when coupled with the observed rise in debt levels<sup>5</sup>.

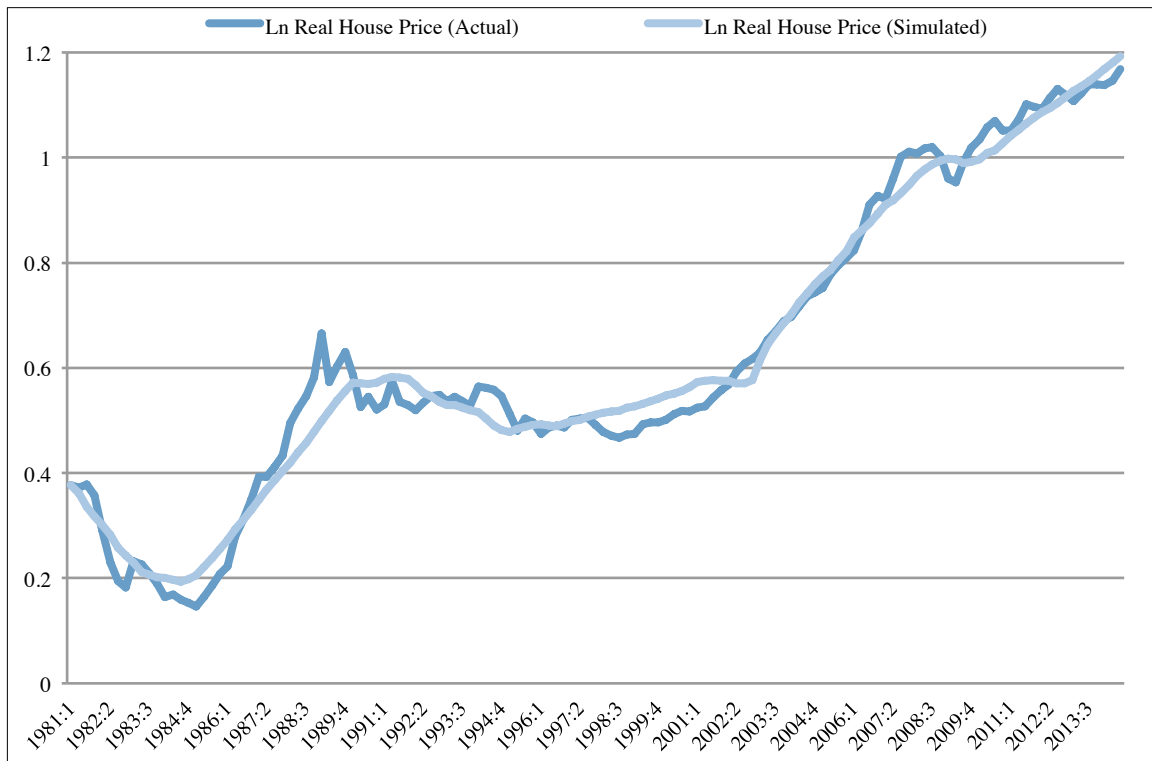
Figure 6 illustrates graphically the rotational shift in the demand curve for housing occurring between the two periods. We can clearly see that the estimated equation now closely follows the path of the actual real house price observed in the economy over the past 33 years. Interestingly, beginning in the third quarter of 2012, real house prices actually dipped below the level suggested by the model with this pattern continuing until the present day, suggesting that house prices are actually *undervalued* should the latest model indeed represent the new equilibrium house price.

## Consumer Debt and the Threat of Interest Rate Hikes

One can only speculate as to what has truly triggered the change in the determination of house prices. However, there may exist a notable consequence of this transformation that lies in the relationship between the increasing significance of income in the determination of house prices and the previously examined trend towards growing debt levels. This connection, which will be the topic of the following paragraphs, may hold the potential to cause a severe correction in house prices should the central bank choose to increase the governing interest rate.

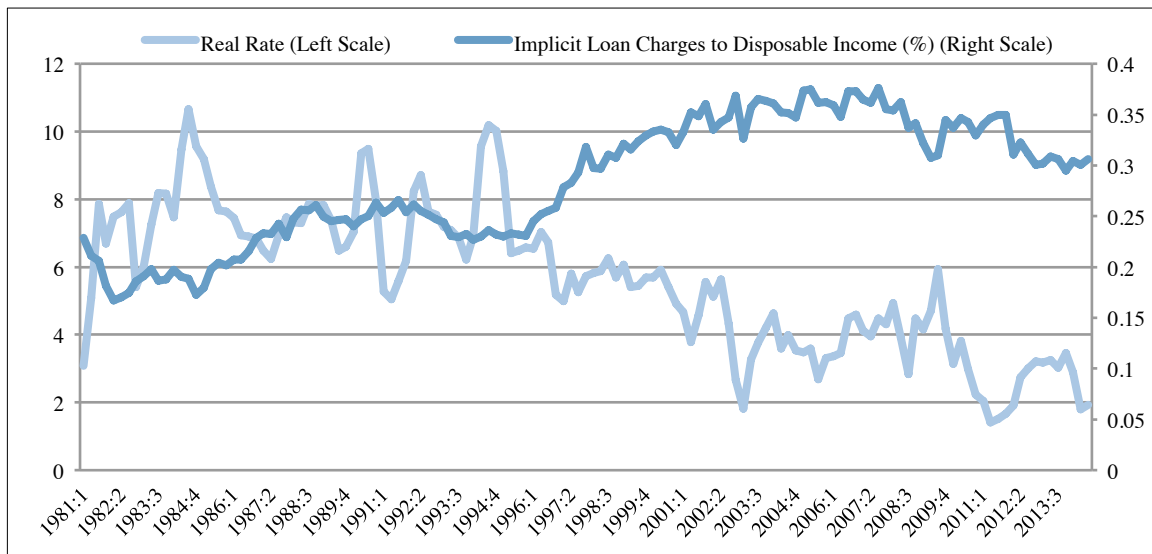
<sup>5</sup> Explanations for the decreased role of demography (and in particular, the 25-44 age group) in determining house prices may include trends toward delayed household formation and the increased role of housing alternatives (ex. condominiums). However, this subject lies outside the realm of our paper and is best to be explored in other research.

**Figure 6: Actual vs. Simulated Real House Prices (Accounting for Structural Break)**



Over the past decade, debt levels have risen to unprecedented heights in large part motivated by a decreasing interest rate. However, while lower interest rates have made taking on debt cheaper, households do not seem to be devoting any less of their income towards charges on these loans. That is, as shown in Figure 7, implicit loan charges as a percentage of disposable income actually began to steeply rise in the mid-1990s and plateau over the recent past despite a falling interest rate.

**Figure 7: Real Mortgage Rate vs. Implicit Loan Charges to Disposable Income**



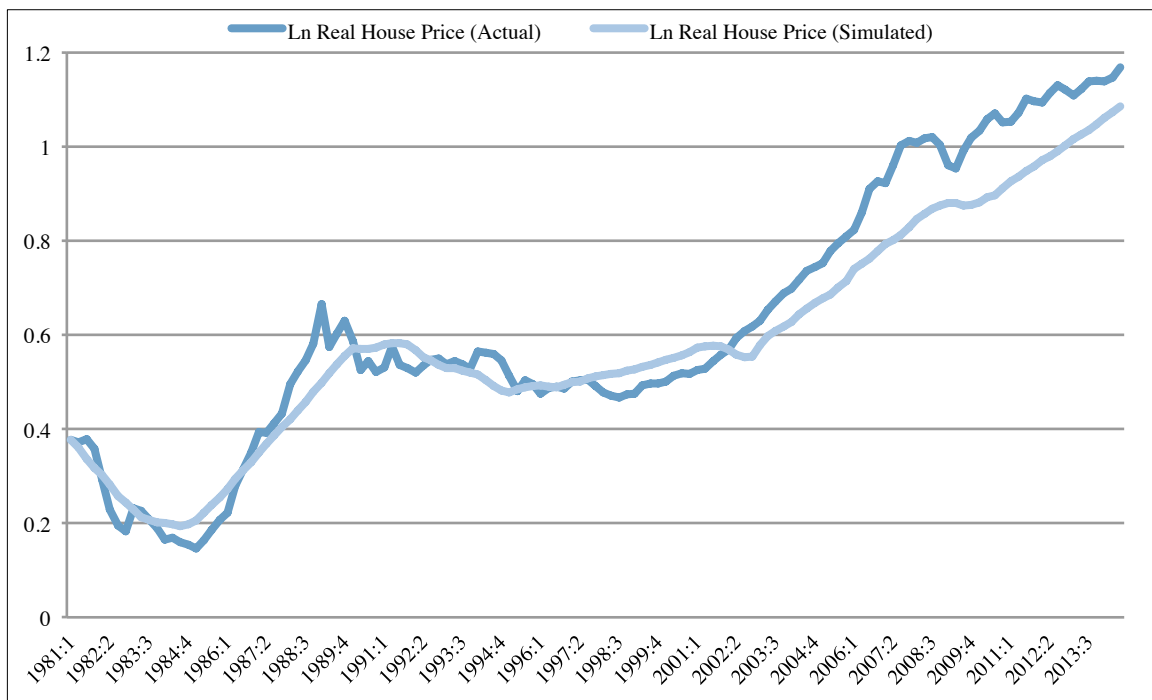
Source: Statistics Canada



Should the Bank of Canada decide to increase the interest rate after keeping it so low for so long, the portion of household income dedicated to meeting debt obligations may rise, and eventually lead to a material correction in the housing market. We attempt to model this correction through hypothetical decreases in the variable real discretionary income. As discussed in earlier sections, the *real discretionary income* variable used in our analysis was constructed as household disposable income less various expenses and implicit loan charges. By deducting the latter, we are directly incorporating the effect that increases in debt may have on a household’s income, and ultimately, house prices prevailing in the economy.

Rough and ready measures of the price elasticity of demand for housing with respect to income can be calculated through use of the coefficients estimated in Table 2. From these results, it can be shown that this elasticity was 1.22 in the earlier period (1981-2002), while the same measure was 2.76 in the later period (2003-2014)<sup>6</sup>. Equivalently, this means that while a one percent change in incomes previously triggered a 1.22 percent change in the price of housing, the same change in income now results in a 2.76 percent change. As we can see, this represents a very substantial increase in the significance that income has on the determination of house prices and could have drastic implications on the Canadian economy should incomes decline.

**Figure 8: Actual vs. Simulated House Prices (Accounting for Declines in Discretionary Income)**



In line with Bauer (2014), we consider a large correction to be one that causes the real house price to decline by at least 10 percent. According to our above price elasticities, this would be triggered by roughly a 3.75 percent decrease in real discretionary income.

<sup>6</sup>  $\epsilon_{H1}^d = \frac{\text{coefficient on income}}{\text{coefficient on lagged price}} = \frac{-.1666}{-.1362} = 1.22$      $\epsilon_{H2}^d = \frac{\text{coefficient on income}}{\text{coefficient on lagged price}} = \frac{-.3753}{-.1362} = 2.76$

Figure 8 illustrates what this magnitude of decline would have looked like over the 2003-2014 period. Not surprisingly, the growth in house prices would have been substantially muted, foreshadowing what could happen to the housing market if this kind of slump should occur in the future.

It should be noted that while the effect of a relatively small decrease in income is clearly significant, the same cannot be said of a hike in the interest rate. While the average household's debt burden is rising, it still does not demand a high enough portion of income to cause a material threat. Our calculations show that implicit loan charges must rise by approximately 1250% to trigger a 10 percent decline in house prices. Thus, we can infer that an interest hike alone is not enough to trigger a crash; increasing rates must be coupled with other exogenous shocks to income in order for there to be a material house price correction.

## Conclusion

Our analysis of the Canadian housing market finds evidence of overvaluation, however only in the sense that current prices cannot be justified by previously estimated factors. That is, if house prices are presently determined in the same way that they had been in the past, then current prices have severely deviated from their equilibrium levels. Alternatively, it may be viewed that prices have, in fact, reached a new equilibrium provided that they are now determined in a different way than they had been previously.

If this is indeed the case, then our analysis shows that the rapid rise in prices seen over the past decade has been the result of an increasing significance in the role of income in determining house prices. While this development has the potential to cause a significant correction in the housing market should incomes materially decline, simple calculations showed that it is very unlikely that this erosion in wealth would come solely from a hike in the interest rate. Rather, increasing rates must be coupled with other exogenous shocks to income in order for there to be a material house price correction.

One possible caveat in our methods of analysis should be noted. As described by Cheung (2014), national house prices may serve as a poor signal of underlying market conditions, given the heterogeneous nature of Canadian housing markets. Analysis performed by Allen et al. (2006) found that there exists stark separation between the various housing markets across the country, with only weak long-run correlation in price movements among major urban centers. By aggregating our data on a national level, results may only reflect dynamics in a select few major cities and cross-city variation may be lost or sully the conclusions suggested by our model.

Despite potential shortcomings, we believe that our research may add measurable evidence to the heavily contentious housing bubble debate. While other literature stops short of explaining why house prices have risen so severely, we attempt to shine a light on this question and quantify the Bank of Canada's dark prophecy concerning a possible link between house prices and consumer debt levels. Further research should be done at the city-level, to determine if the overvaluation is truly a national threat.

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