

# Medium-Term Fluctuations in Canadian House Prices

---

Brian Peterson, *Financial Stability Department*, and Yi Zheng, *Canadian Economic Analysis Department*

- House prices in Canada have experienced a steady annual increase for more than a decade. Understanding the key factors behind this price rise is important for assessing the implications for future growth in output and inflation and the risks to financial stability.
- In Canada, as in other countries, movements in land and house prices over long time horizons are driven primarily by changes in population and per capita income. Over shorter horizons—a decade or less—house prices may outpace population and income in some periods and lag behind them in others.
- This article explores the key factors behind these “medium-run” fluctuations in house prices that emerge when one views housing as both a consumer durable and an asset. The analysis presented here suggests that interest rates, expected movements in future prices and changing liquidity in the housing market all play a role in the determination of house prices, especially over the medium term.

After more than 10 years of appreciation in many parts of the country, house prices have reached a historically high level relative to income and, given the increase in household indebtedness, the exposure of households and the financial system to fluctuations in house prices has increased markedly.<sup>1</sup> Understanding the key factors underlying the increases in house prices is important for assessing the implications of these price movements for future growth in output and inflation and the risks to the stability of the financial system.

To understand developments in house prices, we need to recognize the dual nature of housing both as a durable consumption good and as an asset.<sup>2</sup> As is the case for other consumer durables, housing provides a stream of services (i.e., shelter) over an extended period of time. Thus, the *long-run* trend in house prices should be determined by fundamental factors of supply and demand. In the *short to medium run*, however, housing supply adjusts slowly to changes in demand, potentially leading to larger price swings than would be expected in the long run. Since a house is a large purchase that often requires a substantial amount of financing, interest rates and credit conditions can affect house prices. In addition, a house is also an important asset for many households, so factors such as expected capital gains or the liquidity of the housing market can further influence house prices. Adding the asset

---

<sup>1</sup> See Crawford and Faruqi (this issue).

<sup>2</sup> Poterba (1984) is one of the first papers to augment a consumption-based model of housing with features of an asset market.

elements to a standard model of housing as a consumer durable can improve our understanding of house-price dynamics, particularly over the medium run.

This article draws on theory and empirical evidence to examine a number of factors that help to explain movements in Canadian house prices. An overview of the changes in regional house prices in Canada over the past 30 years shows that growth in both income and population can largely explain the rising trend in house prices over this period. These factors alone, however, cannot account for the fluctuations around the long-run trend over shorter horizons. The bulk of the article investigates the determinants of these medium-run movements. Our research indicates that approaches incorporating effective mortgage rates, house-price expectations and the liquidity of the housing market are needed to understand the behaviour of house prices, especially over the medium term. The work described here represents substantial progress toward a better understanding of movements in house prices in Canada, but more research would be helpful. Important areas for future work are discussed in the concluding section.

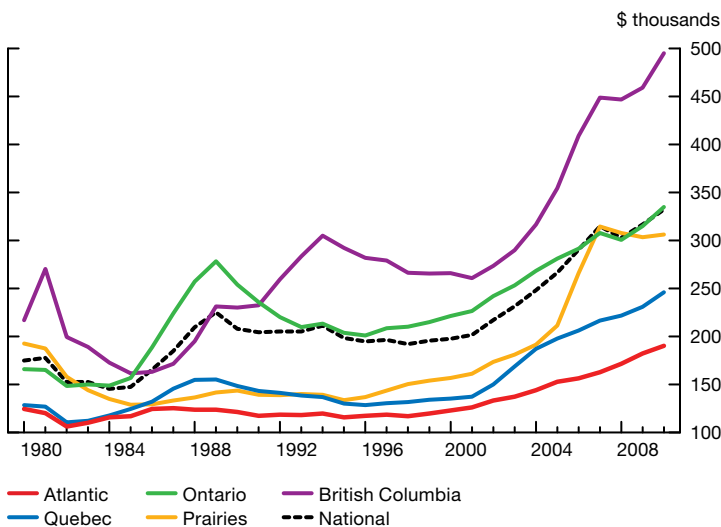
## Long-Run Movements in Canadian House Prices: An Overview

Three observations can be made regarding the behaviour of real house prices in Canada’s resale market since 1980 (**Chart 1**).<sup>3,4</sup> First, house prices have differed substantially across regions and have, for most of the period, been higher in British Columbia and Ontario than elsewhere in Canada. Second, real house prices tend to increase over the long run, with an average cumulative gain of 88 per cent across regions since 1980, although growth varied from 54 per cent in Atlantic Canada to 130 per cent in British Columbia. Third, in addition to upward trends, there are also shorter periods of expansion and contraction in house prices, and these price movements

*House prices have differed substantially across regions and tend to increase over the long run*

**Chart 1: Average real resale house prices in Canada**

Annual, by region, deflated by consumer price index, rebased to 2010



Sources: Canadian Real Estate Association and Statistics Canada

Last observation: 2010

<sup>3</sup> Besides regional variations in housing markets, there are also significant differences among cities within the same province or region.

<sup>4</sup> Though the data used for much of the analysis presented here are on existing homes (resales), this article is relevant for prices of both new and existing homes.

are often common across regions. Examples include the period of rapid price growth in the late 1980s and in the past decade, and the period of slow price growth in the 1990s.

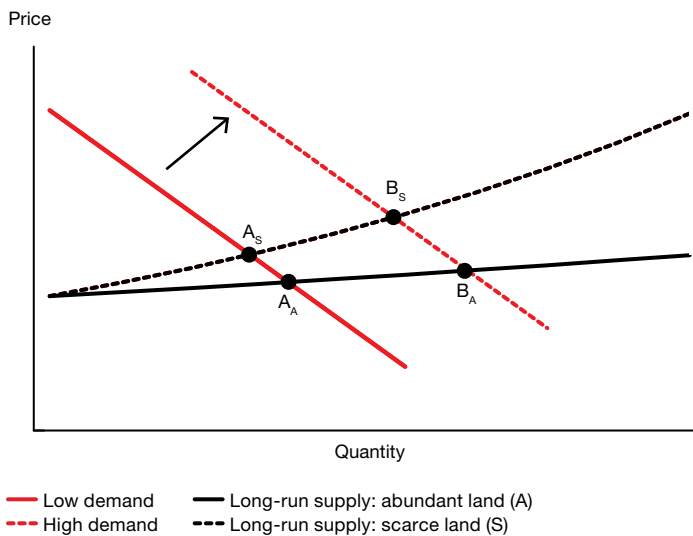
### Long-run movements in house prices

In a standard model that treats housing as a consumer durable, movements in prices over long time horizons are determined by supply of and demand for housing (Capozza and Helsley 1989; Mayer and Somerville 2000; Smith 1969a, 1969b). Growth in both population and per capita income leads to permanently higher demand for housing, in terms of quantity and quality.<sup>5,6</sup> The resulting increase in house prices would be greater in areas where land is scarce ( $A_S$  to  $B_S$  in **Figure 1**), than in areas where land is more abundant ( $A_A$  to  $B_A$ ).<sup>7</sup>

To illustrate the explanatory power of the long-run factors, **Chart 2** depicts the ratios of house prices to provincial gross domestic product (GDP), which is primarily influenced by both per capita income and population, for five regions in Canada.<sup>8</sup> Given that these ratios show no trend over the 30-year sample period, one could conclude that the trend rise in Canadian house prices observed in **Chart 1** is indeed associated with growing population and

*The trend rise in Canadian house prices is associated with growing population and income*

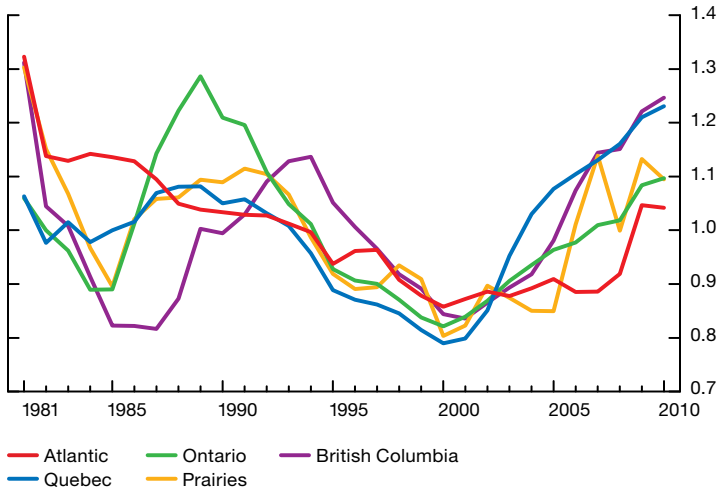
**Figure 1: Supply and demand curves for scarce and abundant land**



- 5 The discussion in this section uses the Canadian Real Estate Association Multiple Listing Service (MLS) resale price, which does not adjust for changes in housing quality. While this is clearly a shortcoming, it is the only measure of house prices with a long history and wide geographical coverage. Other analyses in this article use different measures. See **Appendix 1** on page 40 for a discussion of measures of house prices in Canada.
- 6 In theory, the age composition of the population could also influence house prices, as a larger proportion of individuals at the age when they would form a household would imply a higher demand for housing. In practice, however, econometric studies have not found a robust relationship between age composition and house prices. The declining proportion of the youth population (ages 25 to 39) since the turn of the millennium in many developed economies, including Canada, certainly cannot explain rising house prices over the same period.
- 7 A housing unit is made up of a structure and land. In the long run, the supply of structures, relative to the supply of residential land, is assumed to be more elastic because the construction industry can more easily adjust its capacity over this horizon in response to price movements. Therefore, the slope of the long-run supply curve of housing is primarily determined by the scarcity of land.
- 8 Disposable income would be a more relevant measure of income for this purpose, but data are not available on a provincial basis. In national data, the ratio of house prices to GDP follows the ratio of house prices to disposable income very closely, but the differences between these measures could be more important at the regional level. Note that the ratio of house prices to per capita GDP does have a rising trend, which is consistent with the idea that land is becoming more scarce over time.

**Chart 2: House prices relative to provincial gross domestic product**

Ratio of nominal Multiple Listing Service resale house prices to nominal GDP, annual, average per region = 1



Sources: Canadian Real Estate Association and Statistics Canada

Last observation: 2010

income, which has increased demand, coupled with an upward-sloping long-run supply curve owing to the increasing scarcity of land for residential development, primarily in urban areas.<sup>9</sup>

## Movements in House Prices over the Medium Run

The remainder of the article focuses on explaining medium-run movements in house prices, considering housing both as a consumer durable and as an asset. **Chart 2** shows that movements in resale house prices over a horizon of a decade or less can be large, sometimes rising or falling by 30 per cent relative to GDP. These medium-run movements also appear to be correlated across Canada, especially after 1995. This suggests that, even though housing markets are considered to be local, similarities can be observed across regions, reflecting the influence of common national or global factors.<sup>10</sup> The research discussed below uses both aggregate and regional analysis to highlight some of these common factors.

The following two subsections concentrate on housing primarily as a consumer durable. The first discusses theory and the second empirical work that incorporates the effects of interest rates. The consumer-durable approach explains much, but not all, of the movements in house prices. In the final two subsections, we add the additional element that housing is also an asset and show that user cost and liquidity can contribute to medium-run movements in house prices.

### Housing as a consumer durable over the medium run

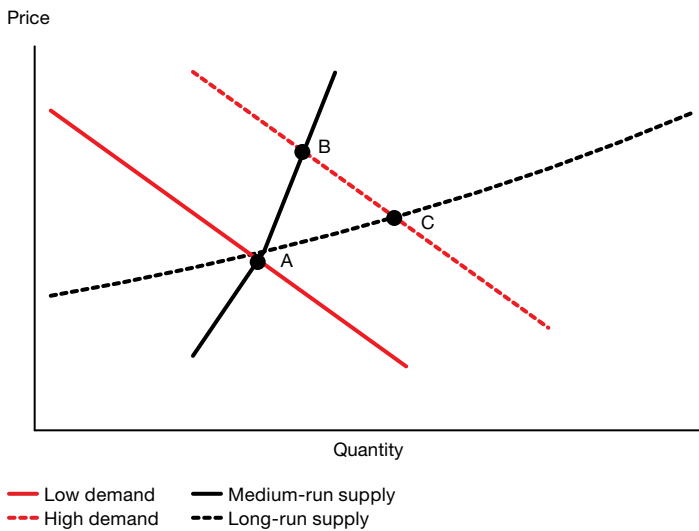
Over the medium run, the standard consumption-based model of housing assumes that the supply of housing adjusts slowly, because of the time and planning required for the construction industry to adjust its capacity and to

*Over the medium run, the supply of housing adjusts slowly*

<sup>9</sup> Davis and Heathcote (2007) estimate that most of the movements in house prices in the United States can be attributed to changes in the value of land, not structures. While data limitations prevent us from conducting a similar exercise, the same conclusion probably applies in Canada.

<sup>10</sup> After controlling for population and income, we find evidence that regional house prices move together in the long run, particularly after the mid-1990s. In contrast, Allen et al. (2009) find no evidence of a similar long-run relationship across city house prices over a shorter sample period.

**Figure 2: Supply and demand in the medium run and long run**



bring new housing developments to market. This implies that the medium-run supply curve is steeper than the long-run supply curve (**Figure 2**). In the medium run, an increase in demand causes prices to increase (moving the equilibrium in the housing market from point A to point B in **Figure 2**). Over time, supply responds and house prices adjust downward to a new long-run equilibrium (point C).<sup>11</sup>

Housing demand might rise owing to the long-run fundamentals of per capita income and population, but it may also increase for other reasons. At shorter horizons, for example, housing demand<sup>12</sup> can be influenced by changes in interest rates and overall credit conditions.<sup>13</sup> As a result, the medium-run increase in prices may be larger than the long-run increase because of the slow adjustment of supply and other factors that may temporarily boost demand.

*Housing demand can be influenced by changes in interest rates and overall credit conditions*

## Interest rates

Taking into account the differences in house-price dynamics over the long and medium run, Zheng (forthcoming) uses an error-correction model that permits the estimation of a long-run relationship between house prices and various underlying factors and also captures the adjustment of prices back to the long-run level when certain factors cause them to rise or fall temporarily. One finding is that deviations of house prices from the long-run trend take about six years to adjust. This model also provides estimates of the effects of real effective mortgage rates<sup>14</sup> on Canadian house prices, after

<sup>11</sup> The downward price adjustment need not be a fall in real or nominal house prices; the adjustment may occur during a period of slow growth in house prices relative to fundamentals such as population or income.

<sup>12</sup> As argued in Smith (1969a), changes in interest rates and credit market conditions can influence the demand for owner-occupied housing, whereas growth in population and income affects the overall demand for housing, including rental housing.

<sup>13</sup> In our later discussion of housing as an asset, we note that demand could also be influenced by expectations of growing house prices (see "User costs and price expectations" on page 35). Theoretically, however, expectations of future prices should affect the price-to-rent ratio, so rents could adjust rather than prices.

<sup>14</sup> The measure of the real effective mortgage rate incorporates discounts and allows a changing mix between fixed- and variable-rate mortgages over time. This is conceptually equivalent to the effective mortgage rate used for calculating the affordability index in the *Financial System Review* published by the Bank of Canada.

controlling for real disposable income per household and population.<sup>15, 16</sup> The results imply that, of a cumulative increase of 45 percentage points in real house prices between the fourth quarter of 2001 and the third quarter of 2010 (the most recent episode of steady growth in house prices), increasing population accounts for up to 15 percentage points, followed by rising real household disposable income at 11 percentage points, and declining real effective mortgage rates at 6 percentage points.<sup>17</sup> While the remaining 13 percentage points can be partly attributed to a recovery from the sluggish price growth of the 1990s, other factors may exert an influence on medium-run movements in house prices.

In the next two sections, we examine the role of price expectations and market liquidity in generating medium-run movements in house prices.

### User costs and price expectations

The analysis so far has considered housing primarily as a consumer durable. To understand house-price dynamics more fully, it is useful to expand our approach and consider housing as an asset as well. We first describe the user-cost approach.

This approach considers a homeowner's willingness to buy a house rather than rent, which depends on a comparison of the costs and benefits associated with these two options for housing. Homeowners avoid paying rent, but incur maintenance costs, opportunity costs (since they give up interest income from an alternative safe investment, such as government bonds) and face a risk premium stemming from the uncertainty of the return on the investment when the house is eventually sold.<sup>18</sup> Meanwhile, these costs of home ownership would be reduced by the amount of appreciation the household expects from its investment. Intuitively, if prices are expected to rise because of a belief in a future improvement in fundamentals, a household should be more willing to own rather than rent, causing prices to rise relative to rents.<sup>19</sup> More formally, rent should equal the user cost of a house, given by:<sup>20</sup>

$$\text{User cost} = \text{House price} \times (\text{maintenance cost} + \text{opportunity cost} + \text{risk premium} - \text{expected price appreciation}). \quad (1)$$

<sup>15</sup> The dependent variable is the Teranet–National Bank National Composite House Price Index extended backwards, using data from Royal LePage and MLS, deflated by the consumer price index.

<sup>16</sup> Alternative specifications, including proxies for construction costs and financial innovations, are also tested, but prove unsatisfactory, in part, because of a lack of consistently defined data covering a sufficient length of time for these variables. Supply-side data are limited, as discussed by Dupuis and Zheng (2010).

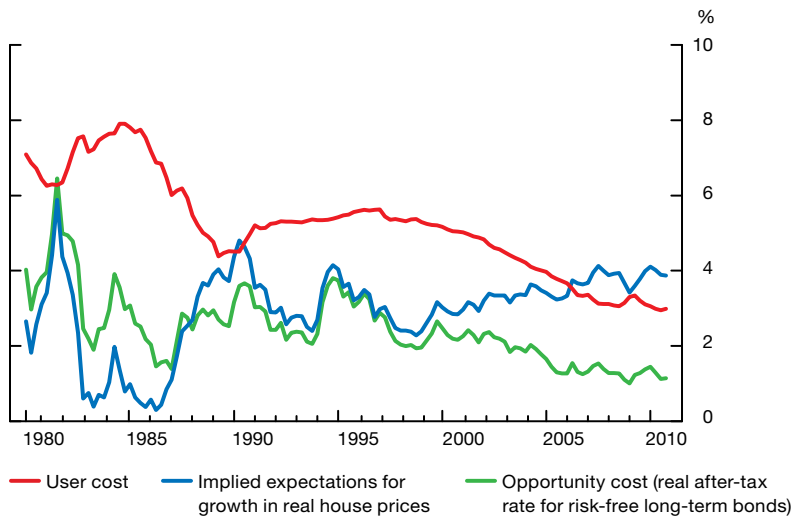
<sup>17</sup> Falling real interest rates have been a global phenomenon over the past couple of decades. More broadly, prior to the recent financial crisis, access to credit in many economies had become easier, owing to financial innovation and a large supply of capital from the global savings glut (Carney 2011). This easing of global credit conditions before the crisis likely contributed to the significant and widespread increases in house prices that many advanced countries experienced over this period (IMF 2008).

<sup>18</sup> Alternatively, a mortgage rate could be used instead of a government bond rate when financing is involved in the purchase.

<sup>19</sup> For a complete model, see Poterba (1984).

<sup>20</sup> For simplicity, we assume that rental housing and owner-occupied housing offer comparable services. Hence, the market rent would be equivalent to the imputed rent for owners. More realistically, the quality of service offered by rental housing is likely lower than that offered by owner-occupied housing. This, combined with the existence of rent control in some parts of Canada, means that market rent is actually lower than imputed rent for owners. Nevertheless, as long as the difference between the two remains stable, the time-series property of the user-cost measure calculated using the market rent is not materially affected.

**Chart 3: User cost of capital, expectation of price growth and opportunity cost**



Source: Authors' calculations

Last observation: 2010Q4

With data on rents, house prices and the real after-tax yield on long-term government bonds (as a proxy for opportunity cost), and the assumption that the maintenance cost and risk premium stay constant at slightly under 6 per cent, equation 1 allows us to calculate the implied expectations for growth in real house prices.<sup>21</sup> This is shown in **Chart 3**, along with the user cost (expressed as a percentage of the house price) and the opportunity cost. In Canada, two distinct episodes of declines in the user cost of capital over the past three decades can be identified, each associated with a period of appreciating house prices. In the first episode (the second half of the 1980s), the user cost fell sharply, despite an increase in real long-term interest rates. In the user-cost model, this is interpreted as reflecting a rise in expectations about the growth of house prices. The current episode, which began around 2000, has occurred at a more moderate pace, but has lasted twice as long. The model suggests that both the falling real interest rates and the expectations for rising house prices have contributed to the reduction in the user cost of capital during the current episode. This confirms the association between declining long-term interest rates and an increase in housing demand, but also suggests that expectations of future price increases could help to explain the recent rise in house prices.<sup>22</sup>

*Expectations of future price increases could help to explain the recent rise in house prices*

## Market liquidity

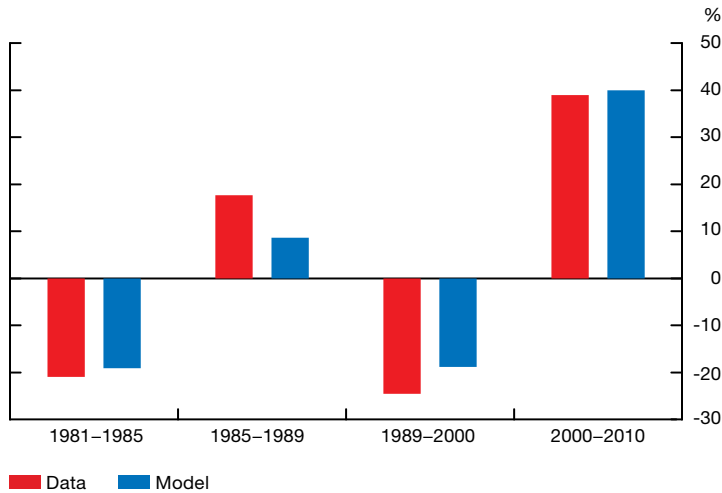
As shown in **Chart 2**, there are medium-run movements in regional house prices that are not explained by provincial GDP (which incorporates the long-run factors of population and income). These movements are cyclical, and cumulative increases and decreases in prices relative to GDP are approximately 20 to 30 per cent (**Chart 4**, the red bars representing data). The two previous subsections focused on the national level to argue that these medium-run movements in house prices were partly attributable to changes in economy-wide interest rates and to changes in expectations of future house-price growth. In this final subsection, we focus on the regional level

<sup>21</sup> Specifically, we assume a maintenance cost (including property taxes) of 2.7 per cent, and a risk premium of 3 per cent. The risk premium is estimated over the 30-year sample period using the consumption-based capital-asset-pricing model (Geltner 1989).

<sup>22</sup> It would be desirable to enhance the error-correction model mentioned earlier with a direct measure of house-price expectations (such as those derived from surveys), but this is prevented by data limitations.



**Chart 4: Cumulative increase in prices relative to gross domestic product, averaged across regions**



Sources: Canadian Real Estate Association and Statistics Canada (data), Bank of Canada calculations (model)

Last observation: 2010

and introduce an alternative, albeit complementary, approach that focuses on the role of the changing liquidity of housing. An empirical link between liquidity in the housing market and medium-run movements in house prices is present in all regions, although changes in liquidity in each region may differ in size and when they occur. For the purposes of exhibition, however, we aggregate the results across regions or show national results.

Similar to user cost, liquidity is a property of an asset, reflecting the ease with which an asset can be bought and sold. There are several ways to measure liquidity in the housing market. Good indicators are the time it takes for a house to sell, the vacancy rate of owner-occupied houses or a measure of sales to available supply, such as houses listed for sale. However, data limitations can make it difficult to construct consistent measures of these indicators for a sufficient length of time to perform empirical analysis. As an alternative, researchers often use a measure of turnover, defined as the ratio of sales to the existing stock of houses, which captures the volume of transactions in the housing market. The factors that affect demand, such as interest rates, income growth, population growth, credit conditions and price expectations, can all influence liquidity.<sup>23</sup>

Beginning with Stein (1995), there is a well-documented relationship between growth in real house prices and turnover.<sup>24</sup> Peterson (forthcoming) documents such a relationship in Canada at both the regional and national levels (see **Chart 5** for the national relationship). Changes in turnover capture all of the cyclical periods of high and low growth in real house prices. Peterson (2012) shows similar evidence for the United States.

What can generate the relationship between turnover and prices? Peterson (2012) offers an approach based on the liquidity of a house.<sup>25</sup> This model

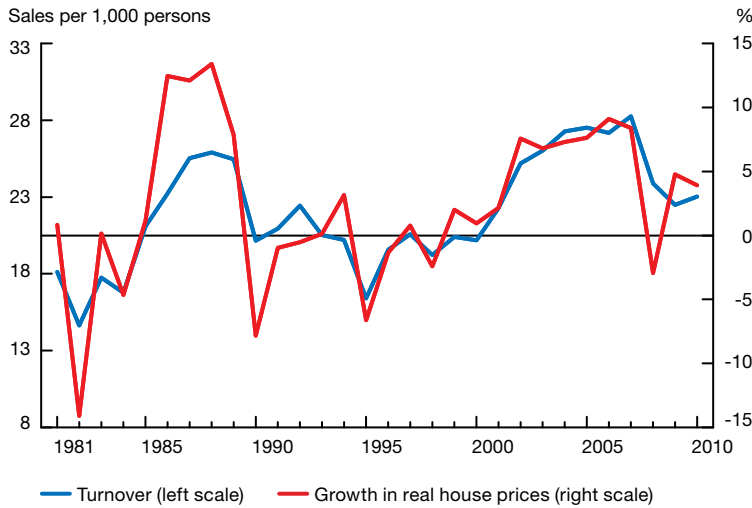
<sup>23</sup> Supply can also have an impact on liquidity, affecting prices. See Peterson (2012).

<sup>24</sup> Englund (2011) has an overview of the evidence.

<sup>25</sup> A complementary approach is the work by Stein (1995) and Ortalo-Magné and Rady (2006), which relies on the observation that most housing is purchased with a mortgage. An increase in income of young households could raise the demand for starter homes among credit-constrained first-time homebuyers. The resulting increase in house prices could raise the equity of current homeowners so that they can afford to buy a larger house. This raises the demand for housing further, increasing turnover and boosting prices.



**Chart 5: Growth in real house prices and turnover**



Sources: Canadian Real Estate Association and Statistics Canada

Last observation: 2010

accounts for the key features of housing markets: Individual houses may be very different, prices are typically determined through negotiation between a buyer and seller, and only a subset of the housing stock is bought and sold in a given year. In this approach, demand drives liquidity, which is measured by turnover. When demand is high and there are many buyers relative to sellers, buyers may raise their offer (or bidding price). Therefore, a temporary increase in demand would raise house prices above the long-run trend by raising the liquidity of a house. Over time, as the market cools, the liquidity of a house would fall back to normal, and prices would revert to the long-run trend. As long as demand remains high,<sup>26</sup> however, new entrants to the market may not realize that the prices of houses previously sold were bid up, because housing was more liquid. If current buyers and sellers use *comparables*<sup>27</sup> to price houses, a persistent increase in demand will lead buyers to continue to bid prices up, escalating price rises even further.<sup>28</sup> During a downturn, the effect works in reverse, depressing house prices, with sellers accepting a discount relative to past sales because of a decrease in the liquidity of a house.

Using this liquidity approach, Peterson (forthcoming) estimates medium-run movements in Canadian house prices that can be attributed to changes in turnover at the regional level. Such an approach can explain medium-run movements in prices that are not influenced by GDP (**Chart 4**, the blue bars representing the model). This suggests that cyclical changes to the liquidity of a house can explain medium-run movements in house prices that are not determined by long-run fundamentals such as population and income.<sup>29</sup>

*Cyclical changes to the liquidity of a house can explain medium-run movements in house prices*

<sup>26</sup> Demand could remain high for several reasons. The mechanism mentioned by Stein (1995) is one example. Alternatively, Shiller (2005) argues that an increase in prices raises expectations of future price increases, creating a feedback loop and raising future demand. These effects can also generate momentum in house prices where an above-trend increase in house prices in one year leads to above-trend increases in subsequent years.

<sup>27</sup> Comparables are houses that have recently been sold and have similar characteristics to a house that buyers and sellers are bargaining over.

<sup>28</sup> Peterson (2012) estimates that this effect accounts for over 70 per cent of the above-trend growth in house prices in the United States from 1995 to 2006.

<sup>29</sup> Peterson (forthcoming) also finds that house-price momentum and reversion to fundamentals are almost entirely captured by movements in turnover.

However, in order to fully understand medium-run movements in house prices, the reasons for cyclical movements in housing liquidity need to be better understood.

## Concluding Remarks

This article has argued that income and population are important determinants of Canadian house prices over the longer term and can help explain much of the increase in house prices over the past decade. Other factors are at work, however. Research at the Bank of Canada and elsewhere indicates that a combination of declining long-term effective mortgage rates, expectations of rising future house prices and changes in the liquidity of the housing market have also contributed to the gains in house prices in the past decade. Over history, these other factors are associated with the medium-run tendency of house prices to rise faster than their long-run trend for a number of years and then subsequently adjust back to trend.

The Bank of Canada conducts ongoing research and analysis to better understand the movement and determinants of house prices. Future research should seek to develop models that better incorporate the dual nature of housing as both a durable consumption good and an asset, particularly the links between credit market conditions, interest rates, leverage and housing demand.<sup>30</sup> It would also be worthwhile to explore how expectations of house prices are formed. Finally, to enhance the research, more comprehensive data are needed on house prices, construction costs, land values, credit conditions and house-price expectations.

---

<sup>30</sup> Recent work at the Bank of Canada has focused on this area. See Christensen et al. (2009).

Appendix 1

## Indicators of House Prices in Canada

A prerequisite for a better understanding of the housing market is a well-constructed indicator of house prices. There are three main criteria for a “useful” index of house prices. It should: (i) measure constant quality, (ii) represent a range of properties across regions and (iii) cover a sufficiently long time span. The first criterion states that an indicator of house prices should track price changes not due to quality improvements. The second criterion requires that the subset of properties forming the basis of the indicator represent the universe of properties in terms of structural and geographical coverage. The third criterion calls for time-series data that span multiple market cycles in order to differentiate between

trend and cyclical movements in prices. None of the commonly used indicators of house prices in Canada meets all three criteria. **Table A-1** summarizes the key features of these indicators. Most of the national analysis in this article is based on the Teranet–National Bank National Composite House Price Index.<sup>1</sup> The Canadian Real Estate Association Multiple Listing Service (MLS) average home price is used for regional analysis or when a longer historical perspective is required.

<sup>1</sup> In addition to the indicators that we have listed in Table A-1, the Canadian Real Estate Association recently released a constant-quality index of house prices (the MLS House Price Index) dating back to 2005.

**Table A-1: Key features of five indicators of house prices**

Indicator	Statistics Canada New Housing Price Index (NHPI)	Statistics Canada Apartment Building Construction Price Index	Canadian Real Estate Association MLS average home price	Teranet–National Bank National Composite House Price Index	National Accounts implicit price index for residential structures
Price value or index	index	index	value	index	index
Constant quality?	partial	partial	no	yes	partial
Frequency	monthly	quarterly	monthly	monthly	quarterly
First value	January 1981	1988Q1	January 1980	February 1999	1961Q1
Publication lag	1.5 months	1.5 months following end of quarter	2 weeks	2 months	2 months
Source of data	building contractors	building contractors	real estate boards	provincial land registries	various
Structure coverage	single, semi-detached, row unit, other (but mainly single)	apartment building	single, semi-detached, row unit, apartment, other	single, semi-detached, row unit, condominium	new construction (of all structural types), renovation and ownership transfer costs
Structure-specific indicator available?	no	yes	no	no	no
Geographical coverage	21 metropolitan areas	7 metropolitan areas	25 metropolitan areas, 10 provinces	11 metropolitan areas	Canada
Methodology	chain Laspeyres index, weighted by building completion of the previous 3 years, valued at 1997 prices among the regions; average model price within region	chain Laspeyres index, weighted by building permits of the previous 3 years, valued at the fourth quarter of the last year among the regions; fixed weighted among trade groups within region	simple average/median price of properties sold via the MLS; a weighted (yet unpublished) version of the national average takes into account provincial proportions of units of privately owned housing stock as reported in the 2006 Census	repeat-sales index (June 2005 = 100) for each region similar to the Case-Shiller Home Price Index in the United States; national average is weighted using the value of housing stock in the 2006 Census	derived indirectly as the ratio of the nominal to real value of residential investment, with each component of the real value deflated separately using a number of price indexes, including the NHPI, the Industrial Product Price Index, wage rates and the MLS average prices
Seasonal adjustment?	no	no	yes	no	yes
Revisions?	no	yes	yes	yes	yes

## Literature Cited

- Allen, J., R. Amano, D. P. Byrne and A. W. Gregory. 2009. "Canadian City Housing Prices and Urban Market Segmentation." *Canadian Journal of Economics* 42 (3): 1132–49.
- Capozza, D. R. and R. W. Helsley. 1989. "The Fundamentals of Land Prices and Urban Growth." *Journal of Urban Economics* 26 (3): 295–306.
- Carney, M. 2011. "Growth in the Age of Deleveraging." Speech to the Empire Club of Canada and the Canadian Club of Toronto, Toronto, Ontario, 12 December.
- Christensen, I., P. Corrigan, C. Mendicino and S.-I. Nishiyama. 2009. "Consumption, Housing Collateral, and the Canadian Business Cycle." Bank of Canada Working Paper No. 2009-26.
- Crawford, A. and U. Faruqi. 2011–12. "What Explains Trends in Household Debt in Canada?" *Bank of Canada Review* (this issue): 3–15.
- Davis, M. A. and J. Heathcote. 2007. "The Price and Quantity of Residential Land in the United States." *Journal of Monetary Economics* 54 (8): 2595–620.
- Dupuis, D. and Y. Zheng. 2010. "A Model of Housing Stock for Canada." Bank of Canada Working Paper No. 2010-19.
- Englund, P. 2011. "Swedish House Prices in an International Perspective." Chapter I.1 in *The Riksbank's Inquiry into the Risks in the Housing Market*, 23–66. Stockholm: Sveriges Riksbank.
- Geltner, D. 1989. "Estimating Real Estate's Systematic Risk from Aggregate Level Appraisal-Based Returns." *Real Estate Economics* 17 (4): 463–81.
- International Monetary Fund (IMF). 2008. "The Changing Housing Cycle and the Implications for Monetary Policy." Chapter 3 in *World Economic Outlook* (April).
- Mayer, C. J. and C. T. Somerville. 2000. "Residential Construction: Using the Urban Growth Model to Estimate Housing Supply." *Journal of Urban Economics* 48 (1): 85–109.
- Ortalo-Magné, F. and S. Rady. 2006. "Housing Market Dynamics: On the Contribution of Income Shocks and Credit Constraints." *Review of Economic Studies* 73 (2): 459–85.
- Peterson, B. 2012. "Fooled by Search: Housing Prices, Turnover and Bubbles." Bank of Canada Working Paper No. 2012-3.
- Peterson, B. "The Canadian Housing Market: Turnover and Prices." Bank of Canada Working Paper (forthcoming).
- Poterba, J. M. 1984. "Tax Subsidies to Owner-Occupied Housing: An Asset-Market Approach." *Quarterly Journal of Economics* 99 (4): 729–52.
- Shiller, R. J. 2005. *Irrational Exuberance*, 2nd ed. Princeton: Princeton University Press.

- Smith, L. B. 1969a. "A Bi-Sectoral Housing Market Model." *Canadian Journal of Economics* 2 (4): 557-69.
- . 1969b. "A Model of the Canadian Housing and Mortgage Markets." *Journal of Political Economy* 77 (5): 795-816.
- Stein, J. C. 1995. "Prices and Trading Volume in the Housing Market: A Model with Down-Payment Effects." *Quarterly Journal of Economics* 110 (2): 379-406.
- Zheng, Y. "A Model of House Prices for Canada." Bank of Canada Discussion Paper (forthcoming).