Are Mortgage Rates Bubbling Up Trouble for Canadas Metropolitan Housing Sector?

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2009

Are Mortgage Rates Bubbling Up Trouble for Canadas Metropolitan Housing Sector?*

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August 27, 2009

Abstract

This paper determines how mortgage rate and income shocks affect new and resale housing prices, housing starts, and housing sales in Canadas metropolitan areas. We assess the variance decompositions and impulse response results to mortgage rate and income shocks. An additional set of VARs is estimated to document whether the stock price, as an alternative source of investment, reduces the importance of the mortgage rate. Our results show that the importance of the mortgage rate and income varies significantly by metropolitan area and to a lesser degree, by the component of the housing market examined. More precisely, we find that: 1) two of BCs major metropolitan areas housing markets, Vancouver and Victoria, are vulnerable to interest rate bubble;. 2) Mortgage rates, and by extension the Bank of Canada monetary policy, seems to have little direct impact on Albertas major metropolitan housing markets, Calgary and Edmonton, while income can be expected to have a drastic effect; and 3) The housing markets of Ontarios major metropolitan area and Canadas Capital Region are prone to mortgage rate bubbles, but the impact is dampened due to their connectedness to national financial markets. What these results mean in terms of policy-making decision is that close attention needs to be paid to housing markets in Canada that are vulnerable to spikes in mortgage rates as we are coming out of the recession provoked by the housing market meltdown in the United States. Although it is true that Banking regulations in Canada have helped weather the storm, with the massive fiscal stimulus implemented in both Canada and the United States, eventually strong aggregate demand may build up pressure on prices to rise and interest rate will have to increase in order to maintain price stability, thereby causing troubles for mortgagees.

JEL Classification:

Keywords: Housing Markets, Metropolitan Areas in Canada, Monetary Policy, Stock Prices, Provincial Income, Variance Decomposition

1. Introduction

The objective of this paper is to determine how mortgage rate and income shocks affect housing prices, housing starts, and housing sales in Canada's metropolitan areas. Housing is an important part of Canada's economy, especially in its urban markets. The loss of wealth due to downturns or burst bubbles in the housing market can thus be quite severe. The US market experienced a rapid inflation in housing prices up until the sub prime mortgage market fell apart and the economy moved into a recession. As macroeconomic fallout in the US continues to spread, it has sparked debate as to the Canadian housing market's vulnerability to these macroeconomic disturbances. Many Canadian markets have experienced large booms in their housing prices within the last decade (see Figure 1); however, these booms may have resulted in over speculation and may be collapse if interest rates are jolted back to a higher long-run level. For example, an international study by Girouard *et al* (2006) determined that the rent-price ratio in Canada was 13% overvalued. A recent study of 8 major Canadian metropolitan areas by Somerville and Swann (2008) showed that most of the markets were overvalued. Further, there is substantial debate as to what factors influence the housing market. If the interest rate is deemed to be a very important factor in the housing market, then the market may be seen to be fuelled be speculative investment that is vulnerable to changes in monetary policy, particularly when the mortgage rate becomes unusually low. This study seeks to determine the relative importance of income and mortgage rates in contributing to housing market fluctuations. Our paper examines how income and mortgage rates impact housing prices, housing starts, and housing sales in Canada's metropolitan areas.

A Vector Autoregression model is used to determine impulse response functions and variance decompositions. The impulse responses are used to determine the effect of a shock to the housing market variables in the model over a period of fifteen quarters. Variance decompositions are used to assess what percentage of housing market variation is explained by the model's variables. The housing market VAR literature shows that monetary shocks have a significant impact on housing. In general, the impulse response of housing prices to a monetary shock has a "hump shaped" effect, gradually rising and declining (Iacoviello 2002; Lastrapes, 2002). Otrok and Terrones (2005) combined a Dynamic Factor Model with a partially identified VAR. The authors' analysis showed that monetary shocks from the US had substantial impacts on international housing prices. Lastrapes (2002) used a VAR with long run restrictions and showed the variation of new house prices and sales explained by a monetary shock peaked at 14% and 46%, respectively. New housing sales showed a significantly larger response (2.5%) to a monetary shock than housing prices (0.7%). The response of existing house sales was slower than the response of prices. In contrast, for the Swedish housing market Hort (2000) finds that the impulse response of housing sales to an interest rate shock was quicker than housing prices.

Kim (1999) used an SVAR to measure both demand and supply shocks to test Monetary Business Cycle theory and Real Business Cycle theory. The SVAR impulse response showed that interest rate shocks had the strongest effect on housing prices and starts, confirming the importance of Monetary Business Cycle theory. Iacoviello (2002) used a SVAR to examine how much of the variance of housing prices was explained by GDP, money, interest rates, and inflation for six developed countries. Iacoviello found that interest rates and GDP explained most of the variation in housing prices. Joshi (2006) used a SVAR for India. The variance decomposition showed that interest rates (45%) and credit (27%) explained most of the variation in prices, while income (8%) had a minor impact. A SVAR analysis of the UK by Elbourne (2008) showed that housing prices fell by as much as 0.75% as a result of a 1% rise in the interest rate. The variance decomposition showed that the US Federal Funds rate accounted for more of the forecast error (33%) than the UK Bank Rate, while aggregate demand (using retail sales) accounted for little of the variation. Using an Error Correction VAR and a Choleski variance decomposition, Apergis and Rezitis (2003) showed that the mortgage rate explained the greatest proportion of the variance in housing prices in Greece, followed by inflation and employment.

Vargas-Silva (2008) found that monetary shocks accounted for 11 to 14% of the variation in housing starts using the Choleski decomposition, compared to 4 to 5% in the sign restricted model.

The heterogeneity of regional housing markets is particularly relevant for countries with geographically and economically heterogeneous regional markets such as Canada and the US. Baffoe-Bonnie (1998) determined variance decompositions in the US housing market. Employment and mortgage rate shocks accounted for most of the variation in housing prices and sales, with regional differences in the level and the timing of shocks. Fratantoni and Schuh (2001) used a heterogeneous-agent VAR model to incorporate regional heterogeneity. The panel of regional data showed significant regional variation in the level and duration of responses to monetary shocks. Allen, Amano, Byrne, and Gregory (2007) assessed the housing price determinants of eight major Canadian cities using Fully Modified Ordinary Least Squares. Interest rates only had a negative and significant relationship for Ottawa and Toronto, while provincial GDP showed similar results. Their paper indicated regional heterogeneity within Canada's major metropolitan housing markets.

There have been few analyses assessing the Canadian housing market using VAR techniques. Using a partially restricted Vector Error Correction Model, Pichette and Tremblay (2003) analyzed impulse responses and variance decompositions to show that housing prices have a substantial impact on Canadian consumption. For six developed countries, Sutton (2002) used a VAR to determine the impulse response of housing prices to a shocks arising from GNP, interest rates, and equity prices. The variance decomposition of house prices in Canada had the largest unexplained residual and thus the variance was poorly explained by the variables. Tsatsaronis and Zhu (2004) included Canada in a SVAR analysis of the impulse response and variance decomposition of 17 industrialized countries. Canada was grouped together with several other countries. Housing prices for the grouping were most affected by inflation, followed by interest rates, term spread, and GDP.

This paper uses a Structural VAR to determine the variance decomposition and impulse response functions for housing market variables, as in Adam (2008), Joshi (2006), Tsatsaronis and Zhu (2004), Elbourne (2008), and Iocaviello (2002). As some studies have demonstrated that housing markets are regionally asynchronous (Negro and Otrok, 2005; Allen *et al* 2007) our study has the advantage in that it uses metropolitan housing prices, starts, and sales and metropolitan and provincial labour income. Most of the existing literature has used under identified VARs and therefore could relied on an atheoretical Choleski ordering. There have been relatively few SVAR analyses of the Canadian housing market. This paper fills the gap in the literature by analyzing VARs for a nationally representative sample of ten of Canada's major metropolitan housing markets.

Our paper compares the importance of mortgage rates and income in contributing to housing market variations. We assess the variance decompositions and impulse response results to mortgage rate and income shocks for each metropolitan housing market variable. A "Metropolitan Average" is calculated to show the overall trend for Canada's major urban centres. Lastly, an additional set of VARs is calculated in order to determine if the stock price has the effect of reducing the importance of the mortgage rate, because the stock market is an alternative source of investment to the housing market. Our results show that the importance of the mortgage rate and income varies significantly by metropolitan area and to a lesser degree, by the component of the housing market examined. The results are the most robust for Western Canada's urban areas and for Canada's largest urban centre. BC's metropolitan areas are the most sensitive to mortgage rates, while Calgary and Edmonton are the least sensitive to mortgage rates and the most sensitive to income. In Canada's largest metropolitan area, Toronto, the housing market is also sensitive to the mortgage rate, although income's effect dominates when the TSX is considered.

The remainder of the paper is organized as follows. Section 2 presents the theory and methodology. Section 3 describes and analyses the characteristics of the data. Section 4 discusses the empirical results and Section 5 concludes the paper.

2. Theory and Methodology

Irrational exuberance was first coined by Alan Greenspan and then popularized by Shiller's book and thesis *Irrational Exuberance* (2006). Irrational exuberance occurs when price growth is fuelled by future expectations of price growth, which serves to make the housing market a volatile asset market. Shiller argues that the irrationally exuberant investment that led to the run up and subsequent crash in the stock market in the 1990s shifted to the housing market in the 2000s (Case and Shiller, 2004). Stiglitz provided an earlier definition of asset bubbles that is more salient to our exposition. Stiglitz noted that an asset bubble exists when 'fundamental' factors are not driving price growth (Himmelberg *et al*, 2005). Mortgage rates become more important in a market that is experiencing "irrational exuberance." Mayer, for example, suggests that low interest rates may have been a significant contributor to the run-up in US housing prices after 2000. Further, Mayer suggests that the impact of the mortgage rate is particularly strong if there is a fixed mortgage payment-to-income ratio (Case and Shiller, 2004). In addition, if markets exhibit irrational exuberance based on the belief that prices will continue to go up, then mortgage rates become a substantial factor in the maintenance of housing market growth. The logic of this connection is two-fold. 1) A market experiencing high housing price inflation is more vulnerable to the mortgage rate; 2) If the price growth is not based on economic fundamentals, then the mortgage rate can be seen as a vehicle that fuels the cycle of price growth expectations by allowing people to purchase housing that is beyond their normal budget constraints. To the extent that a decline in the mortgage rate, via the Bank of Canada prime rate, is only temporary, thus exhibiting mean reversion, a mortgage rate decline to low levels may generate an artificially high price for housing. Thus, it is our contention that the markets that are most influenced by the mortgage rate are the markets that exhibit the greatest tendency towards irrational exuberance.

This paper uses the structural vector autoregression method to determine the impact of US monetary policy shocks on Canada and Mexico. This methodology has been used extensively in the economic profession after Sims (1986) and Bernanke (1986) used short-run restrictions and Blanchard and Quah (1989) used long-run restrictions to model innovations using economic analysis in response to Cooley and Leroy's (1985) critique of Sims's (1980) unidentified VAR. Further improvement in the SVAR technique was brought about with the work of Gali (1992) that combines short- and long-run restrictions to identify their model. Our SVAR exposition follows closely Enders (2004).

Assuming Z_t are vectors containing the so-ordered variables (mortgage rate = i_t, real provincial labour income growth = y_t, resale housing prices, new housing prices, and housing sales = rp_t, np_t, s_t, stock prices = sp_t) and (mortgage rate = i_t, real provincial labour income growth = y_t, stock prices = sp_t, housing starts = hs_t) that are driven by the so-ordered structural innovations ε_t = (mortgage rate shock = ε_t^i, income shock = ε_t^y, resale price, new price, and sales shock = ε_t^{rp}, ε_t^{np}, ε_t^s, stock price shock = ε_t^{sp}) and ε_t = (mortgage rate shock = ε_t^i, income shock = ε_t^y, stock price shock = ε_t^{sp}, housing start shock = ε_t^{hs}), which are assumed to follow a normal distribution with covariance matrix equal to the identity matrix, I. Simply put, $E(\varepsilon_t\varepsilon_t^{'}) = I$. Let $B(L)$ be the polynomial lag matrix. Hence, by ignoring the mean values, the system can be written
as:

$$B(L)Z_t = \varepsilon_t \qquad (1)$$

If $B(L)$ is invertible, a condition that only holds if the polynomial lag matrix of the reduced form model is invertible, then one can write the infinite Wold moving average $[MA(\infty)]$ of the structural system as:

$$Z_t = R(L)\varepsilon_t \qquad (2)$$

Where $R(L) = B(L)^{-1}$. However, since the structural model cannot be estimated because ε_t is not observable, one has to first estimate the reduced form model and transform its residuals in order to obtain ε_t. The reduced form VAR representation is as follows:

$$\psi(L)Z_t = e_t \qquad (3)$$

where $\psi(L) = \psi_0 + \psi_1 L + \psi_2 L^2 + \ldots + \psi_p L^p$; L is the lag-operator with $L^i Z_t = Z_{t-i}$, and ψ_0 is the identity matrix. e_t is the reduced-form residuals set with covariance matrix, Ω, being symmetric. In few words, $E(e_t e_t^{'}) = \Omega$. Assuming $\psi(L)$ is invertible, one can write the reduced-form MA(∞) representation as:

$$Z_t = C(L)e_t \qquad (4)$$

Where $C(L) = \psi(L)^{-1}$. Following Blanchard and Quah (1989), the relationship between the structural shocks and the reduced form shocks can be established by equating (2) and (4), the MA(∞) of both systems. It follows that:

$$R(L)\varepsilon_t = C(L)e_t \qquad (5)$$

Since $C(0)$ is equal to I and this equation holds for all t, it is straightforward that:

$$R(0)\varepsilon_t = e_t \qquad (6)$$

By squaring both sides and taking expectations, one finds that:

$$R(0)R(0)^{'} = \Omega \qquad (7)$$

and by substituting (6) in (5):

$$R(L)\varepsilon_t = C(L)R(0)\varepsilon_t \qquad (8)$$

and by dividing both side of (8) by ε_t :

$R(L) = C(L)R(0)$ (9)

Since Ω is symmetric, Equation (7) places $n(n + 1)/2[= 3(3 + 1)/2 =$

$6]$ restrictions on the elements of R(0), the additional $n(n - 1)/2[=3(3-1)/2=3]$

restrictions needed are taken from economic theory in order to fully identify $R(0)$. Knowledge of this matrix enables us to recover i) $R(L)$ given that $C(L)$ is already known from (4); and ii) ε_t from (6). Finally, the variance decomposition and the impulse responses analyses follow from (2).

We estimate the following four models where i_t is the Canadian five year mortgage rate and y_t and sp_t are the respective provincial labour income and TSX stock price index growth variables. The housing market variables are rp_t, the quality adjusted resale housing price proxy, np_t, the New Housing Price Index, hs_t, housing starts, and s_t, housing sales.

$$\begin{bmatrix} i_t \\ y_t \\ rp_t \\ sp_t \end{bmatrix} = \begin{bmatrix} * & 0 & 0 & 0 \\ * & * & 0 & 0 \\ * & * & * & 0 \\ * & * & * & * \end{bmatrix} \begin{bmatrix} \varepsilon^{p} \\ \varepsilon^{s} \\ \varepsilon^{rp} \\ \varepsilon^{sp} \end{bmatrix}, \quad \begin{bmatrix} i_t \\ y_t \\ np_t \\ sp_t \end{bmatrix} = \begin{bmatrix} * & 0 & 0 & 0 \\ * & * & 0 & 0 \\ * & * & * & 0 \\ * & * & * & * \end{bmatrix} \begin{bmatrix} \varepsilon^{i} \\ \varepsilon^{y} \\ \varepsilon^{np} \\ \varepsilon^{sp} \end{bmatrix}$$

$$\begin{bmatrix} i_t \\ y_t \\ sp_t \\ hs_t \end{bmatrix} = \begin{bmatrix} * & 0 & 0 & 0 \\ * & * & 0 & 0 \\ * & * & * & 0 \\ * & * & * & * \end{bmatrix} \begin{bmatrix} \varepsilon^{i} \\ \varepsilon^{y} \\ \varepsilon^{sp} \\ \varepsilon^{hs} \end{bmatrix}, \quad \begin{bmatrix} i_t \\ y_t \\ s_t \\ sp_t \end{bmatrix} = \begin{bmatrix} * & 0 & 0 & 0 \\ * & * & 0 & 0 \\ * & * & * & 0 \\ * & * & * & * \end{bmatrix} \begin{bmatrix} \varepsilon^{i} \\ \varepsilon^{y} \\ \varepsilon^{s} \\ \varepsilon^{sp} \end{bmatrix}$$

We imposed the restriction that provincial income and metropolitan housing market shocks do not influence the national mortgage rate and metropolitan housing market shocks have no contemporaneous effect on Y. Lastly, we impose the restriction that stock prices are the most sensitive and as such do not have a contemporaneous effect on the other variables, except for housing starts. This is because the stock market can be seen as an alternative source of investment for real estate developers and investors, but not for most home purchasers, since the majority of transactions are not for speculation purposes.

3. Data and Data Analysis

Our paper examines a cross section of Canadian metropolitan areas: Halifax, Toronto, Ottawa, Montreal, Winnipeg, Regina, Calgary, Edmonton, Vancouver, and Victoria. For resale housing prices our paper used data from Royal LePage that was tabulated into a proxy for quality adjusted metropolitan housing prices by the University of British Columbia's Centre for Urban Economics and Real Estate.[1] The data is adjusted using Statistics Canada's provincial Consumer Price Index (CANSIM 326-0020) and starts around the third quarter of 1978, except for Halifax which starts in the second quarter of 1992. The New Housing Price Index was retrieved from Statistics Canada's CANSIM Table #327-0005 and starts in 1981. The New Housing Price Index is quality adjusted to measure pure price change in order to remove the measurement of changes in house quality. Housing starts were retrieved from Statistic Canada's CANSIM Table #027-0048 and starts in the third quarter of 1978. Labour income and the five year mortgage rate were retrieved from Statistics Canada's CANSIM tables #027-0015 and #382-0001 and were adjusted using provincial CPI and metropolitan CPI (CANSIM Table #326-0020), respectively. The TSX stock price index was retrieved from the IMF's International Financial Statistics database and was deflated using Statistics Canada's national Consumer Price Index (CANSIM #326-0020).

In order to enhance consistency and comparability, the VARs were all run with lags of four (which is appropriate for quarterly data), because the Akaike Information Criteria and Schwartz Information Criteria gave very wide ranging results and suggested a lag of one when

[1] We tabulated Victoria's price using only data for the City of Victoria due to the unavailability of data.

the stock price was included.[2] Table 1 shows the unit root test results with a trend and intercept. All of the variables have a unit root at a five percent level of significance, except for Victoria's and Vancouver's housing starts. The stationarity of the mortgage rate depends on both the period and the metropolitan Consumer Price Index used. The unit root test results for the mortgage rate indicates that the mortgage rate is non stationary for most series. Calgary, Regina, and Toronto housing sales are stationary, while the rest of the sales series are non stationary. Figure 1 shows that labour income clearly has an upward trend which is consistent with the unit root test results. Stock prices show a clear upward trend, while mortgage rates show a downward trend due to the Bank of Canada's response to the high level of inflation during the 1970s and 1980s, among other factors. Both housing price data series have a fairly strong upward trend. Housing starts do not show a clear upward trend or non-stationarity. Due to the ambiguity of whether or not housing starts are non stationary, our paper estimates housing start variables in levels and an estimate with housing start series in first differences. The results in first differences are included in the appendix.

Table 1 Here

Figure 1 Here

Table 2 shows the decade by decade average growth in resale housing prices. The three metropolitan areas with the fastest growth in prices were Toronto, Vancouver, and Victoria. Edmonton, Halifax, and Winnipeg had the slowest quarterly growth rates in housing prices. Table 3 shows that The New Housing Price Index growth was largest in Calgary and Edmonton. In stark contrast to resale housing prices, Victoria's and Vancouver's new price growth was the lowest. The most recent period from 1998 to 2008 had the highest growth in prices for most cities

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[2] For example, Victoria's new housing price VAR suggest a lag of 7 without the stock price and a lag of one with the stock price included.

for both resale and new housing prices, which is suggestive of a bubble that may be on par with the one that occurred in the 1980s or an indication of increased sensitivity to the currently low mortgage rate. Table 4 shows housing starts were greater from 1998 to 2008 than from 1978 to 1988 for half of the metropolitan areas. Toronto, Montreal, and Vancouver had the most robust housing growth, while the smaller metros lag far behind. Table 5 shows that the smaller metros of Halifax, Ottawa, and Winnipeg had the greatest growth in housing sales volume. A slim majority of metros had more rapid sales volume growth from 1978 to 1988. Table 6 shows the ten year average quarterly growth rate of real labour income. Alberta, British Columbia, and Ontario experienced the largest growth in income. In contrast, Quebec, Manitoba, and Nova Scotia faired the worst in terms of income growth. Income growth was the largest in the period 1998 to 2008. Lastly, Table 7 reveals that mortgage rates were lowest from 1998 to 2008 and stock price growth was highest from 1998 to 2008.

Table 2 Here

Table 3 Here

Table 4 Here

Table 5 Here

Table 6 Here

Table 7 Here

4. Empirical Results

The impulse response results are shown without the standard errors included in order to minimize the volume of figures. In addition, the accumulated impulse responses are reported and the graphs. All of the VARs were tested for stability by determining if the roots are inside the unit circle. All of the VARs were stable, with all roots lying inside of the unit circle. Non-cumulative and cumulative results with their standard errors included and the stability test results are available upon request.

4.1. *Impulse Response of Resale Housing Prices*

Figure 2 shows the impulse responses of resale housing prices to one standard deviation shocks before and after the inclusion of the TSX stock price in the VARs. All of the responses to income and stock price shocks were positive and all of the responses to mortgage shocks were negative. The majority of impulse responses to income shocks are significant within two standard errors, while only four responses to mortgage rate shocks are significant. Ottawa and Vancouver are the only metros that have statistically significant responses to stock prices. On average, resale housing prices have a peak response to an income shock in either the second or third quarter. In contrast, the price response to mortgage rates peaks in the third quarter. Vancouver, Calgary, and Victoria respond the most to income, with peak non accumulative responses of 1.9%, 1.5%, and 1.5%, respectively, and peak accumulative responses of 4.8%, 4.9%, and 4.1%, respectively. Calgary's peak response is less than Vancouver's, but is more persistent over time. Victoria's and Vancouver's housing markets are strongly influenced by mortgage rates, with a response similar to their income shock responses. When the stock price index is included, the mortgage rate impact decreases while the response to income increases slightly; however, stock prices only have a small positive impact on resale housing prices.

Figure 2 Here

4.2. *Impulse Response of New Housing Prices*

Figure 3 shows the impulse responses of new housing prices. The majority of responses to income and mortgage shocks were significant within two standard errors, while responses to stock prices were only significant for Montreal and Ottawa. The metropolitan average shows that the response of prices to a mortgage shock is slightly larger and shorter lived than the response of prices to an income shock. Both responses peak in the second quarter; however, the response to income takes much longer to subside. Income generates the largest housing price response for Calgary (0.8%), Edmonton (0.7%), and Toronto (0.5%). Similarly to resale prices, the mortgage rate generates the largest response in Victoria (-0.8%), Toronto (-0.6%), and Vancouver (-0.5%). These metros had respective peak accumulative responses to income of 4.5%, 4.6%, and 3.7% and respective peak accumulative responses to the mortgage rate of -2.0%, -3.8%, and -1.9%. The response of Toronto's prices arising from a mortgage rate shock is clearly much more persistent than for Victoria and Vancouver. When the stock price index is included, the response to the mortgage rate is smaller and the response to income is slightly larger, which is particularly evident for Victoria. Their impact is greatest in Calgary, Edmonton, and Ottawa. The metropolitan average for the impulse responses of housing prices to mortgage shocks is similar to those found for Greece in Apergis and Rezitis (2003). The impulse responses are also somewhat similar to those found in Kim and Coulson (1999).

Figure 3 Here

4.3. *Impulse Response of Housing Starts*

Figure 4 shows the impulse responses of housing starts. When estimated with starts in levels, all of the responses to income shocks were positive and most of the responses to mortgage rate shocks were negative. The majority of responses are significant within two standard errors, except the responses to stock prices. The metropolitan average shows that housing starts have a double hump shaped response to an income shock, which peaks by the second quarter. In contrast, the response to mortgage rates, on average, persists for an additional two periods. Housing starts in Calgary (1.2%), Edmonton (1.1%), and Victoria (1.1%) have the largest responses to income shocks, which is consistent with the new price estimates. Winnipeg (-0.9%), Vancouver (-0.9%), and Victoria (-1.1%) starts respond the most to mortgage rate shocks. The accumulative responses are much larger than for housing prices, with responses of the above metros equal to 12%, 12%, 6%, -13%, -6%, and -6%, respectively. The response of Winnipeg's starts is much more persistent than Vancouver's and Victoria's responses over time. When the stock price index is included the impulse responses to mortgage rate and income shocks change in the same manner as for the new housing price VARs. The stock price index causes a similar impulse response as for new housing prices, except there is a small negative response after the fourth quarter. In contrast to these estimates, the first differenced VARs show much smaller and more erratic impulse responses. Further, almost none of the impulse responses are significant within two standard errors.

Figure 4 Here

4.4. *Impulse Response of Housing Sales*

The responses of housing sales that are shown in Figure 5 contrast with the results from the other VARs. Most of the responses to mortgage rate shocks are negative within two standard errors, while only three responses to income are significantly positive. Victoria's (-8%), Halifax's (-6%), and Edmonton's (-6%) housing sales are the most responsive to the mortgage rate, while income shocks have a minimal impact on housing sales. The peak accumulative responses of Victoria, Toronto, and Calgary to a mortgage rate shock are the highest at -8%, -6%, and -6%, respectively. These results indicate that the shock to sales is immediate and short lived, which also contrasts with the impacts on housing prices and starts. The addition of the stock price index shows a small negligible change and most of the responses to stock prices are insignificant and negative.

Figure 5 Here

4.5. *Variance Decomposition of Resale House Prices*

Nearly one-third of Calgary's housing price variation is explained by income shocks, followed by 20% for Vancouver and Victoria. Victoria is the most impacted by mortgage rates, with nearly one-quarter of its price variation influenced by mortgage rates. Vancouver's prices are affected almost as much by mortgage rates, with 20% of price variation explained. The metropolitan average shows that mortgage rates are a less important component of housing sales prices and that this difference is increased slightly when stock prices are included in the VARs, which itself is a minimal explanatory variable.

Table 8 Here

4.6. *Variance Decomposition of New Housing Prices*

Income explains one-fifth to one-third of Calgary, Edmonton, Toronto, and Victoria prices. The mortgage rate shock explains over a quarter of Toronto's prices and approximately 20% of Montreal's, Ottawa's, Vancouver's, and Victoria's prices. The metropolitan average shows that income is slightly more important than mortgage rates with and without the stock price included. In particular, income explains nearly one third of Toronto's house price variation when stock prices are included and the importance of mortgage rates decrease by a quarter. Stock prices explain almost ten percent of Calgary's and almost twenty percent of Ottawa's housing prices, while they are a minimal factor in the other metropolitan areas' housing prices.

Table 9 Here

In comparison, the variance in housing prices explained by the mortgage rate are about 50% larger than the results found for industrial countries in Tsatsaronis and Zhu (2004), while their results for GDP were half the size of our results for income. Vargas-Silva (2008) and Lastrapes

(2002) found that 10% of house price variation in the US was explained by mortgage rates and money supply shocks, respectively. In contrast to our results for Canada, Joshi (2006) found that GDP only explained 8% of housing price variation in India and mortgage rates explained nearly fifty percent. For six European countries Iacoviello (2002) found that a high percentage of house price variation was explained by GDP. Interest rates explained 10% to 60% of price variation, similar to US regional and national responses to mortgage rates in Boffoe-Bonnie (1998). Kim and Coulson (1999) found that mortgage rates explained almost 40% in the US; however, personal income explained only two percent. Adam (2008) found that 33% of UK house price variation was explained by the US Federal Funds rate, while the UK interbank rate and retail sales explained only about 5% and 20%, respectively. Thus, the results for Canada's housing market indicate greater importance of income and mortgage rates than some literature but less importance than in other literature. The results for Canada are similar to Vargas-Silva (2008), Lastrapes (2002), and to a lesser extent Baffoe-Bonnie (1998).

4.7. *Variance Decompositions of Housing Starts*

Income explains nearly two-fifths of Calgary's and Edmonton's housing start variation, and over twenty-five percent of Toronto's housing start variation. In contrast, mortgage rates contribute to nearly forty percent of Winnipeg's housing starts and nearly a quarter of the variance in Vancouver housing starts. The average of the metropolitan areas shows that income is fifty percent more important than mortgage rates. With the stock price index included in the VAR, income is nearly 250% more important than mortgage rates. The change attributable to including stock prices is particularly apparent with income's increased contribution in Victoria, Toronto, and Edmonton and the mortgage rate's decreased contribution in Winnipeg, Victoria, Toronto, and Vancouver. In comparison, Kim and Coulson's (1999) results showed that the mortgage rate explained up to 50% of housing starts variance in the US, while personal income explained less than two percent of forecast error variance. Vargas-Silva (2008) found that between 11% and

14% of housing start variation was explained by mortgage rates. These results are similar to the "Metropolitan Average" of our results.

Table 10 Here

4.8. *Variance Decomposition of Housing Sales*

Mortgage rates account for almost one-third of Victoria's and Winnipeg's housing sales variations and almost one-quarter of Toronto's and Edmonton's housing price variation. However, Winnipeg's impulse response is very erratic. The metro average indicates that over twenty percent of price variation is explained by mortgage rates. In contrast, the variance explained by income is only about one-quarter of mortgage rates. Lastly, the stock price only explains 3% of sales variation. In comparison, Lastrapes (2002) found that using long-run and short-run restrictions money supply shocks explained approximately 50% and 20% of new house sales and 25% and 35% of existing house sales, respectively. Our housing sales data consists mostly of existing house sales; thus, our results are slightly less than Lastrapes results using short-run restrictions. Baffo-Bonnie's regional analysis of the US showed that the mortgage rate explained a peak of between 6% and 31% for the four regions examined and 20% for national sales. These results are also fairly similar to our results.

Table 11 Here

5. Conclusion

Among the metropolitan areas several conclusions can be drawn. On average, the speed of impulse responses of resale housing prices to mortgage rates is more persistent than the response of new housing prices. In contrast, the response of new housing prices to an income shock is more persistent than the response of resale prices. The response of housing starts is even slower than the response of housing prices for both mortgage rate and income shocks. Lastly, the housing sales response to a mortgage rate shock peaks, on average, in the first quarter and does not last very long.

For resale housing prices and starts, on average, income is a larger contributor than mortgage rates, particularly when the stock price is included. The results for new housing prices show that across the metropolitan areas both variables have roughly the same impact. Income explains almost two times more of the variance of housing starts than mortgage rates when the stock price is included. Lastly, the variance decompositions for housing sales show that the mortgage rate is substantially more important than income. There are significant variations between metropolitan areas and regions. The results for the metropolitan areas of Victoria and Vancouver indicate that these markets are vulnerable to mortgage rate induced bubbles, which is revealed by the fact that for most of their VARs the mortgage rate is more important than income in contributing to fluctuations in the housing market.[3] The housing markets of Montreal and Winnipeg, and to a lesser extent Ottawa, also show a fair bit of sensitivity to mortgage rate shocks. In contrast, Calgary and Edmonton are minimally affected by mortgage rates, but substantially affected by income. This is particularly true for new prices and starts, although the results for housing sales differ. Toronto's results indicate that mortgage rates and income are of roughly equal importance until the stock market is considered, which makes income substantially more important. For almost all of the metropolitan housing VARs, stock prices have a marginal impact on the metropolitan housing market. The only metro that is considerably influenced by the stock market is Ottawa.

[3] When the stock price is included the difference is reduced.

The results for Calgary and Edmonton are consistent with the high level of income growth in Alberta. Income growth in Alberta has been the fastest next to BC's income growth. The importance of mortgage rates in Vancouver, Victoria, and Toronto is consistent with their high housing prices. In high priced and high price growth housing markets the mortgage rate's importance is amplified.[4] These results are fairly consistent with our *priors* as it is reasonable to expect that a metropolitan housing market in a region with high income growth would be mostly influenced by income, while mortgage rates would be more important in a metropolitan area with very high housing prices.

These results suggest that Vancouver and Victoria are the most prone to "irrational exuberance" which can lead to mortgage induced housing bubbles, followed by Toronto, Winnipeg, Montreal, and Ottawa. In contrast, Calgary and Edmonton housing markets are determined by economic fundamentals as demonstrated by the importance of labour income, which explains from one-third to nearly one half of the variation in their housing markets.

What this means for policy makers in British Columbia, Ontario, and Alberta in particular is that: 1) Two of BC's major metropolitan areas' housing markets are substantially vulnerable to interest rate bubbles. Even if economic growth starts to improve in BC, an increase in mortgage rates may cause their housing markets to continue to falter. If mortgage rates are increasing and income growth is faltering, the severity will be exacerbated. 2) Mortgage rates, and by extension Canadian monetary policy, seems to have little impact on Alberta's major housing markets. 3) The housing markets of Ontario's major metropolitan area and Canada's Capital Region are prone to mortgage rate bubbles, but the impact is dampened due to their economy's interconnectedness with national financial markets. 4) Drops in housing sales are a good predictor

[4] There is some inconsistency with this conclusion due to the behaviour of Victoria's and Vancouver's new housing prices, which show much slower growth than other metropolitan areas.

of the potential for future drops in house prices, but there is a lag. The current situation in the Canadian housing market has seen its largest declines in sales at this point, while prices have dropped by a less substantial volume. Given the importance of income in some markets, housing prices may see larger declines when asking prices catch up to the economy. Lastly, 5) Our results show that for Canada's housing market the sensitivity to mortgage rate bubbles and the sensitivity to economic fundamentals depends on the metropolitan area examined. It is important to note that the importance of the mortgage rate is, to a degree, understated, since theoretically housing prices are more sensitive to changes in mortgage rates when rates are low and prices are high. As mortgage rates have been precipitously declining over the last several decades and there has been a recent boom in housing prices (2002-2008), the sensitivity to mortgage rates may have also grown over the years.

6. References

Allen, J. Amano, R., Byrne, D., Gregory, A. (2007). Canadian City Housing Prices and Urban Market Segmentation. *SSRN Working Paper Series*, May 20.

Apergis, N., Rezitis, A. (2003). Housing prices and macroeconomic factors in Greece: prospects within the EMU. *Applied Economics Letters*, 10, 799-804.

Baffoe-Bonnie, J. (1998). The Dynamic Impact of Macroeconomic Aggregates on Housing Prices and Stock of Houses: A National and Regional Analysis. *Journal of Real Estate Finance and Economics*, 17 (2), 179-197.

Campell, S., Davis, M., Gallin, J., Martin, R. (2006). What Moves Housing Markets: A Variance Decomposition of the Rent-Price Ratio. *James A. Graaskamp Center for Real Estate* Working Paper, April.

Case, K., Shiller, R. (2004). Is There a Bubble in the Housing Market? Cowles Foundation for Research in Economics, Yale University.

Chirinko, R., Haan, L., Sterken, E. (2004). Asset Price Shocks, Real Expenditures, and Financial Structure: A Multi-Country Analysis. CCSO Working Papers, November.

Elbourne, A. (2008). The UK Housing Market and the Monetary Policy Transmission Mechanism: An SVAR Approach.

Fratantoni, M., Schuh, S. (2000). Monetary Policy, Housing, and Heterogeneous Regional Markets. Federal Reserve Bank of Boston Working Paper Series No. 00-1.

Gallin, J. (2008). The Long-Run Relationship Between House Prices and Rents. *Real Estate Economics*, 36 (4), 635-658.

Gallin, J. (2006). The Long-Run Relationship between House Prices and Income: Evidence from Local Housing Markets. *Real Estate Economics*, 34 (3), 417-438.

Girouard, N. et al. (2006), "Recent House Price Developments: The Role of Fundamentals", OECD Economics Department Working Papers, No. 475, OECD Publishing.

Hall, S., Psaradakis, Z., Sola, M. (1997). Switching error-correction models of house prices in the United Kingdom. *Economic Modelling* 14, 517-527.

Himmelberg, C., Mayer, C., Sinai, T. (2005). Assessing High House Prices: Bubbles, Fundamentals, and Misperceptions. Federal Reserve Bank of New York Staff Report #218.

Hort, K. (2000). Prices and Turnover in the Market for Owner-Occupied Homes. *Regional Science and Urban Economics*, 30, 99-119.

Iacoviello, M. (2002). House Prices and Business Cycles in Europe: A VAR Analysis. Boston College Working Papers (WP540), October.

Joshi, H. (2006). Identifying Asset Price Bubbles in the Housing Market in India – Preliminary Evidence. *Reserve Bank of India Occasional Papers*, 27 (1-2), 73-88.

Kim, M., Coulson, N. (1999). Sources of Fluctuations in the Housing Market. *International Economic Journal*, 13 (1), 57-70.

Klyuev, V. (2008). What Goes Up Must Come Down? House Price Dynamics in the United States. *IMF Working Paper* No. 08/187

Lastrapes, W. (2002). The Real Price of Housing and Money Supply Shocks: Time Series Evidence and Theoretical Simulations. *Journal of Housing Economics* 11, 40-74.

Malpezzi, S. (1998). A Simple Error Correction Model of House Prices. *Journal of Housing Economics* 8, 27-62.

Meese, R., Wallace, N. (2003). House Price Dynamics and Market Fundamentals: The Parisian Housing Market. *Urban Studies*, 40 (5–6), 1027–1045.

Negro, M. Otrok, C. (2005). Monetary Policy and the House Price Boom across U.S. States. FRBA Working Paper #24, October.

Otrok, C., Terrones, M. (2005). House Prices, Interest Rates, and Macroeconomic Fluctuations: International Evidence. Federal Reserve Bank of Atlanta, Housing, *Mortgage Finance, and the Macroeconomy Conference*, May 19.

Pichette, L., Tremblay, D. (2003). Are Wealth Effects Important for Canada? Bank of Canada Working Paper, 30.

Somerville, T., Swann, K. (2008). Are Canadian Housing Markets Over-priced? *Discussion Papers*, August.

Stevenson, S. (2008). Modeling Housing Market Fundamentals: Empirical Evidence of Extreme Market Conditions. *Real Estate Economics*, 36 (1), 1-29.

Sutton, G. (2002). Explaining changes in house prices. *BIS Quarterly Review*, September.

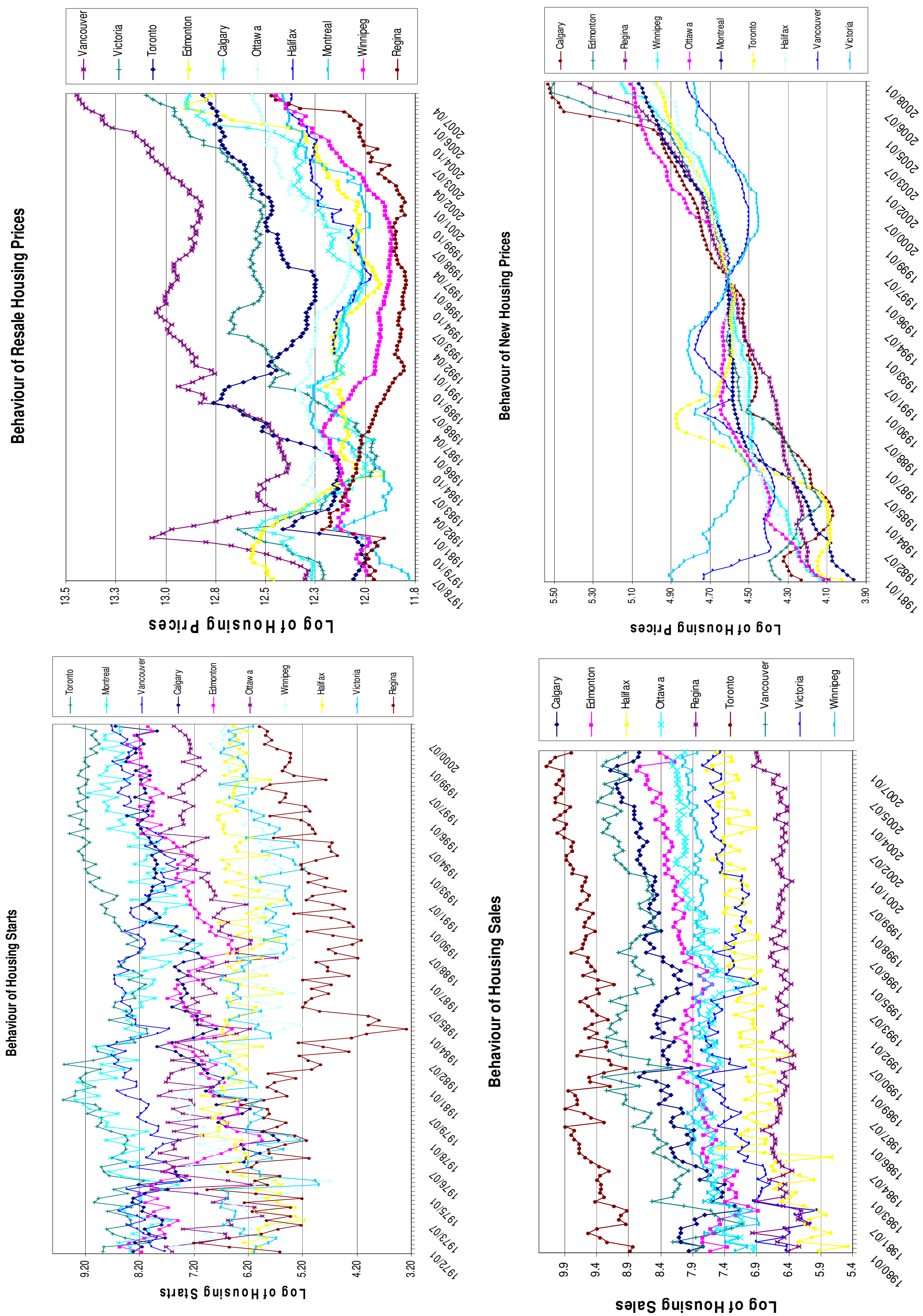
Tsatsaronis, K., Zhu, H. (2004). What Drives Housing Price Dynamics: Cross-Country Evidence. *BIS Quaterly Review*, March.

Vargas-Silva, C. (2008). Monetary policy and the U.S. housing market: A VAR analysis imposing sign restrictions. SSRN Accepted Paper Series (Forthcoming in *Journal of Macroeconomics*).

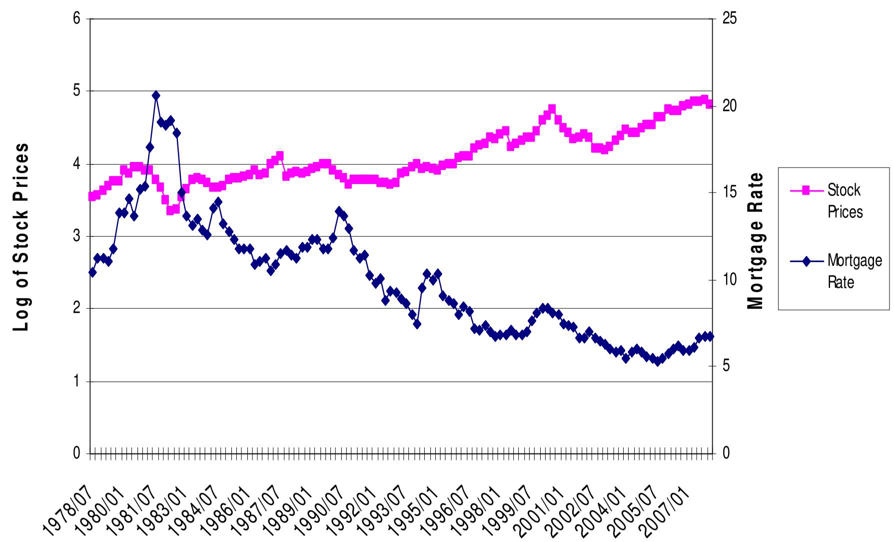
Table 1: Unit Root Test Results	ADF	DF-GLS
Stock Price Index	-2.925447	-2.909817
Income Alberta	-0.686587	-1.180929
Income British Columbia	-0.945116	-1.095030
Income Manitoba	0.716268	-0.718052
Income Nova Scotia	-1.972889	-1.870348
Income Ontario	-1.869360	-1.642214
Income Quebec	-1.742894	-1.682542
Income Saskatchewan	0.637242	-0.168501
Resale Prices Calgary	-0.441380	-0.732391
Resale Prices Edmonton	-0.405823	-0.688539
Resale Prices Halifax	-1.835546	-1.231065
Resale Prices Montreal	-1.863221	-1.612932
Resale Prices Ottawa	-0.762642	-1.951650
Resale Prices Regina	1.752500	-0.374368
Resale Prices Toronto	-2.239272	-2.226399
Resale Prices Vancouver	-2.479238	-2.461854
Resale Prices Victoria	-0.759508	-1.784654
Resale Prices Winnipeg	0.314675	-0.712744
New Prices Calgary	-2.805782	-2.133839
New Prices Edmonton	-2.663550	-2.274454
New Prices Halifax	0.732564	-0.824309
New Prices Montreal	-1.804564	-1.517670
New Prices Ottawa	-1.424667	-1.274660
New Prices Regina	3.874543	0.279777
New Prices Toronto	-1.853103	-2.019099
New Prices Vancouver	-3.287031	-2.043988
New Prices Victoria	-2.196277	-1.420404
New Prices Winnipeg	0.936936	-0.903406
Starts Calgary	-2.331058	-1.318898
Starts Edmonton	-2.494095	-1.896044
Starts Halifax	-3.400531	-1.749221
Starts Montreal	-1.960619	-1.988649
Starts Ottawa	-2.053779	-2.095530
Starts Regina	-1.688971	-1.239318
Starts Toronto	-2.322518	-2.080380
Starts Vancouver	-4.050069**	-3.916463**
Starts Victoria	-5.155647**	-5.091332**
Starts Winnipeg	-3.172402	-1.584310
Housing Sales Calgary	-4.556499**	-4.235213**
Housing Sales Edmonton	-5.066182**	-2.633041
Housing Sales Halifax	-3.259431	-1.845515
Housing Sales Ottawa	-5.168054**	-2.281111
Housing Sales Regina	-6.339306**	-6.307797**
Housing Sales Toronto	-5.370404**	-4.405927**
Housing Sales Vancouver	-3.031152	-2.916613
Housing Sales Victoria	-3.354402	-2.923379
Housing Sales Winnipeg	-4.754476**	-2.383676

*MacKinnon (1996) one sided critical values at 1%, 5%, and 10% are -4.046072, -3.452358, and -3.151673 and -3.571600, -3.023000, and -2.733000, for the ADF and DF-GLS tests, respectively.

Figure 1: Housing Market, Income, Mortgage Rate, and Stock Price Time Series Data.



Behaviour of Real Stock Prices and Nominal Mortgage Rate



Behaviour of Income

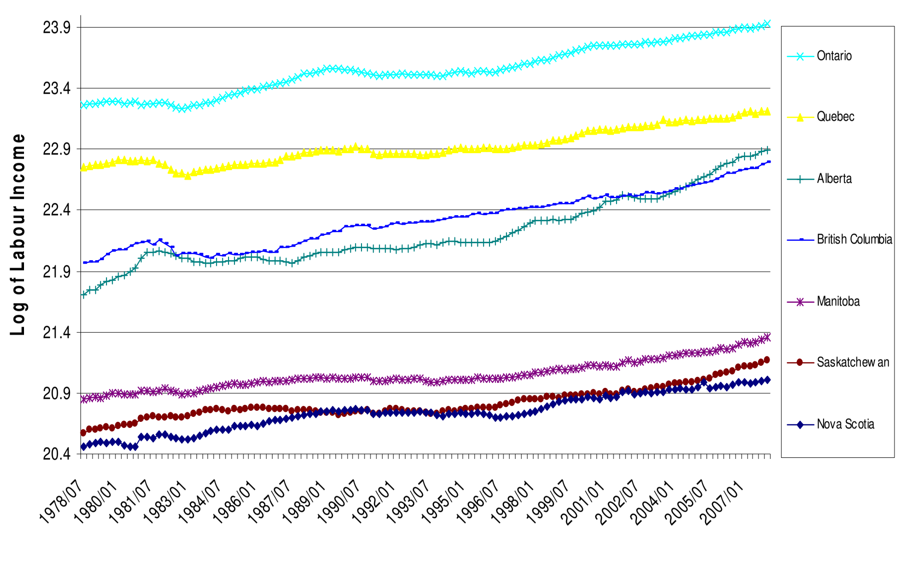


Table 2: Real Resale Housing Prices, Ten Year Quarterly Average											
Decades	**Prices**	Halifax*	Montréal	Ottawa**	Toronto	Winnipeg***	Edmonton	Calgary	Vancouver	Regina	Victoria
1978:4-1988:3	**Mean**	NA	1.27	0.70	1.53	0.48	-0.78	-0.22	0.97	0.07	-0.06
	Stand Dev	NA	3.48	2.38	5.51	2.19	4.55	4.32	7.37	4.30	4.98
	Maximum	NA	8.42	6.63	20.33	7.47	15.95	9.33	30.75	16.89	10.97
1988:4-1998:3	**Mean**	-0.41	-0.58	-0.52	-0.40	-0.73	-0.09	0.14	0.79	-0.24	1.12
	Stand Dev	1.59	1.20	1.08	3.54	1.04	2.23	2.76	4.27	1.10	3.67
	Maximum	2.41	1.41	0.59	12.13	0.96	7.03	6.08	18.40	1.79	13.67
1998:4-2008:1	**Mean**	0.90	1.06	1.32	1.04	1.54	1.98	1.96	1.55	1.74	1.44
	Stand Dev	3.04	2.85	2.10	1.61	1.80	4.69	5.01	2.58	4.80	2.53
	Maximum	12.27	10.65	7.08	5.02	5.66	16.54	21.85	12.18	24.84	8.58
1978:4-2008:1	**Mean**	0.38	0.58	0.45	0.72	0.41	0.34	0.60	1.10	0.50	0.83
	Stand Dev	2.63	2.79	2.03	3.97	1.96	4.11	4.20	5.14	3.82	3.90
	Maximum	12.27	10.65	7.08	20.33	7.47	16.54	21.85	30.75	24.84	13.67

Source: UBC Centre for Urban Economics and Real Estate and Royal LePage. *Data starts in 1992:2, **Data starts in 1982:4, ***Data starts in 1978:4. Data is based on the average of the sale price of executive detached two storey dwellings and bungalows in order to approximate a quality adjusted series. Each series is for the metropolitan areas, except for Victoria which is only for the City of Victoria due to data availability.

Table 3: New Housing Price Growth, Ten Year Quarterly Average											
		Halifax*	Montréal	Ottawa	Toronto	Winnipeg	Regina	Calgary	Edmonton	Vancouver	Victoria
1978:4-1988:3	**Mean**	0.68	1.56	1.34	1.71	0.93	0.73	0.63	0.55	-0.33	-0.45
	Stand Dev	0.80	1.22	1.23	4.00	1.06	1.33	2.48	2.27	3.35	2.74
	Maximum	3.36	4.42	4.08	11.03	3.69	7.53	5.22	7.78	5.97	7.20
1988:4-1998:3	**Mean**	0.44	0.29	0.40	0.05	0.42	0.86	0.73	0.33	-0.18	-0.60
	Stand Dev	0.86	0.48	1.31	0.73	0.59	0.69	0.83	0.63	1.44	1.49
	Maximum	2.01	1.40	4.99	1.22	2.11	3.20	2.63	1.55	3.08	3.91
1998:4-2008:1	**Mean**	1.05	1.33	1.11	1.02	1.76	2.39	2.87	3.03	1.15	1.18
	Stand Dev	1.21	0.62	0.86	0.46	1.64	2.19	4.11	3.47	0.81	1.21
	Maximum	4.49	2.71	3.49	2.35	8.82	8.82	16.06	12.73	3.43	4.24
1978:4-2008:1	**Mean**	0.69	1.03	0.93	0.92	0.96	1.20	1.24	1.11	0.11	-0.08
	Stand Dev	0.99	1.03	1.24	2.57	1.22	1.59	2.77	2.52	2.33	2.12
	Maximum	4.49	4.42	4.99	11.03	8.82	8.82	16.06	12.73	5.97	7.20

Source: UBC Centre for Urban Economics and Real Estate and Royal LePage. *Data starts in 1984:4

Table 4: Housing Starts, Ten Year Quarterly Average											
		Calgary	Edmonton	Halifax	Montréal	Ottawa	Regina	Toronto	Vancouver	Victoria	Winnipeg
1978:4-1988:3	**Mean**	1800	1782	588	5394	1496	390	6730	3335	496	997
	Stand Dev	1323	1228	266	2578	689	232	2581	964	196	514
	Maximum	4166	5208	1179	11922	2897	1327	14728	5494	932	2026
1988:4-1998:3	**Mean**	1766	1233	556	3677	1022	120	5449	4392	519	426
	Stand Dev	615	389	168	1728	420	59	2173	993	227	193
	Maximum	3485	2165	852	8357	2021	338	14486	6476	1039	948
1998:4-2008:1	**Mean**	3346	2701	639	4956	1491	214	9721	3720	447	538
	Stand Dev	687	909	135	1838	375	90	1606	1293	183	199
	Maximum	5652	4504	871	9432	2522	396	13330	6020	823	995
1978:4-2008:1	**Mean**	2295	1899	594	4673	1335	242	7280	3817	488	655
	Stand Dev	1183	1087	200	2193	557	185	2793	1168	204	417
	Maximum	5652	5208	1179	11922	2897	1327	14728	6476	1039	2026
Source: Statistics Canada.											

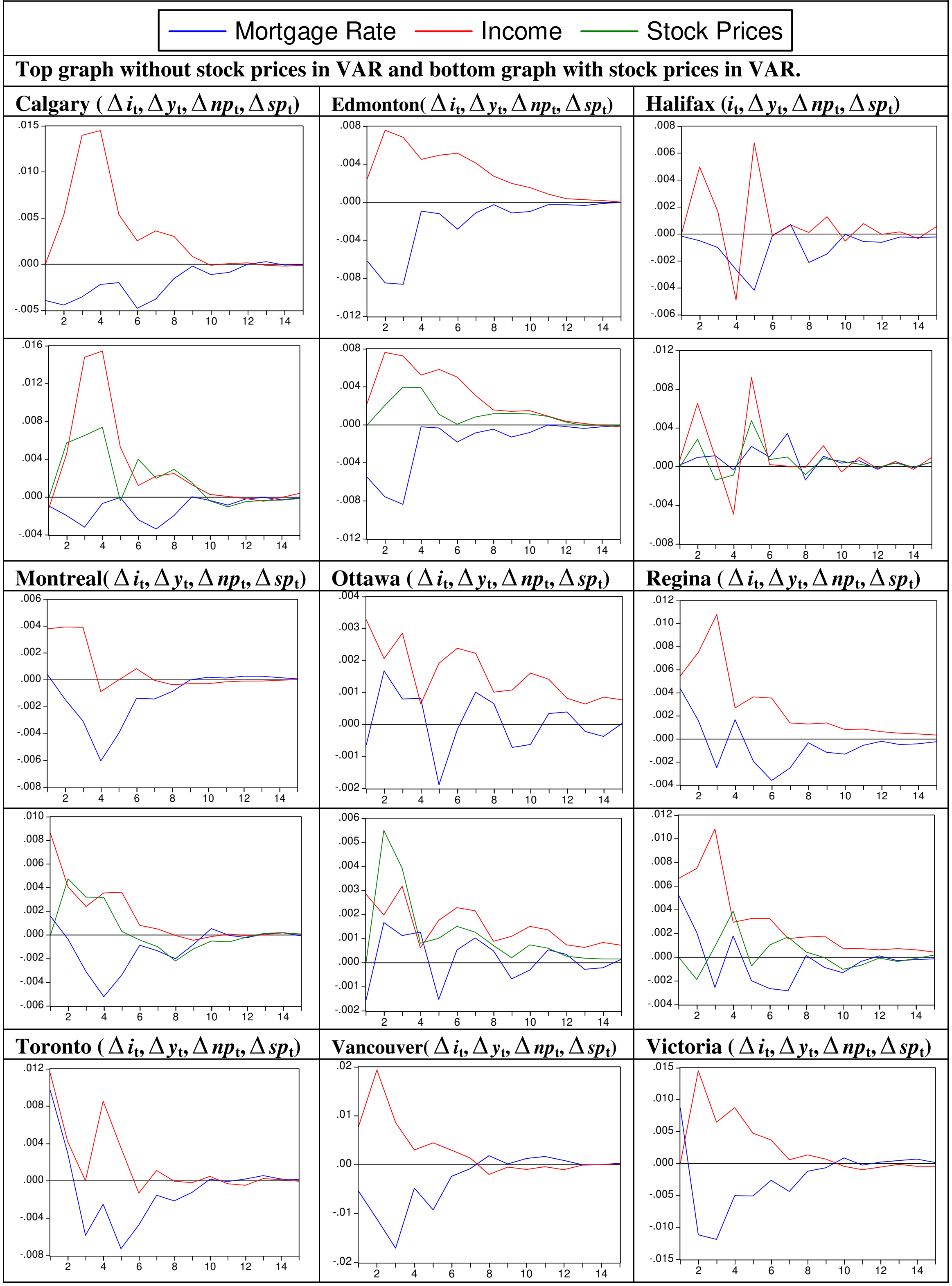
Table 5: Housing Sale Growth, Ten Year Quarterly Average										
		Halifax	Ottawa	Toronto	Winnipeg	Edmonton	Calgary	Regina	Vancouver	Victoria
1978:4-1988:3	**Mean**	15.56	7.14	3.37	5.84	3.17	4.57	3.63	5.25	6.12
	Stand Dev	60.45	31.61	21.44	31.36	20.79	25.54	27.26	24.65	26.73
	Maximum	208.22	77.76	52.83	83.73	35.43	74.38	75.80	54.17	77.28
1988:4-1998:3	**Mean**	10.67	7.04	3.64	5.85	3.41	2.39	4.42	1.52	0.87
	Stand Dev	46.28	40.84	26.42	37.04	26.34	25.18	31.07	22.12	22.15
	Maximum	118.59	97.44	84.70	78.26	56.77	69.24	67.42	62.75	47.70
1998:4-2008:1	**Mean**	6.31	4.79	3.52	6.26	4.63	3.25	5.56	3.47	4.21
	Stand Dev	36.99	32.86	24.62	38.67	28.81	22.55	32.10	21.50	24.76
	Maximum	74.88	66.65	51.54	79.59	57.83	53.70	69.42	47.50	66.05
1978:4-2008:1	**Mean**	11.17	6.43	3.51	5.96	3.67	3.41	4.47	3.41	3.70
	Stand Dev	49.32	35.21	24.00	35.29	25.06	24.39	29.81	22.74	24.49
	Maximum	208.22	97.44	84.70	83.73	57.83	74.38	75.80	62.75	77.28
Source: Statistics Canada										

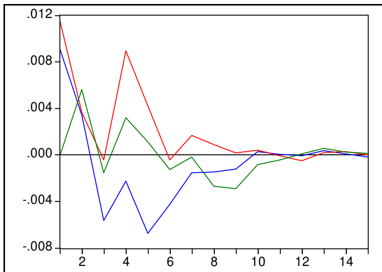
Table 6: Real Income Growth, Ten Year Quarterly Average								
		Nova Scotia	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
1978:4-1988:3	**Mean**	0.69	0.32	0.68	0.46	0.46	0.87	0.52
	Stand Dev	1.74	1.39	1.23	1.01	1.17	2.16	2.07
	Maximum	8.38	3.56	2.92	2.33	4.03	8.43	3.74
1988:4-1998:3	**Mean**	0.14	0.18	0.25	0.14	0.30	0.69	0.68
	Stand Dev	1.08	1.01	0.90	0.86	1.09	1.11	0.96
	Maximum	1.99	1.86	2.23	1.51	2.24	3.06	3.55
1998:4-2008:1	**Mean**	0.60	0.69	0.78	0.74	0.81	1.55	0.94
	Stand Dev	1.51	1.03	0.73	1.03	1.04	1.49	1.09
	Maximum	3.90	3.72	1.98	3.02	2.93	5.18	2.76
1978:4-2008:1	**Mean**	0.48	0.39	0.57	0.44	0.52	1.03	0.71
	Stand Dev	1.48	1.17	1.00	0.99	1.11	1.68	1.46
	Maximum	8.38	3.72	2.92	3.02	4.03	8.43	3.74

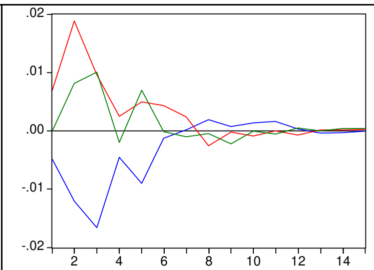
Table 7: Real Toronto Stock Exchange Price Growth and Nominal Mortgage Rates, Decade by Decade - Quarterly					
		1978:4-1988:3	1988:4-1998:3	1998:4-2008:1	1978:3-2008:1
Stock Prices	**Mean**	**1.20**	**1.07**	**1.79**	**1.41**
	Stand Dev	8.71	5.92	6.72	7.17
	Maximum	18.47	13.42	16.23	18.47
Mortgage Rates	Mean	**13.49**	**9.76**	**6.59**	**9.97**
	Stand Dev	2.71	2.05	0.85	3.47
	Stand Dev	20.55	13.97	8.36	20.55

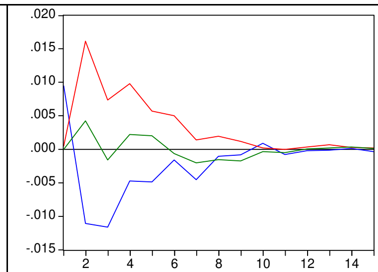
Source: Statistics Canada CANSIM Table 027-0015 and IMF International Financial Statistics.

Figure 2: Response of Resale Housing Prices to Structural One S.D. Mortgage Rate, Provincial Income, and Metro Income Innovations ± 2 Standard Errors.



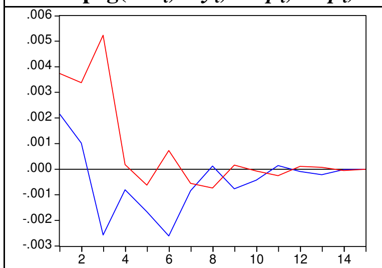


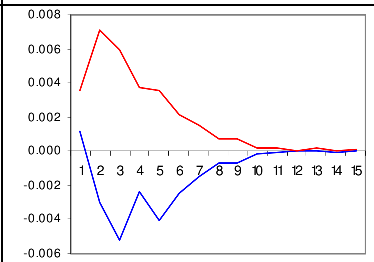


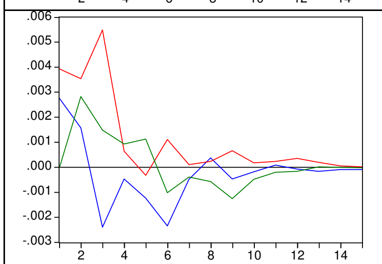


Winnipeg($\Delta i_t, \Delta y_t, \Delta np_t, \Delta sp_t$)

Average of Metro Responses







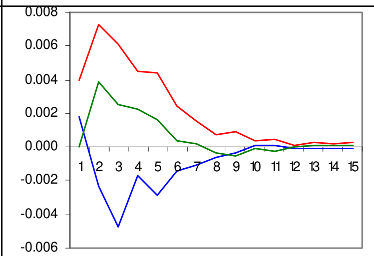
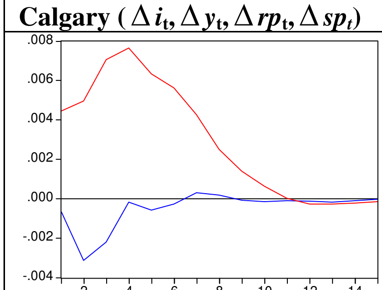


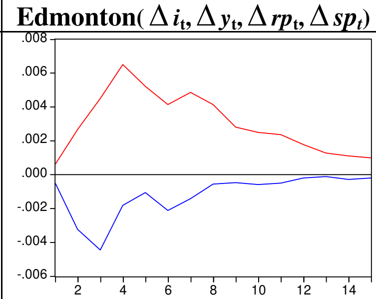
Figure 3: Response of New Housing Prices to Structural One S.D. Mortgage Rate, Provincial Income, and Metro Income Innovations ± 2 Standard Errors.

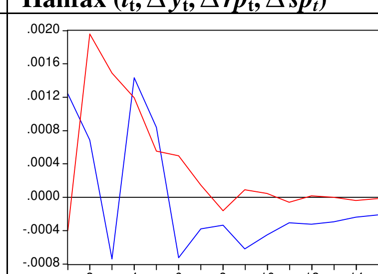
Mortgage Rate — Income — Stock Prices

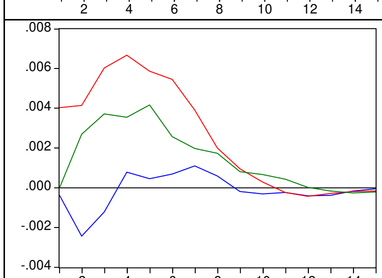
Top graph without stock prices in VAR and bottom graph with stock prices in VAR

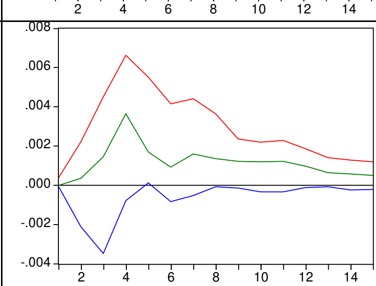
Calgary ($\Delta i_t, \Delta y_t, \Delta rp_t, \Delta sp_t$) | **Edmonton($\Delta i_t, \Delta y_t, \Delta rp_t, \Delta sp_t$)** | **Halifax ($i_t, \Delta y_t, \Delta rp_t, \Delta sp_t$)**

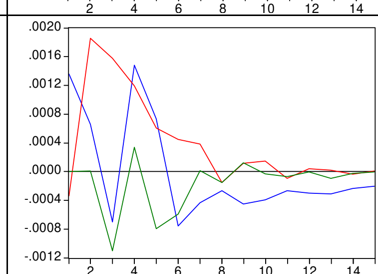




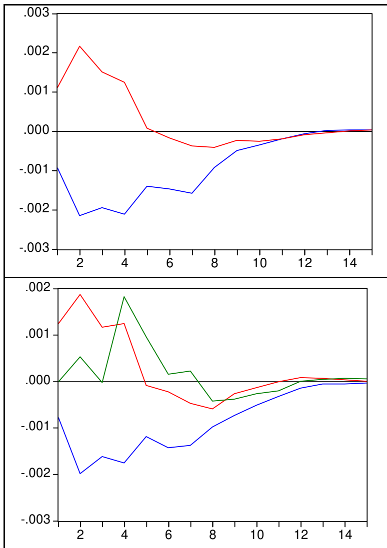
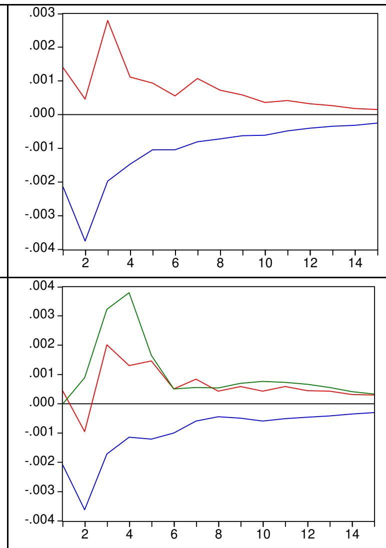
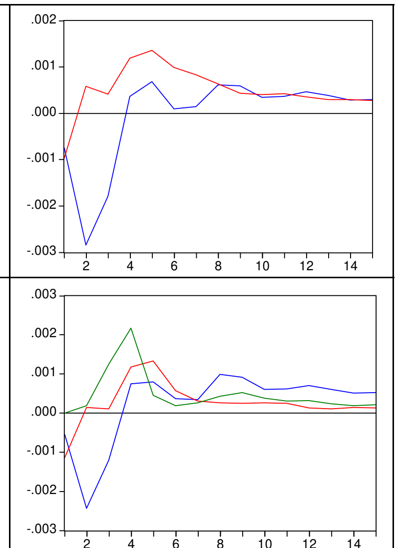




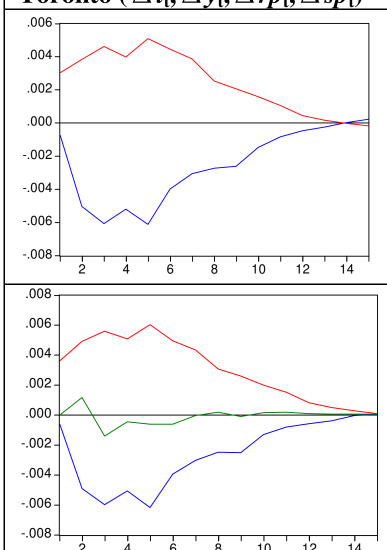
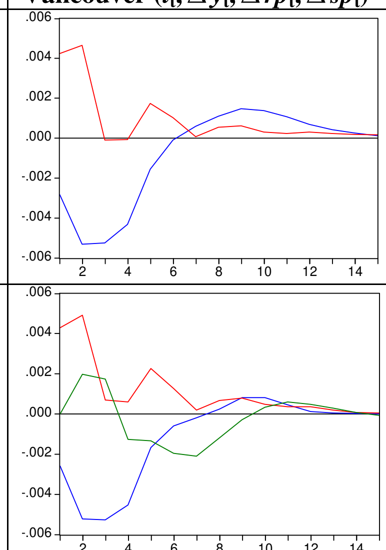
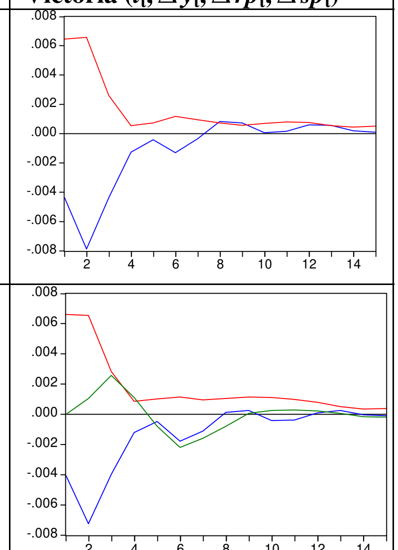




Montreal ($i_t, \Delta y_t, \Delta rp_t, \Delta sp_t$) | **Ottawa ($i_t, \Delta y_t, \Delta rp_t, \Delta sp_t$)** | **Regina ($i_t, \Delta y_t, \Delta rp_t, \Delta sp_t$)**

Toronto ($\Delta i_t, \Delta y_t, \Delta rp_t, \Delta sp_t$) | **Vancouver ($i_t, \Delta y_t, \Delta rp_t, \Delta sp_t$)** | **Victoria ($i_t, \Delta y_t, \Delta rp_t, \Delta sp_t$)**

Winnipeg ($i_t, \Delta y_t, \Delta rp_t, \Delta sp_t$) | **Average of Metro Responses**

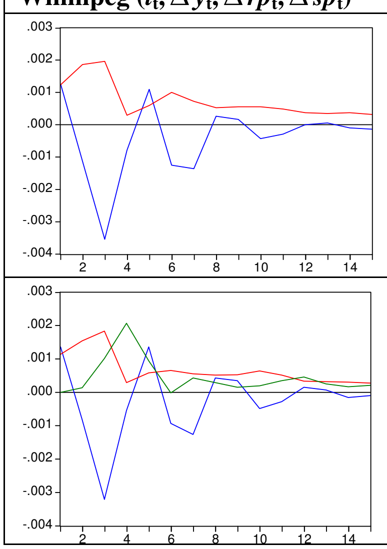
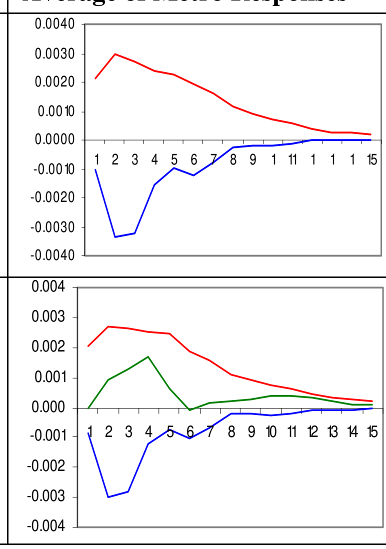
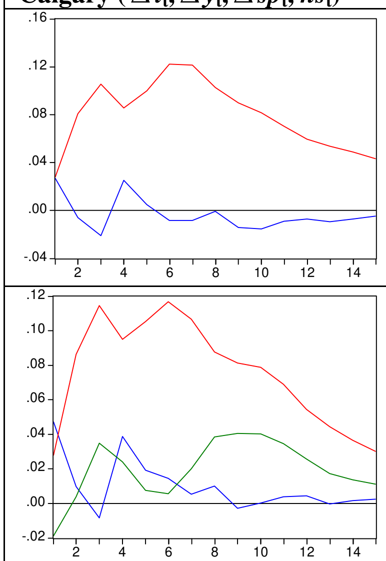



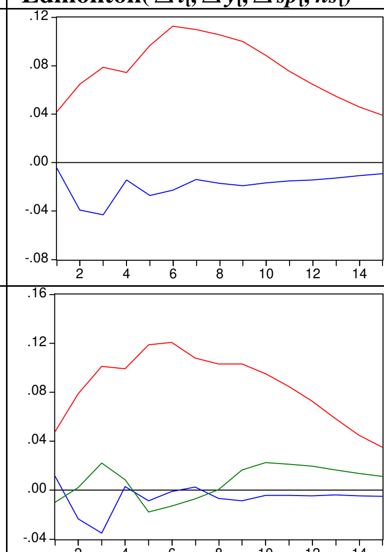
Figure 4: Response of Housing Starts to Structural One S.D. Mortgage Rate, Provincial Income, and Metro Income Innovations ± 2 Standard Errors.

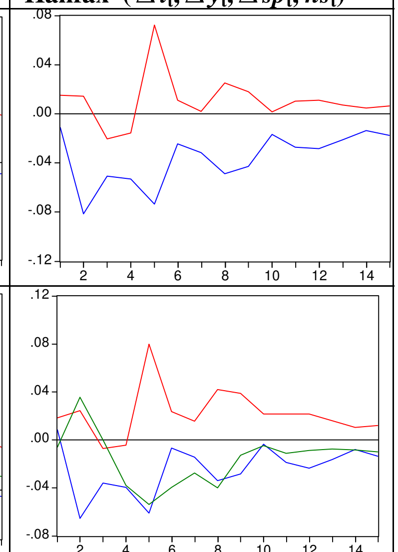
Mortgage Rate — Income — Stock Prices

Top graph without stock prices in VAR and bottom graph with stock prices in VAR

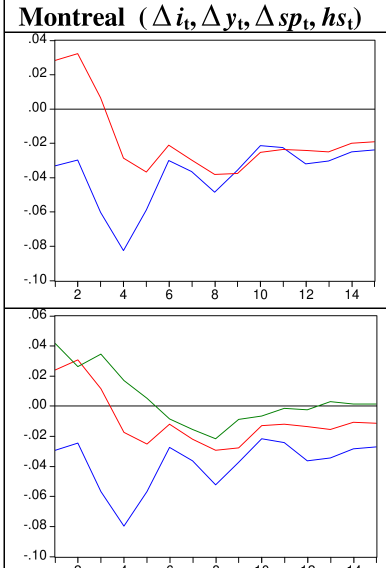
Calgary ($\Delta i_t, \Delta y_t, \Delta sp_t, hs_t$)	**Edmonton**($\Delta i_t, \Delta y_t, \Delta sp_t, hs_t$)	**Halifax** ($\Delta i_t, \Delta y_t, \Delta sp_t, hs_t$)

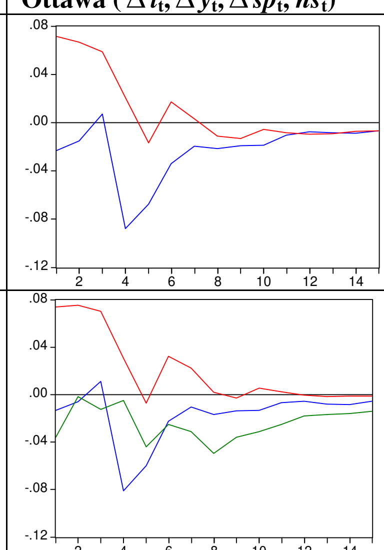


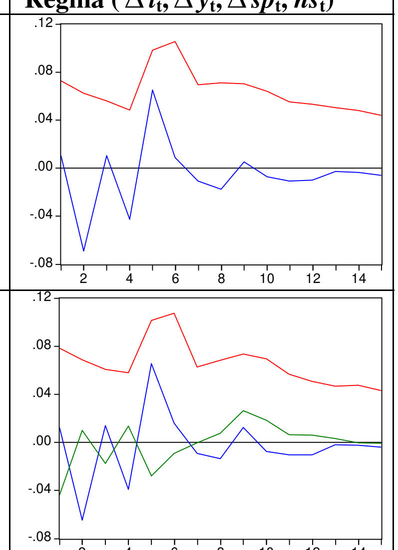




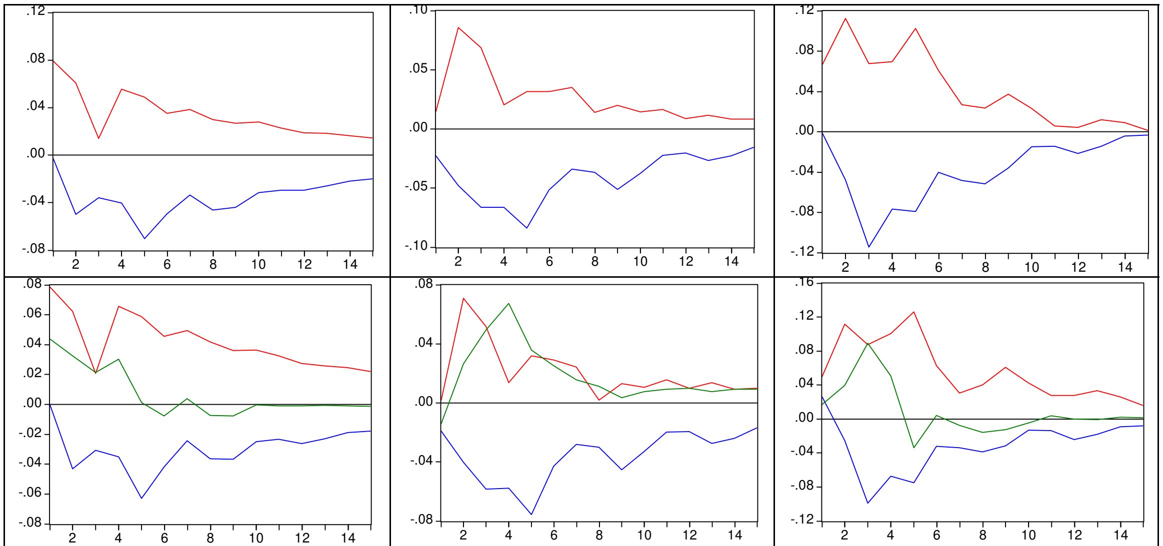
Montreal ($\Delta i_t, \Delta y_t, \Delta sp_t, hs_t$)	**Ottawa** ($\Delta i_t, \Delta y_t, \Delta sp_t, hs_t$)	**Regina** ($\Delta i_t, \Delta y_t, \Delta sp_t, hs_t$)







Toronto ($\Delta i_t, \Delta y_t, \Delta sp_t, hs_t$)	**Vancouver** ($\Delta i_t, \Delta y_t, \Delta sp_t, hs_t$)	**Victoria** ($\Delta i_t, \Delta y_t, \Delta sp_t, hs_t$)



Winnipeg ($\Delta i_t, \Delta y_t, \Delta sp_t, hs_t$)

Average of Metro Impulse Responses

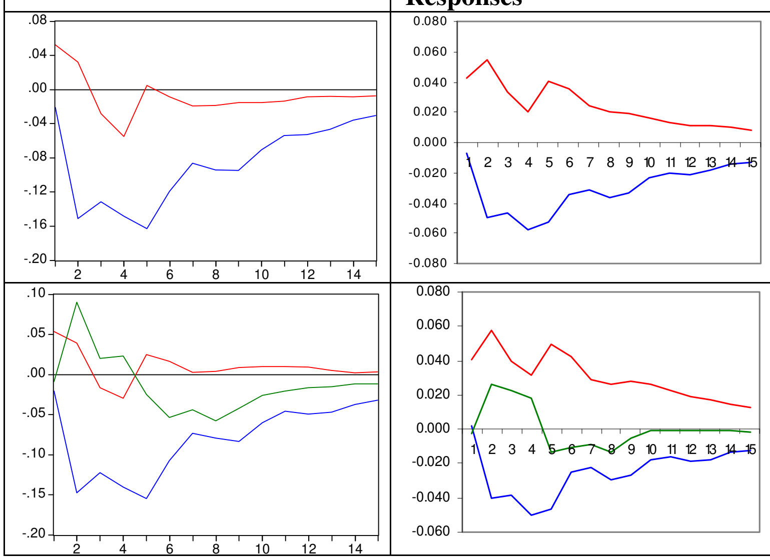
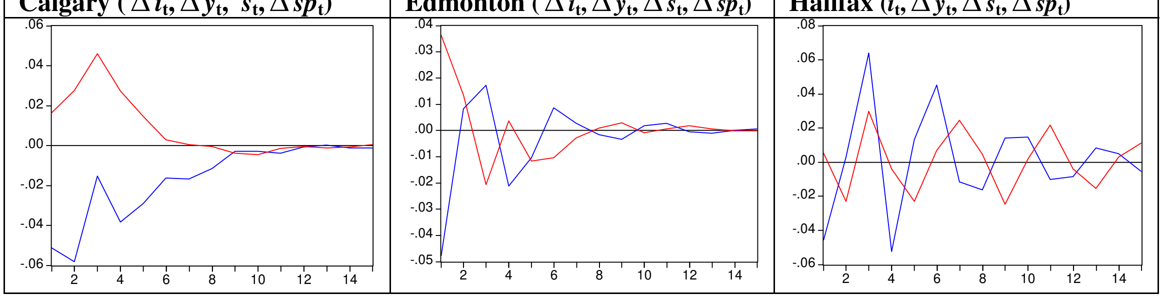


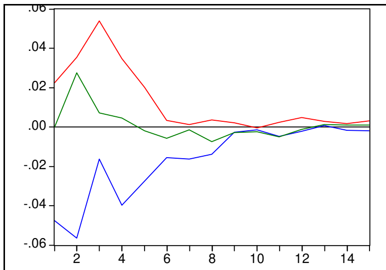
Figure 5: Response of Housing Starts to Structural One S.D. Mortgage Rate, Income, and Stock Price Innovations ± 2 Standard Errors

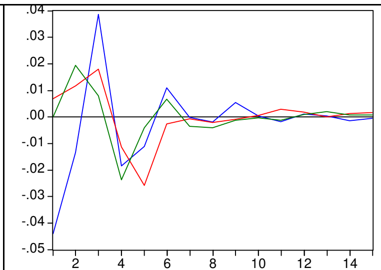
Mortgage Rate — Income — Stock Prices

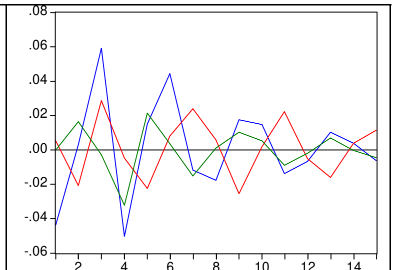
Top graph without provincial income in VAR and bottom graph with provincial income in VAR

Calgary ($\Delta i_t, \Delta y_t, s_t, \Delta sp_t$) **Edmonton ($\Delta i_t, \Delta y_t, \Delta s_t, \Delta sp_t$)** **Halifax ($i_t, \Delta y_t, \Delta s_t, \Delta sp_t$)**





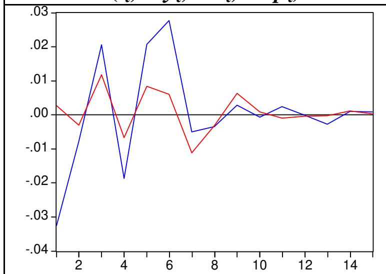


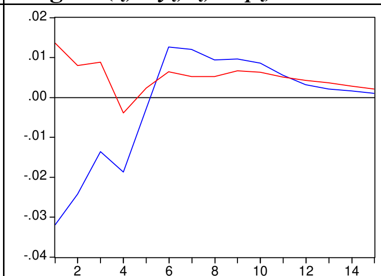


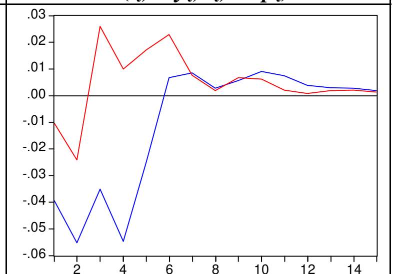
Ottawa (i_t, Δy_t, Δs_t, Δsp_t)

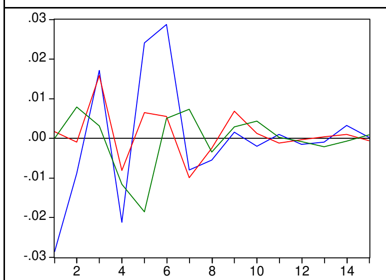
Regina (i_t, Δy_t, s_t, Δsp_t)

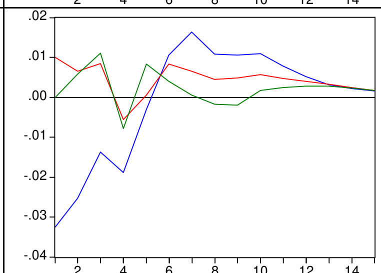
Toronto (i_t, Δy_t, s_t, Δsp_t)

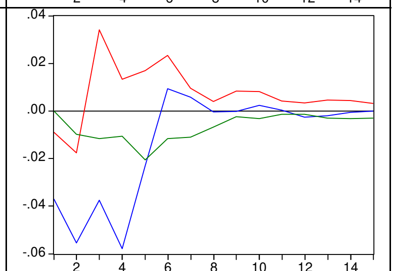








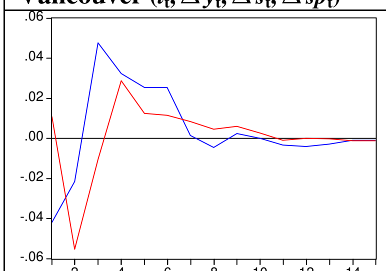


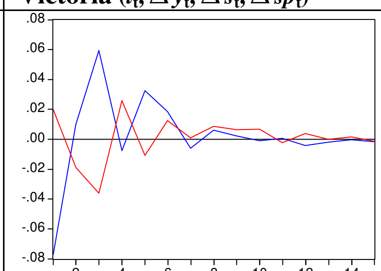


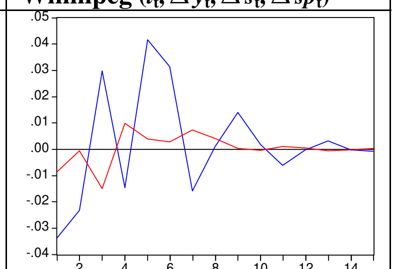
Vancouver (i_t, Δy_t, Δs_t, Δsp_t)

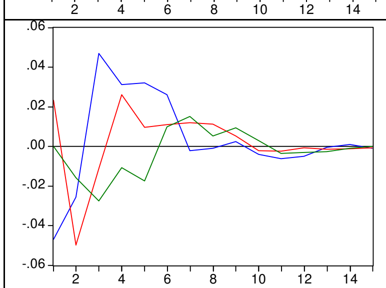
Victoria (i_t, Δy_t, Δs_t, Δsp_t)

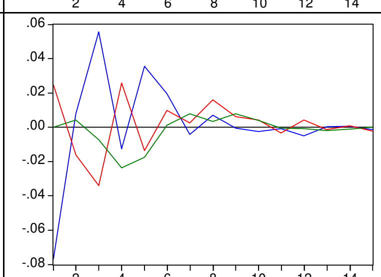
Winnipeg (i_t, Δy_t, Δs_t, Δsp_t)

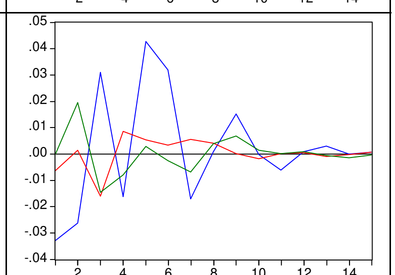




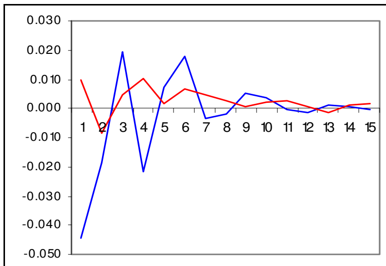








Average of Metro Impulse Responses



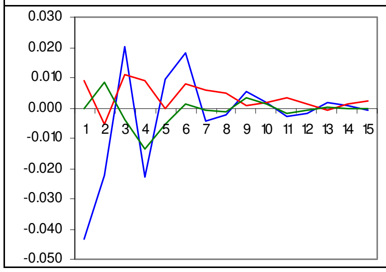


Table 8: Resale Housing Prices VAR Levels

	Without Stock Prices in VAR			With Stock Prices in VAR			
	Mortgage Shock	Supply Shock	Starts	Mortgage Shock	Supply Shock	Starts	Stock Prices
Calgary ($\Delta i_t, \Delta y_t, \Delta np_t, \Delta sp$)							
1	1.23	0.00	98.77	0.08	0.11	99.81	0.00
5	3.10	25.34	71.57	0.82	26.90	65.38	6.91
10	5.12	25.81	69.07	1.86	26.45	63.51	8.18
15	5.16	25.80	69.04	1.90	26.40	63.46	8.24
Edmonton ($\Delta i_t, \Delta y_t, \Delta np_t, \Delta sp$)							
1	2.68	0.43	96.89	2.08	0.34	97.58	0.00
5	10.11	8.44	81.44	8.18	9.18	80.75	1.89
10	10.35	11.13	78.53	8.27	11.02	78.63	2.08
15	10.35	11.17	78.47	8.27	11.05	78.55	2.13
Halifax ($i_t, \Delta y_t, \Delta rp_t, \Delta sp$)							
1	0.00	0.00	99.99	0.00	0.08	99.91	0.00
5	3.13	11.76	85.11	0.74	17.10	78.42	3.74
10	3.91	11.78	84.30	2.43	17.09	76.50	3.98
15	3.99	11.83	84.18	2.51	17.13	76.38	3.97
Montreal ($\Delta i_t, \Delta y_t, \Delta np_t, \Delta sp$)							
1	0.03	2.45	97.52	0.43	12.35	87.22	0.00
5	8.04	5.82	86.14	6.19	14.83	73.74	5.24
10	8.52	5.88	85.60	6.95	14.65	72.36	6.04
15	8.54	5.88	85.58	6.95	14.64	72.32	6.09
Ottawa ($\Delta i_t, \Delta y_t, \Delta np_t, \Delta sp$)							
1	0.13	3.47	96.40	0.85	2.81	96.34	0.00
5	2.05	6.94	91.01	2.50	6.18	79.92	11.40
10	2.46	10.05	87.49	2.80	8.87	76.67	11.67
15	2.54	10.96	86.51	2.88	9.65	75.84	11.63
Regina ($\Delta i_t, \Delta y_t, \Delta np_t, \Delta sp$)							

1	1.53	2.46	96.01	2.13	3.53	94.33	0.00
5	2.33	15.39	82.28	2.97	15.68	80.01	1.34
10	3.73	16.09	80.18	3.99	16.39	78.00	1.63
15	3.77	16.17	80.06	3.99	16.47	77.87	1.66
Toronto ($\Delta i_t, \Delta y_t, \Delta rp_t, \Delta sp$)							
1	8.48	11.97	79.55	7.52	12.13	80.35	0.00
5	12.49	15.07	72.44	10.80	14.97	71.45	2.79
10	14.00	14.82	71.18	11.80	14.62	69.84	3.74
15	14.01	14.82	71.16	11.80	14.62	69.81	3.77
Vancouver ($\Delta i_t, \Delta y_t, \Delta np_t, \Delta sp$)							
1	1.80	3.82	94.38	1.58	3.27	95.15	0.00
5	20.32	19.92	59.76	19.37	18.69	54.17	7.76
10	20.38	20.13	59.49	19.20	19.37	53.62	7.81
15	20.47	20.13	59.40	19.26	19.36	53.56	7.82
Victoria ($\Delta i_t, \Delta y_t, \Delta np_t, \Delta sp$)							
1	8.15	0.00	91.85	10.03	0.03	89.95	0.00
5	22.67	20.40	56.93	22.10	24.97	51.29	1.64
10	23.66	20.79	55.55	22.63	25.76	49.50	2.11
15	23.66	20.84	55.50	22.65	25.76	49.46	2.13
Winnipeg ($\Delta i_t, \Delta y_t, \Delta np_t, \Delta sp$)							
1	1.65	5.08	93.27	2.73	5.61	91.66	0.00
5	3.81	12.94	83.25	4.14	13.88	79.07	2.91
10	5.66	12.88	81.45	5.37	13.70	77.39	3.54
15	5.68	12.89	81.43	5.37	13.72	77.37	3.55
Average of Metropolitan Variance Decompositions							
1	2.57	2.97	94.46	2.74	4.03	93.23	0.00
5	8.81	14.20	76.99	7.78	16.24	71.42	4.56
10	9.78	14.94	75.28	8.53	16.79	69.60	5.08
15	9.82	15.05	75.13	8.56	16.88	69.46	5.10

Table 9: New Housing Price Index VAR Levels							
Without Stock Prices in VAR				**With Stock Prices in VAR**			
	Mortgage Shock	Supply Shock	Starts	Mortgage Shock	Supply Shock	Starts	Stock Prices
Calgary ($\Delta i_t, \Delta y_t, \Delta rp_t, \Delta sp$)							
1	0.16	7.10	92.73	0.05	5.77	94.17	0.00
5	2.14	26.80	71.06	1.16	20.43	71.41	7.00
10	1.98	31.82	66.20	1.33	24.85	65.62	8.20
15	1.99	31.82	66.20	1.38	24.80	65.61	8.21
Edmonton ($\Delta i_t, \Delta y_t, \Delta rp_t, \Delta sp$)							
1	0.14	0.19	99.67	0.01	0.07	99.92	0.00
5	6.28	17.52	76.20	3.08	17.61	76.05	3.26
10	6.50	26.07	67.43	2.83	24.46	68.65	4.06
15	6.43	27.42	66.15	2.77	25.64	67.16	4.42
Halifax ($i_t, \Delta y_t, \Delta rp_t, \Delta sp$)							

1	1.97	0.20	97.83	2.28	0.14	97.57	0.00
5	5.59	8.36	86.06	5.49	7.83	84.72	1.96
10	6.90	8.52	84.59	6.55	8.06	83.10	2.29
15	7.26	8.48	84.26	6.86	8.03	82.81	2.30
Montreal ($i_t, \Delta y_t, \Delta rp_t, \Delta sp$)							
1	2.21	3.22	94.56	1.58	4.11	94.30	0.00
5	16.77	10.58	72.65	12.14	8.36	74.78	4.72
10	20.08	9.66	70.27	15.50	7.81	72.22	4.47
15	20.06	9.67	70.26	15.52	7.77	72.23	4.49
Ottawa ($i_t, \Delta y_t, \Delta rp_t, \Delta sp$)							
1	5.43	2.26	92.30	6.03	0.25	93.73	0.00
5	18.00	8.42	73.59	15.95	6.21	58.31	19.53
10	18.84	9.49	71.67	16.24	6.85	57.48	19.44
30	19.10	9.67	71.24	16.31	7.22	56.61	19.86
Regina ($i_t, \Delta y_t, \Delta rp_t, \Delta sp$)							
1	0.49	0.84	98.67	0.27	1.13	98.61	0.00
5	7.36	2.77	89.87	5.00	2.55	88.78	3.67
10	7.06	3.76	89.18	5.72	2.60	88.04	3.65
15	7.08	3.88	89.04	6.28	2.53	87.57	3.62
Toronto ($\Delta i_t, \Delta y_t, \Delta rp_t, \Delta sp$)							
1	0.31	4.98	94.71	0.20	7.14	92.66	0.00
5	24.36	16.70	58.93	22.67	24.04	52.57	0.72
10	27.31	21.89	50.81	24.94	29.95	44.43	0.67
15	27.31	21.99	50.70	24.91	30.22	44.20	0.67
Vancouver ($i_t, \Delta y_t, \Delta rp_t, \Delta sp$)							
1	4.42	9.86	85.71	3.80	10.29	85.91	0.00
5	19.86	9.98	70.16	19.50	11.07	67.06	2.37
10	20.72	10.18	69.11	19.20	11.32	65.02	4.46
15	21.04	10.18	68.78	19.19	11.35	64.88	4.59
Victoria ($i_t, \Delta y_t, \Delta rp_t, \Delta sp$)							
1	7.80	17.02	75.18	6.61	17.49	75.90	0.00
5	22.98	20.82	56.20	19.33	21.63	56.87	2.16
10	22.78	20.83	56.39	18.97	21.36	55.99	3.69
15	22.71	21.06	56.23	18.84	21.59	55.89	3.69
Winnipeg ($i_t, \Delta y_t, \Delta rp_t, \Delta sp$)							
1	1.79	1.76	96.45	2.09	1.46	96.45	0.00
5	12.87	6.93	80.20	10.63	5.32	79.62	4.44
10	14.04	7.86	78.11	11.53	5.90	78.35	4.23
15	13.75	8.14	78.11	11.24	6.11	78.26	4.38
Average of Metropolitan Variance Decompositions							
1	2.47	4.75	92.78	2.29	4.79	92.92	0.00
5	13.62	12.89	73.49	11.49	12.50	71.02	4.98
10	14.62	15.01	70.38	12.28	14.31	67.89	5.52
15	14.67	15.23	70.10	12.33	14.53	67.52	5.62

Table 10: Variance Decomposition of Housing Starts							
Without Stock Prices in VAR				With Stock Prices in VAR			
	Mortgage Shock	Supply Shock	Starts	Mortgage Shock	Supply Shock	Starts	Stock Prices
Calgary ($\Delta i_t, \Delta y_t, \Delta sp_t, hs_t$)							
1	1.16	1.25	97.59	3.56	1.24	0.56	94.64
5	1.18	22.77	76.05	2.61	25.27	1.36	70.77
10	1.05	39.11	59.84	1.96	36.94	3.15	57.96
15	1.07	41.77	57.16	1.81	38.29	3.82	56.08
Edmonton ($\Delta i_t, \Delta y_t, \Delta sp_t, hs_t$)							
1	0.04	3.56	96.39	0.26	4.83	0.19	94.72
5	2.78	17.31	79.91	1.23	26.73	0.62	71.42
10	2.51	33.75	63.74	0.86	40.56	0.82	57.76
15	2.59	37.07	60.34	0.82	43.83	1.27	54.08
Halifax ($\Delta i_t, \Delta y_t, \Delta sp_t, hs_t$)							
1	0.15	0.26	99.59	0.08	0.41	0.04	99.47
5	13.87	4.97	81.16	8.80	5.95	4.51	80.75
10	16.45	5.14	78.42	9.01	8.16	6.65	76.18
15	17.49	5.18	77.33	9.57	8.78	6.66	75.00
Montreal ($\Delta i_t, \Delta y_t, \Delta sp_t, hs_t$)							
1	1.41	1.03	97.56	1.06	0.71	2.17	96.06
5	11.82	3.02	85.16	10.43	1.90	2.90	84.78
10	12.73	5.11	82.16	11.71	2.81	2.72	82.75
15	12.63	5.59	81.78	12.14	2.77	2.32	82.77
Ottawa ($\Delta i_t, \Delta y_t, \Delta sp_t, hs_t$)							
1	0.42	3.98	95.60	0.14	4.18	0.99	94.69
5	6.94	7.23	85.83	5.42	8.83	1.76	83.99
10	7.20	6.50	86.29	5.07	8.06	4.19	82.68
30	6.94	6.28	86.78	4.91	7.64	4.67	82.78
Regina ($\Delta i_t, \Delta y_t, \Delta sp_t, hs_t$)							
1	0.06	3.04	96.90	0.08	3.44	1.06	95.42
5	3.91	8.60	87.49	3.51	9.61	1.11	85.77
10	3.16	14.77	82.08	2.89	15.33	1.16	80.62
15	2.90	16.34	80.77	2.66	16.64	1.07	79.64
Toronto ($\Delta i_t, \Delta y_t, \Delta sp_t, hs_t$)							
1	0.02	12.23	87.75	0.00	11.78	3.65	84.57
5	10.27	15.47	74.25	7.88	17.99	4.28	69.85
10	14.66	15.99	69.35	10.45	20.79	3.47	65.29
15	15.93	16.05	68.02	11.27	21.55	3.18	64.00
Vancouver ($\Delta i_t, \Delta y_t, \Delta sp_t, hs_t$)							
1	1.34	0.56	98.10	0.97	0.01	0.51	98.51
5	20.06	14.76	65.18	15.84	9.79	10.05	64.32
10	24.02	14.43	61.54	18.39	9.29	8.92	63.40
15	24.80	14.23	60.97	19.00	9.20	8.61	63.19
Victoria ($\Delta i_t, \Delta y_t, \Delta sp_t, hs_t$)							

1	0.00	3.99	96.01	0.68	2.49	0.29	96.54
5	13.05	17.56	69.38	10.23	23.33	6.52	59.92
10	15.25	18.80	65.95	10.99	25.51	5.94	57.57
15	15.52	18.78	65.71	11.18	26.25	5.78	56.79
Winnipeg ($\Delta i_t, \Delta y_t, \Delta sp_t, hs_t$)							
1	0.38	2.34	97.28	0.38	2.60	0.06	96.96
5	32.38	2.77	64.85	30.00	2.31	3.63	64.06
10	38.69	2.57	58.73	32.42	1.89	5.77	59.92
15	39.89	2.59	57.52	33.03	1.84	5.76	59.37
Average of Metropolitan Variance Decompositions							
1	0.50	3.22	96.28	0.72	3.17	0.95	95.16
5	11.63	11.45	76.93	9.59	13.17	3.67	73.56
10	13.57	15.62	70.81	10.38	16.93	4.28	68.41
15	13.98	16.39	69.64	10.64	17.68	4.31	67.37

Table 11: Housing Sales VAR Levels

Without Stock Prices in VAR				With Stock Prices in VAR			
	Mortgage Shock	Supply Shock	Starts	Mortgage Shock	Supply Shock	Starts	Stock Prices
Calgary ($\Delta i_t, \Delta y_t, s_t, \Delta sp_t$)							
1	11.39	1.20	87.42	10.05	2.23	87.72	0.00
5	18.01	8.72	73.27	16.38	12.80	69.12	1.70
10	18.84	8.53	72.63	17.20	12.40	68.56	1.84
15	18.87	8.53	72.60	17.21	12.46	68.44	1.90
Edmonton ($\Delta i_t, \Delta y_t, \Delta s_t, \Delta sp_t$)							
1	14.96	0.27	84.77	12.51	0.31	87.18	0.00
5	22.58	3.98	73.44	18.22	5.81	71.41	4.56
10	22.47	4.03	73.50	18.51	5.75	70.94	4.79
15	22.45	4.14	73.41	18.51	5.81	70.86	4.82
Halifax ($i_t, \Delta y_t, \Delta s_t, \Delta sp_t$)							
1	5.86	0.08	94.06	5.23	0.07	94.70	0.00
5	11.64	2.55	85.81	10.10	2.22	85.48	2.19
10	12.75	3.50	83.75	11.42	3.20	83.16	2.21
15	12.44	4.21	83.35	11.26	3.95	82.53	2.25
Ottawa ($i_t, \Delta y_t, \Delta s_t, \Delta sp_t$)							
1	7.14	0.05	92.81	5.60	0.02	94.38	0.00
5	11.59	1.36	87.05	10.81	1.76	84.73	2.70
10	14.83	2.29	82.88	14.41	2.50	80.02	3.07
15	14.88	2.30	82.82	14.43	2.51	79.97	3.09
Regina ($i_t, \Delta y_t, s_t, \Delta sp_t$)							
1	6.27	1.14	92.59	6.47	0.61	92.92	0.00
5	9.76	1.57	88.67	9.92	1.07	87.74	1.27
10	11.86	2.30	85.84	12.59	1.82	84.26	1.33
15	12.00	2.59	85.41	12.91	2.05	83.60	1.44
Toronto ($i_t, \Delta y_t, s_t, \Delta sp_t$)							

1	7.18	0.50	92.32	6.36	0.38	93.26	0.00
5	24.04	4.49	71.46	24.08	4.97	69.05	1.89
10	22.21	5.58	72.21	21.95	6.21	69.42	2.42
15	21.94	5.50	72.56	21.47	6.24	69.87	2.43
Vancouver (i_t, Δy_t, Δs_t, Δsp_t)							
1	6.18	0.41	93.42	7.92	1.96	90.12	0.00
5	14.98	10.33	74.69	16.54	9.18	70.94	3.35
10	16.13	10.66	73.20	17.47	9.78	68.53	4.22
15	16.21	10.66	73.13	17.58	9.77	68.37	4.28
Victoria (i_t, Δy_t, Δs_t, Δsp_t)							
1	27.01	1.79	71.20	27.04	2.80	70.16	0.00
5	33.63	8.98	57.38	31.98	8.76	56.41	2.85
10	33.89	9.66	56.45	32.09	9.64	55.08	3.20
15	33.90	9.72	56.38	32.09	9.72	54.98	3.21
Winnipeg (i_t, Δy_t, Δs_t, Δsp_t)							
1	11.71	0.74	87.54	11.41	0.42	88.17	0.00
5	27.04	2.44	70.52	27.91	2.30	65.95	3.84
10	32.64	2.67	64.70	33.46	2.42	60.02	4.10
15	32.81	2.67	64.52	33.61	2.42	59.87	4.10
Metropolitan Average							
1	10.85	0.69	88.46	10.29	0.98	88.74	0.00
5	19.25	4.94	75.81	18.44	5.43	73.43	2.71
10	20.63	5.47	73.91	19.90	5.97	71.11	3.02
15	20.61	5.59	73.80	19.90	6.10	70.94	3.06

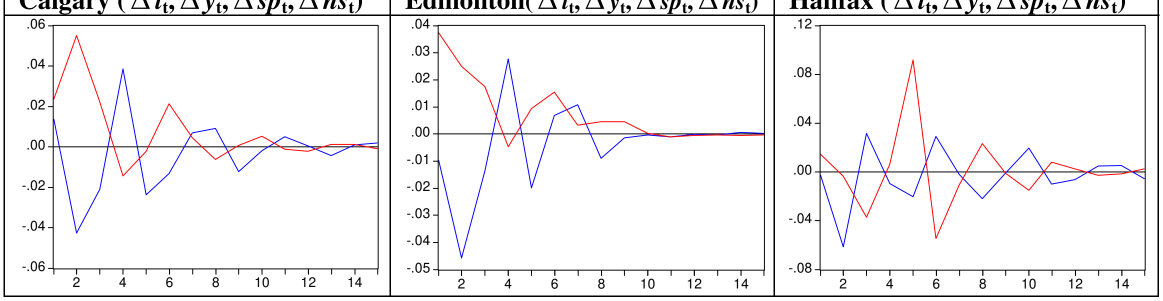
Appendix

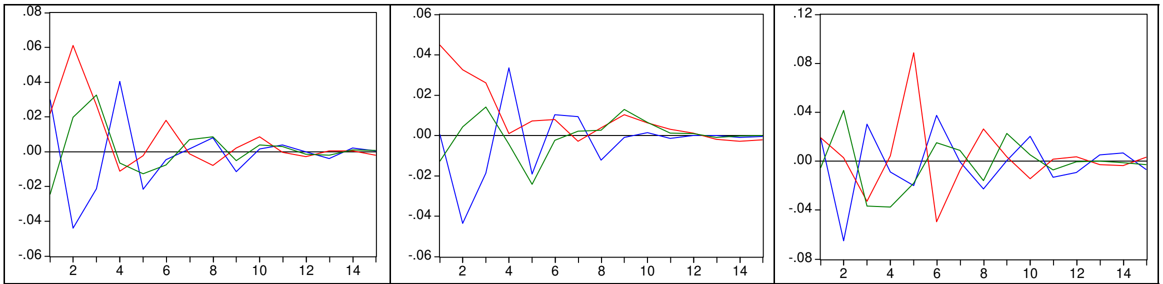
Response of First Differenced Housing Starts to Structural One S.D. Mortgage Rate, Income, and Stock Price Innovations ± 2 Standard Errors

Mortgage Rate — Income — Stock Prices

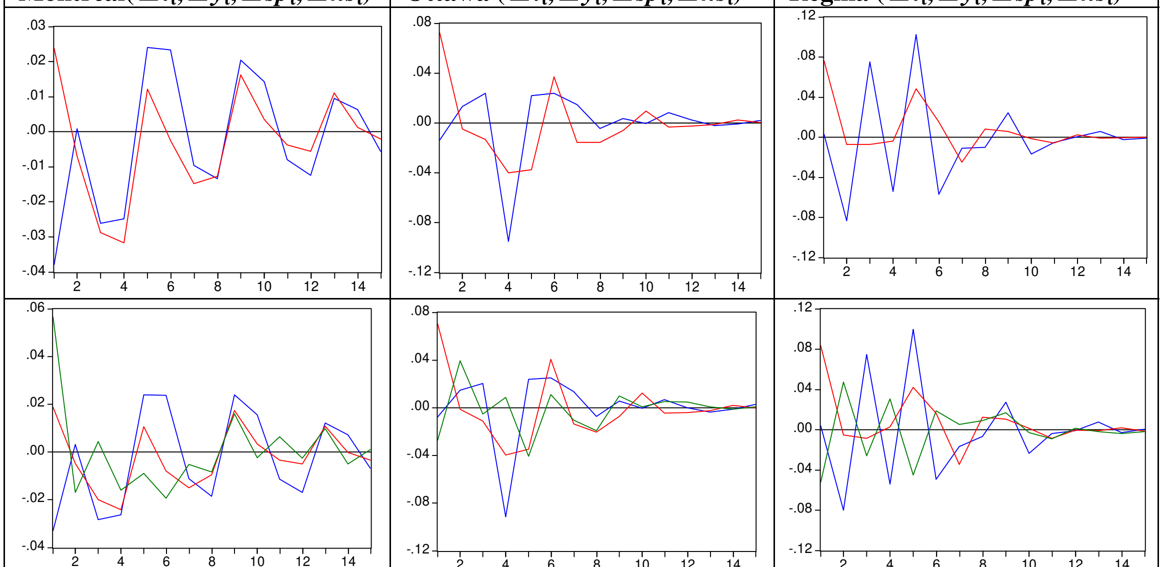
Top graph without provincial income in VAR and bottom graph with provincial income in VAR

Calgary (Δi_t, Δy_t, Δsp_t, Δhs_t) | **Edmonton(Δi_t, Δy_t, Δsp_t, Δhs_t)** | **Halifax (Δi_t, Δy_t, Δsp_t, Δhs_t)**

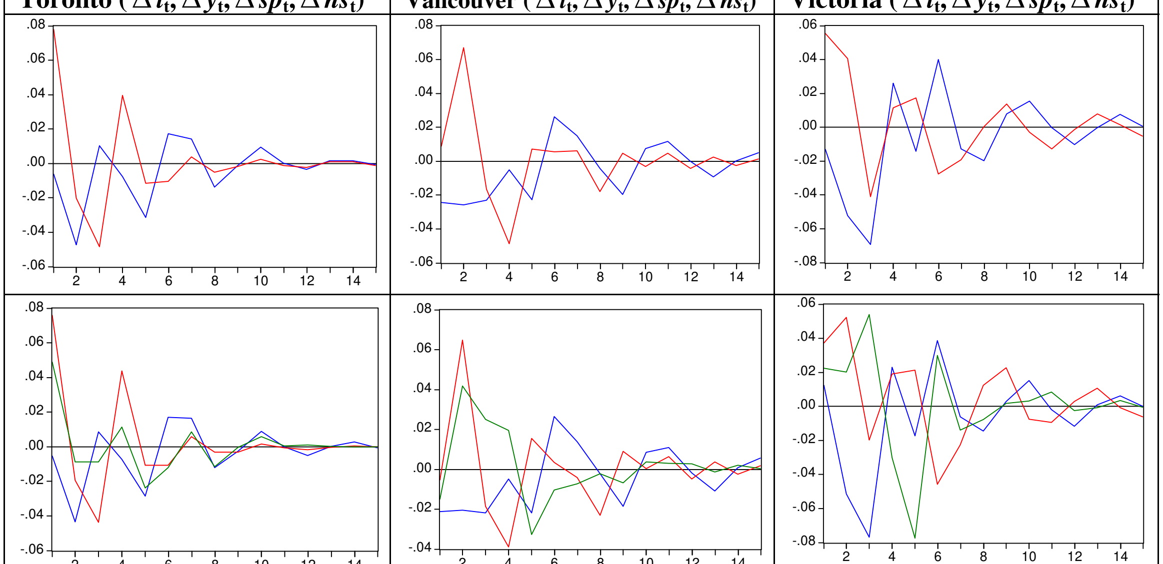




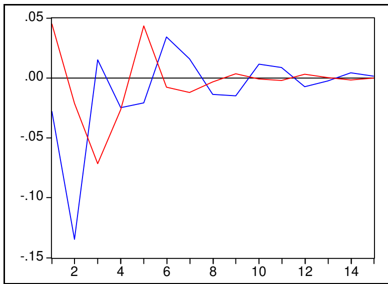
Montreal($\Delta i_t, \Delta y_t, \Delta sp_t, \Delta hs_t$) | **Ottawa** ($\Delta i_t, \Delta y_t, \Delta sp_t, \Delta hs_t$) | **Regina** ($\Delta i_t, \Delta y_t, \Delta sp_t, \Delta hs_t$)

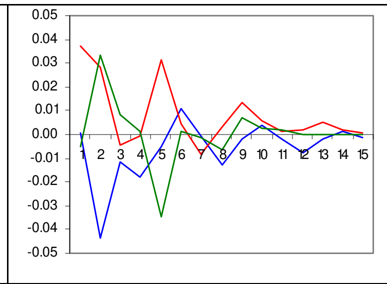


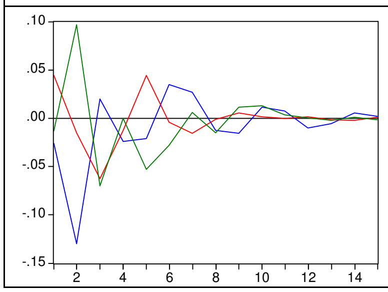
Toronto ($\Delta i_t, \Delta y_t, \Delta sp_t, \Delta hs_t$) | **Vancouver** ($\Delta i_t, \Delta y_t, \Delta sp_t, \Delta hs_t$) | **Victoria** ($\Delta i_t, \Delta y_t, \Delta sp_t, \Delta hs_t$)

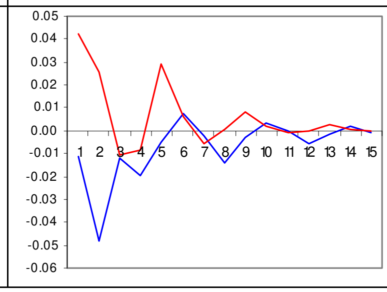


Winnipeg ($\Delta i_t, \Delta y_t, \Delta sp_t, \Delta hs_t$) | **Average of Metro Impulse Responses**









Housing Starts VARs – First Differences							
Without Stock Prices in VAR				With Stock Prices in VAR			
	Mortgage Shock	Supply Shock	Starts	Mortgage Shock	Supply Shock	Starts	Stock Prices
Calgary ($\Delta i_t, \Delta y_t, \Delta sp_t, \Delta hs_t$)							
1	0.27	0.81	98.92	1.27	0.68	0.84	97.21
5	5.34	5.12	89.54	6.14	5.79	2.57	85.49
10	5.80	5.67	88.53	6.30	6.24	2.78	84.68
15	5.85	5.68	88.47	6.34	6.25	2.80	84.62
Edmonton ($\Delta i_t, \Delta y_t, \Delta sp_t, \Delta hs_t$)							
1	0.19	2.72	97.10	0.00	3.90	0.31	95.78
5	5.85	4.04	90.11	6.02	6.09	1.58	86.31
10	6.20	4.48	89.32	6.46	6.35	1.91	85.27
15	6.20	4.48	89.32	6.46	6.39	1.92	85.23
Halifax ($\Delta i_t, \Delta y_t, \Delta sp_t, \Delta hs_t$)							
1	0.01	0.22	99.77	0.38	0.40	0.03	99.19
5	3.24	6.21	90.54	3.59	5.58	2.90	87.94
10	4.14	8.25	87.61	4.74	7.25	3.38	84.64
15	4.25	8.28	87.47	4.93	7.25	3.40	84.42
Montreal ($\Delta i_t, \Delta y_t, \Delta sp_t, \Delta hs_t$)							
1	2.00	0.79	97.21	1.49	0.49	4.38	93.64
5	2.82	2.21	94.97	2.63	1.22	3.19	92.96
10	3.28	2.25	94.47	3.36	1.45	3.07	92.11
15	3.32	2.23	94.45	3.56	1.46	2.97	92.00
Ottawa ($\Delta i_t, \Delta y_t, \Delta sp_t, \Delta hs_t$)							
1	0.14	3.95	95.91	0.04	3.62	0.55	95.79
5	5.39	4.33	90.27	4.78	3.87	2.03	89.32
10	5.67	5.23	89.10	5.07	4.93	2.30	87.69
30	5.71	5.23	89.05	5.10	4.95	2.33	87.62

Regina ($\Delta i_t, \Delta y_t, \Delta sp_t, \Delta hs_t$)							
1	0.00	3.20	96.80	0.01	3.70	1.47	94.83
5	9.90	3.15	86.96	9.11	3.24	3.16	84.49
10	11.22	3.41	85.37	10.27	3.74	3.33	82.66
15	11.24	3.43	85.33	10.29	3.76	3.36	82.58
Toronto ($\Delta i_t, \Delta y_t, \Delta sp_t, \Delta hs_t$)							
1	0.08	11.54	88.38	0.05	10.71	4.41	84.83
5	4.84	14.85	80.31	3.89	13.78	4.42	77.91
10	5.84	14.81	79.35	4.84	13.65	4.83	76.68
15	5.86	14.81	79.33	4.88	13.64	4.82	76.66
Vancouver ($\Delta i_t, \Delta y_t, \Delta sp_t, \Delta hs_t$)							
1	1.47	0.19	98.34	1.13	0.07	0.55	98.24
5	4.02	12.51	83.47	3.10	10.48	6.71	79.71
10	6.15	12.75	81.10	5.06	11.06	6.80	77.08
15	6.51	12.75	80.73	5.44	11.11	6.77	76.67
Victoria ($\Delta i_t, \Delta y_t, \Delta sp_t, \Delta hs_t$)							
1	0.15	2.63	97.22	0.14	1.27	0.46	98.13
5	5.21	4.14	90.65	5.61	3.13	6.31	84.94
10	6.48	4.80	88.72	6.50	4.88	6.71	81.92
15	6.56	4.94	88.50	6.58	5.00	6.74	81.68
Winnipeg ($\Delta i_t, \Delta y_t, \Delta sp_t, \Delta hs_t$)							
1	0.66	1.71	97.63	0.60	1.71	0.15	97.55
5	10.52	5.30	84.18	9.57	4.14	8.67	77.63
10	11.35	5.33	83.32	10.56	4.18	9.14	76.12
15	11.42	5.33	83.25	10.65	4.18	9.14	76.03
Metropolitan Average							
1	0.50	2.78	96.73	0.51	2.65	1.32	95.52
5	5.71	6.19	88.10	5.44	5.73	4.15	84.67
10	6.61	6.70	86.69	6.32	6.37	4.42	82.88
15	6.69	6.72	86.59	6.42	6.40	4.42	82.75