GREDI
Groupe de Recherche en Économie
et Développement International

Cahier de Recherche / Working Paper
15-03

Why has the mortgage debt increased by so much in Canada?

Mario Fortin

UNIVERSITÉ DE
SHERBROOKE

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Mario Fortin*
Université de Sherbrooke

February 2014

Abstract

This paper estimates a reduced form model of the Canadian mortgage demand from 1971 to 2010. Three equations are estimated, one for the average real value of new mortgage loans originated, another one for the number of new loans and a third for the flow of real repayment of existing loans. The results show that the nominal interest rate is the main source of change in the number of new loans while real housing price is the main determinant of the value of new loans. Two other variables, the real per-capita disposable income and the inflation rate, are also significant in changing the flow of new loans originated. A fall in the inflation rate accompanied by a concomitant reduction in the interest rate is in average the main source of increase in households' mortgage debt, because it increase the flow of new loans and at the same time reduces the rate of repayment of existing loans. Between 2000 and 2007, the unprecedented increase in real housing price while inflation was stable became the main factor behind the rise in mortgage debt, mostly because the average mortgage debt increased significantly. After that, the reduction in the interest rate sustained an increase in the number of new loans. The model does not find indications that a change in the supply side of the mortgage market played a significant role in the increased level of mortgage debt.

KEYWORDS : Mortgage market, household debt, Canada

JEL classification : D14, D91, E44

* Département d'économique and GREDI, Faculté d'administration, Université de Sherbrooke, Sherbrooke (QC), CANADA, J1K 2R1, mario.fortin@usherbrooke.ca. I wish to express my sincere thanks to Frank E. Nothaft for his helpful comments and suggestions on a previous version of this paper. I extend my thanks to the participants in the AREUEA 2014 International meeting and to those attending the 20014 Annaul Meeting of the Société canadienne de science économique for their remarks.

INTRODUCTION

The Canadian economy has weathered the great recession of 2008-2009 better than most OECD countries. This is partly explained by the strong level of commodity prices before the recession and its rapid comeback after the trough of 2008. But the main reason lies in the fact that there was no credit crunch during the recession. Indeed, losses on mortgage loans remained sufficiently low that Canadian banks did not need to be recapitalized through a government rescue plan. The main support given to banks during the crisis was directed toward providing them more liquidity with the implementation in 2008 of the Insured Mortgage Purchase Program (IMPP). This program authorized the Canada Mortgage and Housing Corporation (CMHC), a crown corporation, to purchase up to 125 $ billions[1] of mortgage-backed securities from Canadian financial intermediaries (Erman and Perkins, 2009). Most of the increased securitization was made following the implementation in 2001 of the Canadian Mortgage Bond (CMB) program. These bonds are fully guaranteed by the CMHC and, ultimately, by the Canadian taxpayers. This was sufficient to maintain the availability of banking credit throughout the crisis, a key ingredient to prevent a deeper recession. This worked so well that because of the resilience of its banks and its mortgage market, Canada started to be perceived internationally as a model of effective financial and mortgage regulations (Kiff, 2009).

There is a down side however. While the great recession broke the momentum of indebtedness in most other countries, Canadian households continued to borrow cheerfully during and after the crisis. Although all forms of household credit increased, it is mostly the residential mortgage debt, representing 70% of household debt that increased the most in recent years, from $ 813 billion to $ 1,220 billion between 2007 and 2013. As a proportion of disposable income, Canadian household debt now stands around 160 %, a ratio similar or even higher than it was in the US or the UK at the eve of the subprime crisis. In parallel, after a short break in 2009, housing prices started rising again in Canada, continuing a momentum initiated in 2001 to the point that the Canadian housing market is now perceived internationally as one of the most overvalued in the

[1] Data are in Canadian dollars.

world.[2] As a consequence the Bank of Canada wrote in 2013 that the high levels of household indebtedness and housing price constitute the main domestic sources of risk to the financial stability of Canada."[3] It is then legitimate to wonder that if Canada was able to navigate through the recession relatively unscathed, it is perhaps not because of its effective mortgage regulation but simply because it was a late comer to a short-term prosperity sustained by growing household indebtedness.

The Canadian mortgage market was changing before the crisis to allow easier access to mortgage financing in ways similar to those pointed out as culprits of the US subprime crisis such as reduced down payment requirements, longer amortization periods, increased securitization of mortgages and a growing share of government-backed mortgages. According to Crawford, Meh and Zhou (2013) the supervisory framework was sufficient to prevent the underwriting standards to deteriorate as much as in the US in the 2000s. Walks (2014) points out however that with these changes, Canadian banks lack the incentives needed to seriously scrutinize new mortgage borrowers. That would be the major source behind the housing and mortgage boom of the years 2000.

This amount to asking whether the increase in debt is related to the demand for mortgage loans, the so-called market fundamentals, or rather the result of mortgage supply shocks that made loans more accessible. In order to shed some lights to this question, this paper estimates a model of the demand for mortgage debt in Canada between 1970 and 2010. Mortgage demand is theoretically influenced by mortgage interest rates, inflation rate, disposable income, housing price, households' wealth and demography. If supply shocks have played a significant role, they should manifest by unusually large residuals on mortgage debt, or by an unstable relationship between the determinants of demand and mortgage debt.

The main originality of the approach taken in this paper resides in the choice of not studying the amount of debt outstanding directly. Rather the model analyzes the inflow of

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[2] See for example *The Economist's* home price indicators available at http://www.economist.com/news/finance-and-economics/21592646-monetary-policy-may-call-end-house-price-party-castles-made-sand or the OECD's focus on housing price available at http://www.oecd.org/eco/outlook/focusonhouseprices.htm

[3] Bank of Canada, *Financial System Review* , June 2013.

mortgage originations and the outflow of mortgage repayments and calculates the change in mortgage debt outstanding as the net difference. Distinguishing inflows and outflows is important because while the demand for mortgage origination is linked mostly to housing consumption by owner-occupants, portfolio decisions and non-housing consumption are important explanatory factors in the decision to repay the debt. Mortgage originations are further decomposed into the number of new mortgage loans and their average value, two variables reacting to different explanatory variables. The model will then be used to identify possible irregularities that could be related with the changes made to the mortgage supply. Once the flows are explained their consequences for the amount of debt outstanding can be reconstructed.

Many papers have recently studied the determinants of Canadian households' debt, but none approached this question with aggregate time series covering such a long period. Chawla and Uppal (2012) and Hurst (2011) use the 2009 Canadian Financial Capability Survey to study the determinants of Canadian households' debt. Crawford and Faruqui (2012) use the Canadian Financial Monitor, a survey conducted annually since 1999, to conclude that the increased indebtedness of Canadian households was pulled up by an increase in home-ownership rate encouraged by a strong growth of real income and low interest rates which made home-ownership more affordable. In the US, Turinetti and Zhuang (2011) explore the determinants of the debt-service-ratio (DSR). With a panel of US homeowners from 1997 to 2008, Mian and Sufi (2011) study how household indebtedness responds to house price shocks. In the UK, Disney, Bridges and Gathergood (2008) study how price shocks affect households' secured and unsecured debt when a collateral constraint is present. The most similar study to the one conducted here is that of Meng, Hoang and Siriwardana (2013) who explore the determinants of Australian households' debt at the macro level. They find that housing price, population and GDP have a positive impact while interest rate, inflation and unemployment have a negative effect.

The paper is organized as follow. The next section briefly describes the main features of the Canadian mortgage market. The third section presents some elements of the theory of mortgage demand to identify the role played by housing price, inflation, nominal and real

interest rate, household income and wealth. Given the long time period covered by the model, the review will look back to the conditions prevailing in the 70s and the 80s, with the focus put on the changing impact of two borrowing constraints, the loan-to-value ratio (LTV) and the debt-service-ratio (DSR) on the demand for mortgage loans. The fourth section presents the data and the econometric model. The fifth section presents the empirical results and some simulations of counter factual experiences. Discussion will follow before concluding with the main results of the paper.

THE CANADIAN MORTGAGE MARKET

The vast majority of mortgage loans are originated in Canada by chartered banks (75%) and financial cooperative and credit unions (12%), the rest being originated by Trust and mortgage and loans companies, life insurance companies and pension funds (Crawford, Meh and Zhou, 2013). The whole financial sector is dominated by six large chartered banks with nationwide branches, the five largest occupying a leading position since the 19th century.[4] In recent years, these banks have earned the reputation of being among the safest in the world, thanks to the stability displayed during the GFC. As Bordo, Redish and Rockoff (2011) point out however, the factors that protected Canadian banks during the recent crisis have long historical roots and were already playing in similar ways during previous financial crisis, such as the panic of 1907 and the great depression of the 30s. Calomiris and Haber (2013) advance the thesis that the effective regulation of the Canadian banking system is a symptom of deeper political forces. Given that the Bank Act, the law governing chartered banks, is revised every ten years and that the distribution of political power in Canada reduces the risk of its banking policy being captured by special interest groups to develop populist lending practices, the long-term interest of Canadian banks would be better served by adopting a more prudent behavior.[5]

[4] A more complete presentation of the Canadian mortgage market can be found in Crawford, Meh and Zhou (2013). The historical reasons explaining the main differences between the US and Canadian mortgage markets are presented in Redish (2012).

[5] "Mindful of parliament's power, Canadian bankers follow the dictum "Pigs get fat, hogs get slaughtered." The stability of Canada's banking system, therefore, is not the mechanical result of its branching structure; after all, if branching alone guaranteed stability, U.S. banks would have avoided falling prey to the subprime crisis. The true source of Canadian banks' stability has been Canada's political institutions." Calomiris and Haber (2013), "Why Banking Systems Succeed -- And Fail: The Politics Behind Financial Institutions", Foreign Affairs, November-December 2013, online,

When compared to their long-established dominance in the market for commercial loans and deposits, the leading position of banks in the mortgage market is relatively recent. Chartered banks started to make mortgage loans when they were authorized to do so in 1954, but their presence really took off only after the relaxation of the ceiling on interest rates on mortgage loans in the 1967 amendments to the Bank act. Around 85% of mortgage loans have a term of between 2 to 5 years, but the 5-year term is by far the most popular, being chosen by two-thirds of borrowers. The typical mortgage is a 5-year fixed-term loan with limited prepayment options and an amortization period of 25 years. After 5 years, a mortgage has to be rolled over with the interest rate adjusted to the new market condition. The 5-year fixed-rate is also important for shorter term loans because mortgage regulation imposes that borrowers must satisfy the DSR criteria using the higher of the contract rate on their mortgage or the posted rate for a 5-year fixed-rate mortgage.[6]

Less than 10% of borrowers, and only 3% of young borrowers, choose a term longer than five years. The unpopularity of long term mortgages is due to a combination of two reasons. The most important lies is section 10 of the Interest act, a provision which dates back to 1880 and still in force today, that gives a borrower the right to fully repay a loan after 5 years with a maximum penalty of 3 months interest payments (Redish, 2012). Given this legal constraint, longer loans are for practical purposes open loans and the interest premium for this prepayment option makes them unattractive for most Canadians. The second reason, less important, is that the Canadian Insurance Deposit Corporation offers a guarantee only for deposits with a term of 5 years of less. The cost of funding longer term loans is then higher since they create a duration mismatch between assets and liabilities.

Contrarily to the US, interests paid on a mortgage loan are not usually deductible from taxable income, the deduction being allowed only if a loan has been made for a taxable

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http://www.foreignaffairs.com/articles/140162/charles-w-calomiris-and-stephen-h-haber/why-banking-systems-succeed-and-fail

[6] For example if the 5-year interest rate is 5%, a household choosing a term of 3 year with an interest rate of 4% will have the DSR criteria calculated as if he were paying 5% on the loan. The popularity of the 5-year term has changed over time. In the 80s, inflation expectations were so uncertain that the terms of the loans were significantly shortened.

investment purpose. All mortgages in Canada are full-recourse loans, which imply that a homeowner cannot simply walk away when his home is worth less than the mortgage debt. Since strategic default is a costly option the moral hazard and selection effects on borrowers are less present on loans with low or no down-payments. In Canada it is mandatory to insure a high LTV mortgage loan, an insurance that is not required on conventional (low LTV) loans. The main insurer is the CMHC which, because of his statute as a crown corporation, benefits from the explicit guarantee of the federal government and, consequently, has a competitive advantage over private insurers.

Although the underwriting standards might have prevented the development of an important subprime market, the conditions for insuring loans with the CMHC have been nevertheless steadily made easier over time. In 1992, the down-payment requirement to insure loans was lowered from 10% to 5%. In 2003, the maximum insured mortgage limit of $250 000 was removed. To encourage the entry of U.S. private insurer on the Canadian market, and also to make mortgages more affordable, the federal budget of 2006 announced some changes to the regulation of insured loans. The limit between a conventional and a high LTV loan was raised from 75% to 80%. At the same time, the down payment requirement for insurable loans was eliminated for good quality borrowers. Finally, the maximum amortization period was lengthened from 25 to 40 years. With the prevailing interest rates, this last change meant that a household could borrow up to 12% more at a given DSR. The immediate popularity of this extension of the amortization period raised concerns that the relaxation of this institutional constraint could encourage households to borrow irresponsibly.[7]

[7] David Dodge, then Bank of Canada's governor, voiced his concern to the CMHC that these were "…irresponsible moves that would encourage some people to borrow too much or jump into the market before they were ready, creating new risks for the economy." The CMHC's president defended these changes. She insisted that the CMHC was not getting lax but would scrutinize borrowers as ever, but had to move because it was losing market shares to private insurers. (*Ottawa's $800-billion housing problem*, The Globe and Mail, Dec. 26 2012, on-line, http://www.theglobeandmail.com/report-on-business/economy/housing/ottawas-800-billion-housing-problem/article6732755/?page=all. This argument is eerily close to those made by Fannie Mae's ex-Chairman Daniel H. Mudd when asked by a reporter why such an important share of Fannie Mae's business was into high-risk loans. "…the market (…) was moving rapidly away from us. Our market share had been halved as lenders concentrated on adjustable-rate mortgages and Alt-A and sold those loans through securities created by Wall Street firms." Bhushan, Amarendra, 2008, « *What Are Ex-Fannie Mae Chief Daniel H. Mudd Regrets* ? », CEOWORLD Magazine,

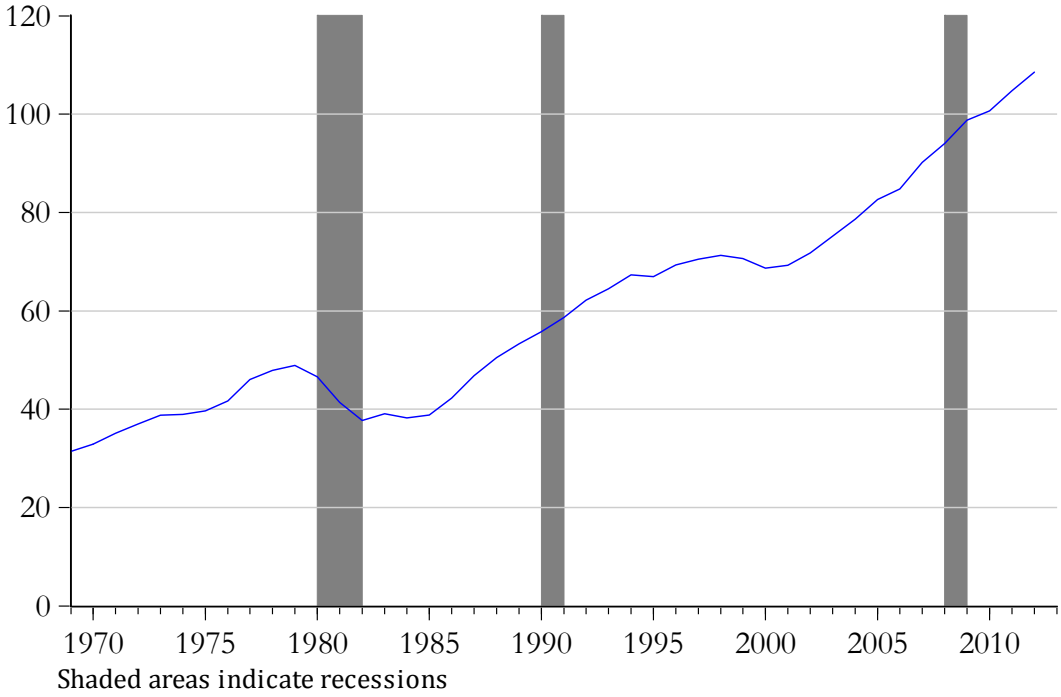
With the unfolding of the great recession, Canadian authorities developed a more acute sense of the dangers associated with households' over-indebtedness and took steps directed toward cooling the housing market. In 2008, the federal government reintroduced the 95% LTV limit to insurable loans and shortened the maximum amortization period to 35 years. In 2010 the amortization was further reduced to 30 years, then to 25 years in 2012, achieving an almost complete return to the conditions that were in place for insurable loans between 1992 and 2006. These moves had also the goal of counterbalancing the risk that the declining interest rates the Bank of Canada had to implement given the falling aggregate demand would provide too much a momentum to households' borrowing. Yet, given the increased easiness of getting a loan insured, it is not surprising that the share of total mortgage debt fully guaranteed by Canadian taxpayers increased from less than 30% in 1992 to over 60% in 2007, and jumped to over 70% in 2009, this 10 percentage point leap in 2 years a direct consequence of the IMPP. With such a large share of mortgages fully guaranteed by the government, taxpayers are significantly put at risk while banks, whose role is to evaluate and these risks, do not bear significant losses in the advent of major defaults on mortgage loans.[8]

As Figure 1 shows, between 1969 and 2012, residential mortgage debt rose from 31% to 108% of disposable income, with much of the increased taking place since 1985. Having in mind key macroeconomic facts of this period helps putting this indebtedness into perspective.

October 30, 2008. On-line http://ceoworld.biz/ceo/2008/10/30/what-are-ex-fannie-mae-chief-daniel-h-mudd-regrets.

[8] In its Economic Surveys of CANADA published in June 2014, the OECD recognizes the moral hazard risk of this situation and recommends tightening mortgage insurance so that only part of lenders' losses would be insured. It also recommends reducing the presence of the CMHC in the mortgage insurance market.

Figure 1: Residential mortgage debt (% of personal disposable income)



Three major recessions have hit the Canadian economy since 1972. The most brutal was in 1981-82 when the real GDP fell by more than 4%, a result of the record hike of the nominal interest rates set in 1980-81 to fight inflation. This succeeded to lower inflation from the yearly average of 10% observed between 1973 and 1982 to around 4% between 1983 and 1989. The recession of 1990-91 was less severe but the subsequent recovery was so weak that the employment rate continued to fall until 1993, making the 1990-93 period most damageable to employment and income than the 1981-82 recession. The battle to eliminate the federal budget deficit and reduce the public debt that was conducted between 1993 and 1998 had a major impact on the domestic demand to the point that the real per-capita disposable income was lower in 1997 than it was in 1989. In this bleak context, households cut durable goods expenditures and the Canadian housing market came from being buoyant in 1989 to a mostly depressed state during most of the 90s. Indeed, given the difficult labor market, household formation rate remained very low during this period. It is only after 1998, when the level of public debt went under control and commodity prices started to recover that a steady economic growth resumed, paving the way to a revival of the housing market after 2000. As to the recession of 2008-09,

despite its worldwide impact, it was less severe in Canada than the two previous recessions.

Figure 2 shows the real value of new loan originations and loan repayments as a proportion of the outstanding mortgage debts, and the net difference between these two flows. The reaction to the 1981-82 events clearly stand out with the sudden and market decline in loan originations as well as the almost doubling in the rate of loan repayment. Since real repayment felt together with the decline in the inflation rate, it implies that households repaid more in nominal terms after 1982 than they did before, a likely response to the rise in the real interest rate on their loans. In more normal time, we can easily observe that loan origination and debt repayment are positively correlated in a year-to-year basis.

Figure 2: Real value of loan originations and repayments in proportion to outstanding mortgage debt

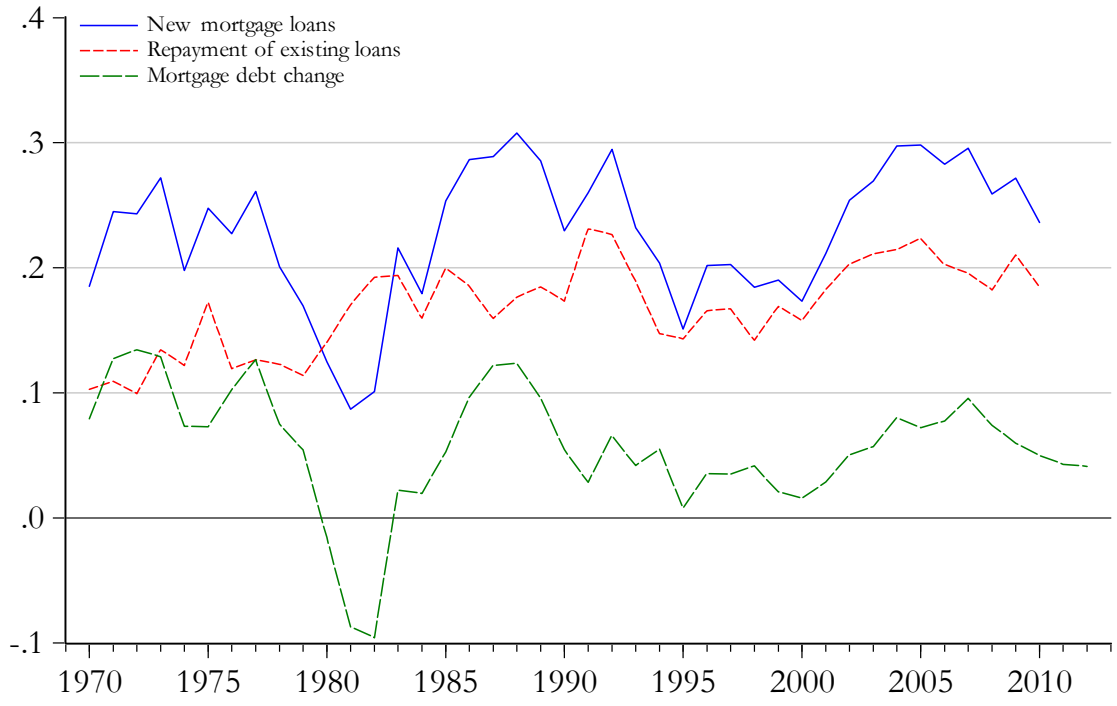


Figure 3 decomposes the changes in loan originations in two components, the annual rate of change in the average real value of each loan and the number of mortgage loans originated. With a standard deviation of 0.06, the average real value of loans is more than three times less variable than the number of loans (standard deviation of 0.20). A bit surprisingly, the correlation between both series is slightly negative (-0.15) and not significant, indicating that the number of loans is not affected by the same factors as those explaining their average value. It is easy to show that the movements in the interest rate explain those in the number of loan origination while changes in housing prices affect the average loan value. Figure 4 shows the normalized values of the rate of change in the number of new loans and, on inverted scale, the change in percentage point of the 5 year mortgage rate. These variables are highly correlated, with a coefficient of correlation of -0.811. As to Figure 5, it displays the rate of change in the average real value of new loans and real housing transaction price.[9] Once again the simple correlation between these series is very high (0.809). As a consequence, the average LTV ratio was contained, with few exceptions, between 50% and 60% during the whole period. This shows that the average value of new mortgage loans and housing price not only share common short term movements but also a common trend. It is now time to look how these broad facts can be related to the theory of mortgage demand.

[9] Real values are in constant 2002 dollars.

Figure 3: Changes in percentage in the real average value and number of loans originated.

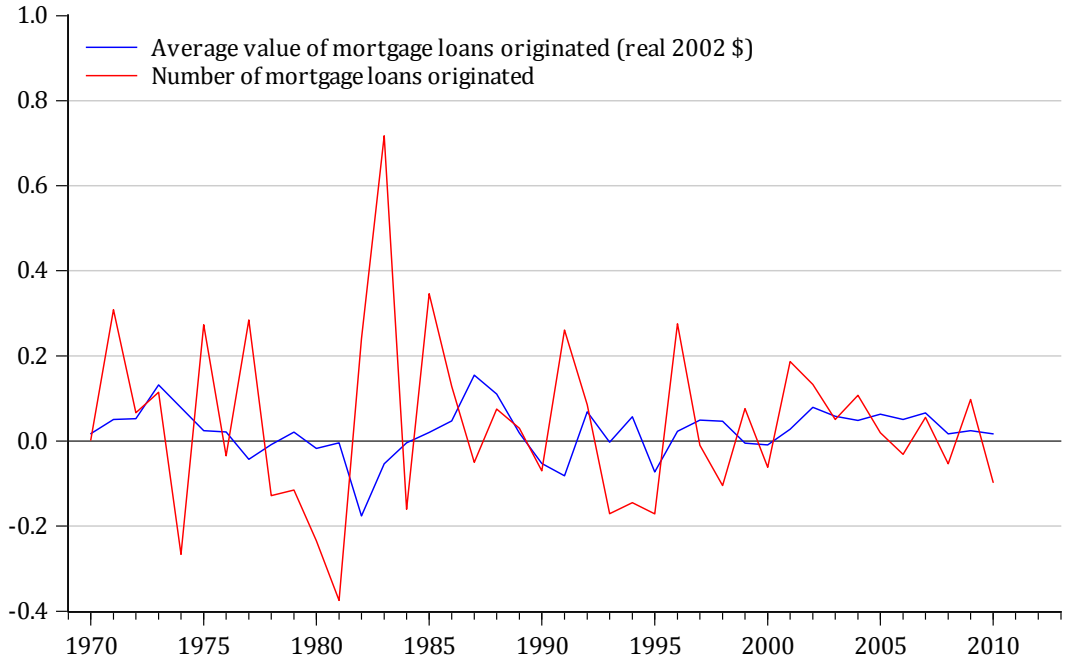


Figure 4: Percentage of variation in the number of loans originated and percentage point of variation (inverted scale) in 5 year interest rate (normalized data).

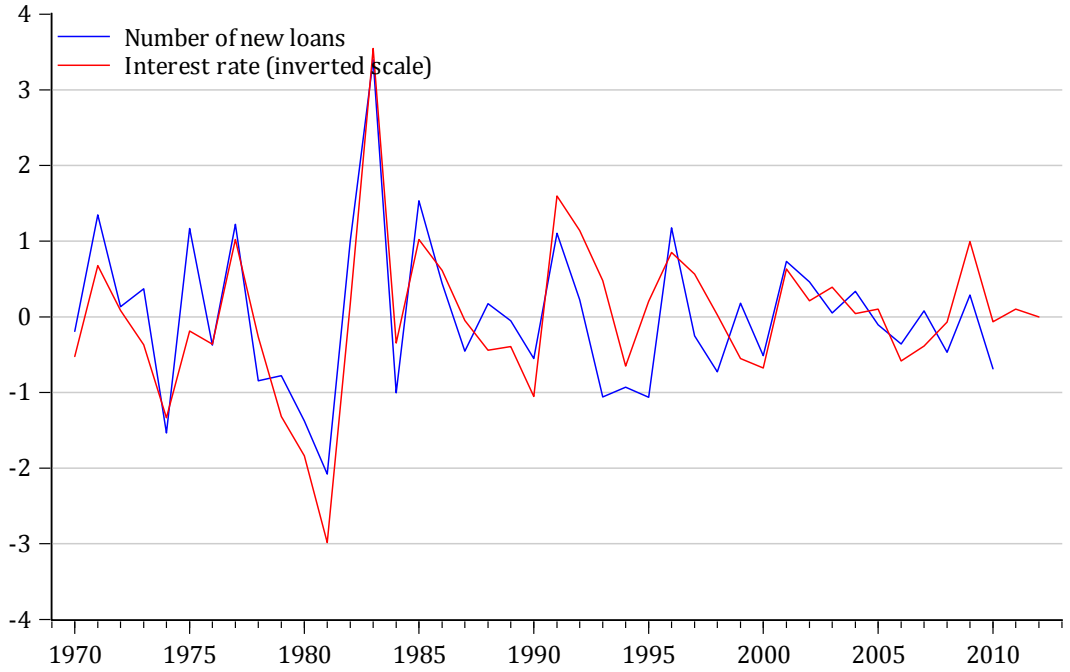
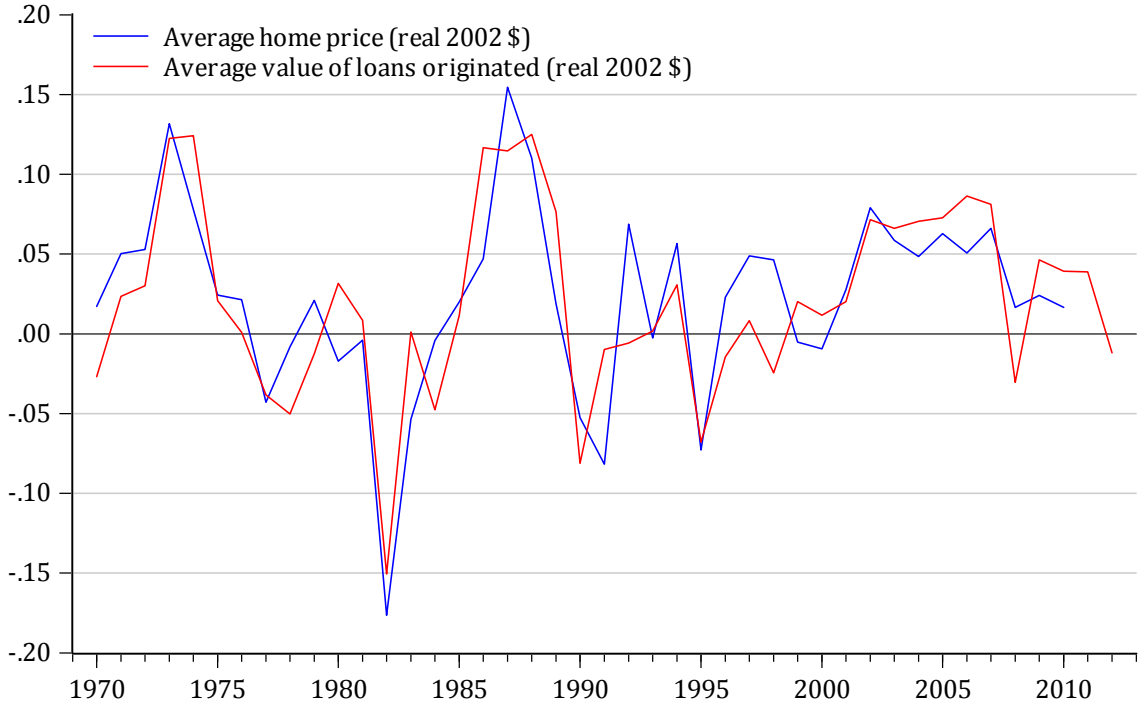


Figure 5: Rate of change in the average real value of mortgage loans originated and real housing price.



THEORY OF MORTGAGE DEMAND AND THE ROLE OF BORROWING CONSTRAINTS

With perfect capital markets, the life-cycle hypothesis predicts that mortgage borrowing is used early in adult life to smooth the time path of housing and non-housing consumption of homeowners under the lifetime income constraint. If a household decides to own rather than renting a home, he buys the quantity of housing capital needed to maximize the discounted utility derived from the desired time path of housing services and non-housing consumption. In this context, mortgage demand simply derives from the demand for owner-occupied housing, a position known as the strong linkage hypothesis (Jaffee and Rosen, 1979). This basic feature predicts that the age profile of mortgage indebtedness should follow an inverted u-shape, reaching a maximum at the time of home purchase early in the adult age before declining thereafter as the household's wealth increases and the debt is progressively repaid.

However, because of uncertain future income, information asymmetries and moral hazard, lenders and legislators set borrowing limits based on household's current income and non-human wealth such that the debt level needed to follow the consumption path

consistent with the lifetime income may exceed these limits. These constraints can be presented as follow. Suppose a household with a non-human wealth w and a current income y wishing to buy a home composed of h infinitesimally small units of capital with a unit purchase price p. When $ph > w$, he must borrow the amount $b = ph - w$ to make this purchase possible. If the LTV cannot exceed a fraction θ of house's value, where $0 \leq \theta \leq 1$, the amount that he can borrow is linked to the house's value by the inequality $b \leq \theta ph$. Substituting this into the financing identity $ph \equiv w + b$ implies that the household's financial wealth, together with the maximum LTV, limits the value of the house he can purchase through the inequality $ph \leq w/(1 - \theta)$ and the mortgage loan's value by the inequality:

$$b \leq \theta w/(1 - \theta) \qquad (1)$$

Inequality (1) shows that as long as $0 < \theta < 1$, the maximum loan value increases with the household's wealth w. It also shows that if the down payment requirement is reduced ($\theta \rightarrow 1$) then the right hand side tends towards infinity and this constraint ceases to exist. As to the DSR constraint, if the loan is repaid over n periods through a constant nominal value annuity with a nominal interest rate i, the nominal mortgage payment is given by $ib/(1-(1+i)^{-n})$.[10] If this payment cannot exceed a proportion α of current income, that is, if $ib/(1 - (1 + i)^{-n}) \leq \alpha y$, then the DSR constraint can be written:

$$b \leq \alpha y(1 - (1+i)^{-n})/i \qquad (2)$$

It is trivial to see that the DSR constraint becomes less severe when y and n increases or when i falls. With these two constraints simultaneously present, the value of the mortgage loan is then limited by:

$$b \leq \min (\theta w/(1 - \theta), \alpha y(1 - (1 + i)^{-n})/i) \qquad (3)$$

Equation (3) shows that the loan's maximum value is dictated by three institutional factors (θ, α and n), one macroeconomic variable (i) and two individual characteristics (w and y). Obviously, the ratio between the household's current wealth and income plays a crucial role in determining if the household is more limited by the LTV or the DSR

[10] It is assumed here that the inflation rate is zero.

constraint. The threshold ratio that makes LTV a more severe constraint is attained when $w/y < (1 - \theta)\alpha(1 - (1 + i)^{-n})/i\theta$. Because if takes time to accumulate the down payment, this situation is most frequently observed in young households.

Ranney (1981) was the first to analyze at the microeconomic model how the LTV constraint affects consumer choice. She assumes a household seeking to buy a large illiquid asset whose partially equity financed, the rest being paid for by borrowing at an interest rate higher than the rate of return earned on liquid assets. She showed that a renter who wants to own a home becomes owner as soon as he accumulates a sufficient down payment. At the time of purchase he uses all his liquidity to increase the house's value as much as possible. Consequently, the LTV constraint always binds at the time of a first home purchase for low wealth households. After the initial purchase, an initial phase follows during which LTV is kept at its maximum value while the progressive accumulation of household's net wealth through savings is used to borrow more in order to acquire a more costly home. A second stage follows later in life during which house's value becomes consistent with the household's permanent income. Then the LTV constraint ceases to be binding and the household starts repaying the mortgage loan. Finally, in a last stage the mortgage is entirely repaid and the household starts accumulating other assets.

Because of the high inflation that prevailed during most of the 70s and the beginning of the 80s, the impact of expected inflation on the demand for owner-occupied was intensively studied. Two effects of inflation were identified if the Fisher hypothesis holds, that is, if real pre-tax interest rates remain constant. On one hand, because of the deductibility of interest paid on the mortgage in the US and the potential taxation of foregone interest on home equity, the real after-tax user cost of owner occupied housing declines when inflation rises. Because of this tax advantage of home ownership, mortgage borrowing is positively affected by inflation. But on the other hand, because nominal interest rates increase with the inflation rate, owning becomes less affordable at the time of purchase. Inflation will gradually increase the nominal income of the household to the point that the real value of mortgage payments will eventually become lower than they would have been without inflation, but the front loading of real debt

amortization reduces mortgage demand for liquidity-constrained households facing a binding DSR constraint (Kearl, 1979). Depending if the former effect is more or less important than the later effect, mortgage demand may increase of decrease with inflation. In parallel, as Schwab (1982) and Wheaton (1985) showed, when the DSR constraint binds the nominal interest rate can become more important than the real interest rate for the demand for owner-occupied housing and, consequently, for mortgage demand.[11]

The empirical evidence generally corroborates the theoretical prediction of the basic life cycle model as to the age profile of household debt. Ioannides (1989) and Ling and McGill (1998) both conclude that LTV is higher at the time of home purchase and decreases thereafter. The same observation is made by Crawford and Faruqui (2012) since the age profile of Canadian households' indebtedness follows the inverted u-shape predicted by the life cycle hypothesis. But many studies confirm also the importance of borrowing constraints for a significant proportion of households. For example, Haurin, Hendershott and Wachter (1996) find that borrowing constraints can reduce by up to a third the probability of home ownership in the US. Breslaw, Irvine and Rahman (1996) for Canada and Leece (2000) for the UK show that households choose longer amortization schedules or an interest-only mortgage to reduce the impact of the DSR constraint. Crawford and Faruqui (2012) find that because of the increased affordability of mortgages made possible by interest rates lower than the long term average, the number of first-time homebuyers in Canada was 10 per cent higher in 2010.

Mortgage borrowing is not motivated only by housing needs but also by non-housing consumption and portfolio considerations. Bailliu, Kartashova and Meh (2011) conclude that in Canada, a sizable portion of the flow of new mortgage financing between 1999

[11] The marginal rate of substitution (MRS) between current and future consumption is the pertinent variable to establish the real user cost of housing capital. For a household constrained only by his lifetime income, this MRS is linked to the real interest rate. But for a household constrained by the DSR, non-housing consumption is the difference between his current income and his current housing expenditures, including mortgage payments. Mortgage payments, which are determined by nominal interest rates, will then shape the time path of non-housing consumption and, therefore, the MRS between present and future consumption.

and 2010 was directed toward consumption and home renovation. Many more studies confirm that home equity extraction was important until 2007 in the US.[12]

Ranney's theoretical prediction that holdings financial assets begins only after the mortgage is repaid is contradicted empirically. According to Jones (1993, 1995), up to 40% of residential mortgage debts in Canada and 73% in the U. S. are not justified by housing investments, a difference consistent with the fact that the mortgage debt is higher when interests paid on mortgage loans are deductible. Brueckner (1997) explains this by the distortion imposed on the portfolio by owning a home. Following Henderson and Ioannides (1987) he considers that a home plays a dual role, being at the same time a durable good providing a flow of housing consumption services, and also an asset in the household's portfolio. While the consumption demand for housing is determined by permanent income, the investment demand is related to current wealth. Consequently, the consumption demand exceeds the investment demand when *w/y* is low and the optimal portfolio of the owner-occupant contains more housing and mortgage debt than the efficient portfolio. The reduction in the portfolio's rate of return that follows from this distortion acts as an implicit housing cost reducing the consumption of housing services and, consequently, mortgage demand. As the household's wealth increases with age, the investment demand for housing grows up while the consumption demand changes only to the extent that its permanent income is modified. In the process one expects a household to progressively rearrange his assets in order to reduce the portfolio's distortion and to gradually repay the mortgage debt while increasing the share of risky assets.

With UK data, Leece (2006) distinguishes between households having an annuity mortgage and those holding an endowment mortgage that have no mandatory repayment of the principal, with the expectation that mortgage choice is influenced by investment motives. He finds that households holding an annuity mortgage are debt maximizer and LTV does not react to portfolio variables. As to the other group however, the nominal interest rate has a negative impact on mortgage debt, which is consistent with a non-housing use of mortgage.

[12] For a survey of the link between housing price and household debt see Finocchiaro, Nilsson, Nyberg and Soultanaeva (2011).

The reduction in inflation in the 90s and the increased global saving rates after 2000 allowed nominal interest rates to fall considerably. According to McGibany and Nourzad (2004) and to Tsatsaronis and Zhu (2004), the easing of the DSR constraint became the primary factor that fueled both housing and mortgage demands. It also implied that LTV became the main limiting factor of indebtedness for a larger proportion of households. In this context, as explained in Almeida, Campello and Liu (2006), lowering the down payment requirement can create a financial accelerator, or more precisely a credit multiplier effect. Indeed, relaxing the LTV constraint simultaneous stimulates mortgage borrowing and housing demand, with a consequent increase in housing price. Households constrained by the LTV can then use their increased home equity to borrow more, thus fueling further increase in housing prices. Since higher housing price stimulates construction, the increased supply of houses will eventually put downward pressure on housing prices But if households fail to perceive that the price increase is not permanent, they may be led to borrow in excess to what is sustainable. Ortallo-Magné and Rady (2006) point out that this amplification exists not only when LTV changes but is present with any shock, such as an income shock, affecting housing price. Of course, when housing price starts to collapse, the financial accelerator plays in the opposite direction amplifying as much the boom as the bust of the housing cycle. The higher is the LTV ratio the larger is the amplification effect, which however does not exist when the LTV constraint is not binding (Disney, Bridges and Gatherwood, 2010). With an average LTV ratio standing around 55%, Canada is not prone to suffer a significant financial accelerator.

In summary, because the borrowing constraints are relaxed when wealth and income increase, mortgage demand is positively related to housing price, to non-human wealth and to households' income. Because housing affordability decreases with nominal interest rates, mortgage demand decreases with nominal interest rates. Mortgage demand is also negatively impacted by the real interest rate since it affects the user cost of owner-occupied housing. Because of the age-profile of mortgage debt, the age structure of the population also plays a role in aggregate mortgage demand. It is also clear that a change in borrowing constraints can change the debt level. Finally, the theory also predicts that

housing price affects mortgage demand, but also a reverted causality between mortgage supply and housing price is present.

THE ECONOMETRIC MODEL AND THE DATA

The econometric model consists in three equations explaining the number of new mortgage loans originated (n_t), their average real value (v_t) and the annual flow of real repayment of mortgage loans (z_t). Most data are available annually until 2012 but those on loan originations that were collected by the CMHC since 1969 stopped to be updated after 2010. Due to this limitation, the database covers the period 1969-2010.[13] The three equations of the basic model are:

$$v_t = f(i_t, i_{t-1}, \pi_t, p_t, y_t, w_{t-1}, pop_t, amort)$$

$$n_t = g(i_t, i_{t-1}, \pi_t, y_t, w_{t-1}, pop_t, amort)$$

$$z_t = h(a_t, i_t, \pi_t, y_t, pop_t, w_{t-1})$$

The explanatory variables are:

i_t: posted nominal interest rate on 5-year mortgage loans[14];

π_t: inflation rate as measured by the annual rate of change of the CPI;

p_t: The average residential transaction price compiled by the Canadian Real Estate Association (CREA) in $ of 2002;[15]

y_t: real per-capita disposable income in $ of 2002;

[13] The CMHC says that these cannot be updated because the Canadian Bankers Association can no longer provide the information. Neither the Bank of Canada nor the Office of the Superintendent of Financial Institutions, the two organisms in charge or supervising financial institutions in Canada, has comparable data. The total mortgage debt outstanding continues to be published on a monthly basis.

[14] Because households negotiate their loans, the interest rate paid on mortgages may be lower than the posted interest rate reported by Statistics Canada.

[15] The CREA started to separate the price of residential and nonresidential transactions only in 1975. Since residential transactions comprise more than 95% of the total, residential prices were calculated for the period 1969-1975 by assuming that residential price had the same growth rate as the price of residential and non-residential taken together. The average transaction price is not adjusted for quality, which for the goal of this empirical investigation is desirable since it better represents the value of the mortgage needed to realize a real estate transaction.

w_{t-1}: annual real rate of change in the Toronto Stock Exchange price index minus the rate of change in population. This serves as a proxy for the average real per-capita wealth at the end of the previous period in real 2002 $.

pop_t : Measure of demographic change.

*amor*t: Dummy variable capturing how the changes in the amortization period between 2006 and 2010 increased the value of a mortgage loan at a given payment with respect to an amortization period of 25 years. The calculation is based on the current interest rate and takes account of the date the changes became effective during the year. The variable is zero before 2006 and takes the values 0.102, 0.119, 0.114, 0.123, 0.123 from 2006 to 2010 respectively. Mechanically, the lowest is the interest rate the largest is the impact of lengthening the amortization period. The sources for all data and the exact calculations are provided in appendix.

Although the specification is easily justified by the economic theory surveyed previously, a short explanation is needed about some of the choices made. The nominal interest rate and the inflation rate are present in all equations in order to test if the real interest rate is significant. To capture the higher indebtedness of young households on mortgage demand, *pop* is the growth rate in the number of people between the age of 25 and 34. It is expected that this variable would have a positive impact on the value and the number of new loans and a negative impact on loan repayment. As to *amort* it is included only in the equations for the value and the number of new loans because there is no likely impact on loan repayment. The reason for adding i_{t-1} in the model is purely empirical. Indeed, it turns out that the lagged interest rate has a significant impact in the model. Finally, the model is estimated in first difference to avoid the problem of spurious correlations and the difficulty of finding cointegrating relations. All variables are measured in logarithmic difference with the exception of i_t and π_t which are in difference of percentage-point. Given that one period is needed to calculate the changes, the estimation covers 40 annual observations from 1971 to 2010.

There are two possible biases arising because of endogenous explanatory variables. First, since housing demand influences mortgage demand while mortgage supply affects housing demand, a simultaneity bias exists between p_t and v_t whose sign depends of the correlation between the shocks on mortgage supply and housing demand. Finding instruments for housing demand that are not significant for mortgage demand is not an easy task, given that households need to borrow to express their housing demand. Two instruments were selected, the employment rate of the population aged 15 or more (e_t) and the lagged housing price $p_{t\text{-}1}$. The second simultaneity bias arises because short term interest rates respond to macroeconomic conditions. To the extent that the 5-year mortgage rate reacts to short term interest rates, and given the fact that the housing and mortgage markets significantly affect Canadian GDP, one can expect i_t to endogenously respond to both v_t and n_t. Two instruments were selected that do not react to current macroeconomic conditions. One is the US government 5-year bonds rate i^*_t and the other is the lagged employment rate $e_{t\text{-}1}$ which is a significant predictor of current interest mortgage rates.

Equation of v_t

We start with the equation for v_t in Table 1. The first model shows the OLS estimates.[16] Beginning with the interest rate, since its coefficient is almost exactly the negative of π_t,, this is consistent with the fact that the current real interest rate affects housing demand. However, contrary to the expected impact of the interest rate on mortgage demand, the sign of i_t is positive. This could happen if the simultaneity bias discusses above is so strong that it captures the impact of the business cycle on the interest rate. As to the lagged nominal interest rate, it is not affected by the bias had has the expected negative impact. The coefficient of housing price is positive and highly significant. The elasticity of 0.73 is statistically lower than 1, indicating a less than proportional response of the average mortgage value to the average housing price. The elasticity of v_t with respect to disposable income is 0.80 and significant at the 5% level. As to demography and wealth,

[16] Although we will not discuss the statistical properties of the models thereafter, all equations have been checked thoroughly for signs of bad specifications and seem well specified. The OLS estimation is made with standard errors corrected for heteroskedasticity by the White procedure.

they do not have a statistically significant impact on mortgage demand. The fact that financial wealth is not significant can be indicative that the LTV constraint is binding only for a small proportion of households. However, caution is needed before concluding too firmly in this direction. Indeed, stocks are primarily owned by older households while the LTV constraint binds mostly for young households. It is then not possible to exclude the possibility that the stock market does not affect the value of new mortgage loans simply because first-time mortgage borrowers do not benefit from this wealth accrual. Finally, *amort* has a negative and highly significant impact. This is contrary to expectations and it cannot easily be related to any exogenous changes in the market.[17]

In order to correct for potential biases in the estimation of p_t and i_t, model 2 shows the results obtained with instrumental variables. The last row shows that the J-test for overidentifying restrictions of the null hypothesis that the instruments are valid is not rejected. Based on the difference in J-Stat, the p-value of the null hypothesis that p_t is exogenous is 0.24 while that for i_t is 0.81. Therefore, the endogeneity of the interest rate is definitely not a problem in this model, a conclusion supported by the fact the the IV estimate of i_t is very close to the OLS estimate. As to p_t however, even if the exogeneity is not rejected at the 5% level the coefficient increases more substantially, from 0.73 to 0.87 and is no longer statistically different from 1, an indication that the biases may indeed lower the coefficient.[18] As to the impact of y_t, it declines from 0.81 to 0.70.

[17] It has been suggested to me that the positive sign could be explained by the fact that a longer amortization opened the mortgage market to households with lower income that buy smaller homes. However, for this explanation to hold, it would be necessary to find that the dummy variable significantly increases the number of new loans. Alas, as shown later, the dummy variable is not significant in the equation for n_t.

[18] The Cragg-Donald F statistics is only 2.23, well below the Stock-Yogo critical value, even at the 30% level. Since the instruments are weak, the GMM estimates may also suffer from biases in the sample and the rejection of exogeneity can be erroneous.

Table 1: Dependent variable is the average value of new loans from 1971 to 2010

	1	2	3	4	5
Variable	OLS	GMM	GMM	OLS	OLS
C	-0.0020 (-0,331)	-0.0021 (-0.311)	-0.0023 (-0.451)	-0.0028 (-0.459)	-0.0031 (-0.509)
Δi_t	0.0059 (1.336)	0.0046 (0.542)			
$\Delta \pi_t$	-0.0065** (-2.402)	-0.0071** (-2.065)			
$\Delta(i_t - \pi_t)$			0.0069** (2.661)	0.0059** (2.383)	0.0052** (2.100)
$\Delta\%p_t$	0.7327*** (7.413)	0.8717*** (4.609)	0.8725*** (6.935)	0.7264*** (7.302)	0.7046*** (7.222)
$\Delta\%y_t$	0.8060** (2.263)	0.6981* (1.729)	0.3698* (1.964)	0.5225** (2.341)	0.4956** (2.175)
$\Delta i_{t-1,}$	-0.0108** (-2.073)	-0.0102* (-1.837)	-0.0110** (-2.695)	-0.0118*** (-2.610)	-0.0120*** (-2.699)
$\Delta\%w_{t-1}$	-0.0194 (-0.673)	-0.0104 (-0.243)			
$\Delta\%pop_t$	-0.4399 (-1.165)	-0.4493 (-1.154)			
dum_amort	-0.4578** (-3.994)	-0.5558** (-3.482)	-0.4822*** (-4.886)	-0.3881** (-4.365)	
R^2	0.82	0.80	0.78	0.80	0.79
D. W.	2.19	2.27	2.16	2.09	2.15
J-Stat. (p-value)		0.245 (0.885)	0.060 (0.806)		

OLS estimates are White's heteroskedasticity consistent estimates. Coefficient significant at the 10%, 5% and 1% level are identified with *, ** and *** respectively. Instruments in equation (2) are $\Delta\%p_{t-1}$, Δe_t, Δi^*_t, and Δe_{t-1} where e_t is the employment rate and i^*_t is the US government 5-year bonds rate. In equation (3) the instruments are $\Delta\%p_{t-1}$ and Δe_t. The t-stat for the coefficients is between brackets except in the last row where it is the p-value of the J-Stat for the suridentification test that instruments are valid.

Given that the endogeneity of the interest rate is rejected, we must conclude that the positive impact of interest rate is not related to the simultaneity bias as suspected in the OLS estimation. The preferred explanation for this counterintuitive result is the fact that the model does not account for the likely negative impact of interest rate on housing price. If p_t declines when i_t rises, the total effect of i_t on v_t can be negative even if the partial direct effect is positive. Also, as we will soon show, i_t has such a strong negative impact on the number of mortgage loans that even if the direct impact on v_t is positive, the total value of loan originations declines substantially when interest rate rises.

Since w_{t-1} and pop_t remains non-significant in model 2, model 3 excludes these variables and it also replaces the i_t and π_t by the real interest rate.[19] Moreover, since the interest rate is now treated as exogenous, only the instruments for p_t are maintained. The main change with respect to model 2 is the important reduction from 0.70 to 0.37 in the coefficient of disposable income. Note however that once again the instruments are weak. Therefore, even if the exogeneity of p_t is not formally rejected, the instruments are weak. Given the large variance of the IV estimates and their possible bias, model 4 presents the OLS estimation of the same specification. The only major changes with respect to the IV estimates is the impact of disposable income which increases to 0.50 while the other coefficients remain very similar.

Since it is difficult to associate the negative coefficient associated with *amort* to a regulatory change or a macroeconomic event happening in 2006, equation 5 shows the model without *amort*. This last model allows analyzing the stability of parameters by recursive least squares. The recursive coefficients, shown in Appendix 2, show that the impact of housing price varies around 1987, a year in which housing price rose by over 15%, but no instability can be observed after. This indicates that the dummy finds a statistically significant but empirically unimportant change in the value of mortgage debt during this period. Moreover, the removal of the debt ceiling in 2002 does not seem to have a significant impact on mortgage debt.

Equation of n_t

The equation for the number of mortgage loans originated is presented in Table 2, beginning with the OLS estimation in model (1). Unsurprisingly, the nominal interest rate is highly significant and important: an increase of one percentage point in the 5-year interest rate reduces the number of new loans by almost 14%. However, the lagged interest rate of 0.056, also highly significant, indicates that a rebound of almost half of the immediate response of the number of new loans happens on the second year. The model finds that a 1% increase in real disposable income causes a 2% increase in n_t significant at the 5% level. As to the inflation rate, its impact is not statistically

[19] The F-Stat associated with these simultaneous restrictions has a p-value of 0.64.

significant at the 10% level. Therefore the number of loans does not react to the real interest rate but is rather related to the nominal interest rate. Thus, the real interest rate affects the value of new loans while the nominal interest rate affects the number of new loans. Finally, we observe that wealth and demography as well as the dummy for 2006 are not statistically significant.

Table 2: Dependent variable is the number of new loans from 1971 to 2010.

	1	2	3
Variable	OLS	GMM	OLS
C	-0.0015 (-0.640)	-0.0032 (-0.138)	-0.1032 (-0.666)
Δi_t	-0.1359*** (-11.179)	-0.1158*** (-7.014)	-0.1352*** (-10.100)
$\Delta \pi_t$	-0.0220 (-1.593)	-0.0248 (-1.678)	-0.0224** (-2.067)
$\Delta \% y_t$	2.0439** (2.185)	1.8784* (2.026)	2.4689*** (3.290)
$\Delta i_{t-1,}$	0.0562*** (5.165)	0.0567*** (4.741)	0.0570*** (5.133)
$\Delta \% w_{t-1}$	0.0402 (0.303)	-0.0567 (-0.457)	
$\Delta \% pop_t$	0.7326 (0.610)	0.2263 (0.195)	
dum_amort	-0.1196 (-0.317)	-0.1259 (-0.359)	
R^2	0.82	0.81	0.82
D. W.	2.41	2.33	2.39
J-Stat. (p-value)		1.178 (0.555)	

OLS estimates are White's heteroskedasticity consistent estimates. Coefficient significant at the 10%, 5% and 1% level are identified with *, ** and *** respectively. Instruments in equation (2) are Δi^*_t, and Δe_{t-1}. The t-stat for the coefficients is between brackets except in the last row where it is the p-value of the J-Stat for the suridentification test that instruments are valid.

To correct the possible bias in the estimation of the coefficient of i_t the second model presents the results with IV. Once again the instruments for i_t are the US government 5-year bonds rate and the lagged employment rate, instruments that are valid as shown by the J-Stat. We observe immediately that the impact of i_t is very similar to the OLS estimated, and in fact sufficiently close that the exogeneity of i_t is not rejected since the

p-value for the null hypothesis of exogeneity is 0.20.[20] Given the similarities between the OLS and the IV estimates, it is not surprising that wealth, population and the dummy continues to be non-significant, since the joint test that they are simultaneously zero has a p-value of 0.83. Therefore, these variables were excluded in model 3 which is estimated with OLS because i_t is exogenous. All coefficients are almost identical to model 1, the only difference being observed on the impact of real disposable income which increases slightly, from 2.04 to 2.47.

Once again, the stability of the models was verified with the recursive least squares shown in Appendix 3. With the exception of a slight decrease of the impact of inflation between 1992 and 1996, all coefficients become stable after 1980. No structural break is significant at the 5%, although a structural break in 1992 is significant at the 10% level.[21] In first instance, this could lead to believe that this almost significant instability is the consequence of an unusually large number of new loans following the reduction of the down-payment requirement in 1992. However, since the model detects large negative residuals at this time, this regulatory change cannot be held responsible for the potential instability. Also, no instability is present after 2006. Therefore, we must conclude that allowing a longer amortization period did not change significantly the amount or the number of mortgage originations in Canada. Mortgage borrowings continued to be related during and after the great recession to housing price, interest rate, inflation and income. No indication of a significant supply shock on mortgage originations is visible in the data.

Equation of z_t

Four models have been estimated for the loan repayment equation, beginning once again with the OLS but with some changes to the list of explanatory variables. Since existing loans are often repaid when new loans are contracted, the total value of loan originations (a_t) appears as an additional explanatory variable. Also, because a longer amortization period should not affect loan repayment, *amort* is excluded from the model. Finally,

[20] In this equation, the test of weak instruments is significant at the 10% level, indicating that the instruments are pertinent.

[21] These conclusions are based on the n-step forecast test. They are not reported on the paper by are available on request.

housing price does not appear in the model because neither its current nor its lagged value was significant in debt repayment.

Table 3: Dependent variable is loan repayment from 1971 to 2010

	1	2	3	4
Variable	OLS	GMM	GMM	OLS
C	0.0730** (3.112)	0.0952*** (3.265)	0.0780*** (-3.774)	0.0741*** (3.239)
$\Delta\%a_t$	0.6871*** (4.380)	0.7727* (1.784)	0.9077*** (3.189)	0.7126*** (4.757)
Δi_t	0.0679*** (3.186)	0.1096* (1.873)	0.0875** (2.397)	0.0736*** (3.091)
$\Delta\pi_t$	0.0551*** (3.151)	0.0535** (2.700)	0.0622*** (5.489)	0.0565*** (4.452)
$\Delta\%y_t$	-1.4588 (-1.190)	-2.7354 (-1.359)	-2.5437** (-2.393)	-1.776* (1.833)
$\Delta i_{t-1,}$	0.0071 (0.417)	-0.0093 (0.785)		
$\Delta\%w_{t-1}$	-0.3023** (-2.077)	-0.3959*** (-2.812)	-0.2889** (-2.099)	-0.3144*** (-2.945)
$\Delta\%pop_t$	-0.2535 (-0.251)	0.1555 (0.173)		
R^2	0.62	0.57	0.59	0.62
D. W.	2.40	2.49	2.21	2.41
J-Stat. (p-value)		1.334 (0.248)	3.944 (0.139)	

OLS estimates are White's heteroskedasticity consistent estimates. Coefficient significant at the 10%, 5% and 1% level are identified with *, ** and *** respectively. Instruments in equation (2) are $\Delta\%a_{t-1}$, Δi^*_t, and Δe_{t-1}. The t-stat for the coefficients is between brackets except in the last row where it is the p-value of the J-Stat for the suridentification test that instruments are valid.

Four variables are significant in the first model. Without surprise, with an elasticity of 0.69 loans origination has a highly significant impact. The semi-elasticity with respect to the nominal interest rate is 0.068: an increase of 1 percentage point in nominal interest rate increases loan repayment by 6.8%. The impact of inflation is also highly significant and important: when inflation increases by 1 percentage point, loan repayment rises by 5.5%. This implies that if the real interest rate remains stable, a 1 percentage point increase in inflation causes loan repayment to rise by 12.3%. The fourth statistically significant coefficient is the wealth elasticity of loan repayment, estimated to be -0.30. This negative impact is not compatible with the hypothesis that households use a capital

gain on the stock market to repay faster the mortgage debt and increase housing equity as expected if they try to achieve a more efficient portfolio as Wheaton (1997) predict. The negative coefficient is more in line with the expected impact of a wealth effect on consumption, that is, households reduce the amount they save out of disposable income, to sustain higher consumption expenditures.[22] As to the lagged interest rate and the demographic variable, they are both non-significant.

Once again, the IV estimation is made to detect the potential endogeneity biases. In addition to the bias of i_t discussed previously, the value of loans origination a_t is also problematic because of the manner in which z_t is calculated. Indeed, data on loans repayment are calculated from the difference between, on one hand, the real value of loan originations and, on the other hand, the net change in the mortgage debt outstanding. With this calculation, there is a direct link between the error terms of a_t and z_t. In addition to i^*_t, and e_{t-1} used as instruments for i_t, a_{t-1} served as the instrument for a_t.

Similarly to the first two equations, the J-Stat confirms that the instruments are valid. But once again, it is not possible to reject the null hypothesis that a_t and i_t are exogenous. The endogeneity test for i_t has a p-value of 0.127 while that for a_t has a p-value of 0.753. Consequently, it is once again not possible to reject the exogeneity of the potentially endogenous variables. But this IV estimation also suffers from weak instruments with the usual consequence that the IV estimates may also be biased and have high variances. Surprisingly, given that the simultaneity bias affecting a_t should lead to an overestimation of the true coefficient, the GMM coefficient of a_t is higher (0.77) than the OLS coefficient. The most important change with respect to OLS is observed for the coefficient of y_t which, at 2.73, is almost twice as large at the OLS coefficient. Models 3 and 4 are the IS and OLS estimation of the parsimonious model that excludes the non-significant variables w_{t-1} and pop_t. The preferred representation is model 4 which comprises four variables significant at the 1% level, that is, a_t with an elasticity of 0.71, i_t

[22] Given that housing price do not impact z_t the interpretation that the negative coefficient is due to a wealth effect on consumption contradicts the empirical finding that consumption is more sensitive to housing wealth than to financial wealth. For example, Bostic, Gabriel and Painter (2009) find that in the US the elasticity of consumption with respect to financial wealth is around 0.02 while its sensitivity to housing wealth is twice as large. However, this result is consistent with the argument made by Buiter (2008) that a change in housing price does not create an aggregate wealth effect but only a redistribution of wealth between households that are short and long on housing consumption.

with a semi-elasticity of 0.071, π_t with a semi-elasticity of 0.056 and w_{t-1} with an elasticity of -0.31. As to disposable income, its elasticity of -1.78 is significant only at the 10% level.

DYNAMIC RESPONSES

In this final section we analyse how various types of hocks affect the flows of loans origination and repayment and the real value of mortgage debt outstanding. To conduct this analysis, the parsimonious models estimated with OLS were retained, that is, model 5 in Table 1, model 3 in Table 2 and model 4 in Table 3. Six scenarios involving a permanent one standard deviation (S.D.) change in an explanatory variable have been simulated. For the whole sample the standard deviations of $\Delta\%p_t$, $\Delta\%y_t$, Δi_t and $\Delta\pi_t$ are respectively 0.059, 0.023, 1.33 and 1.63.[23]These scenarios are:

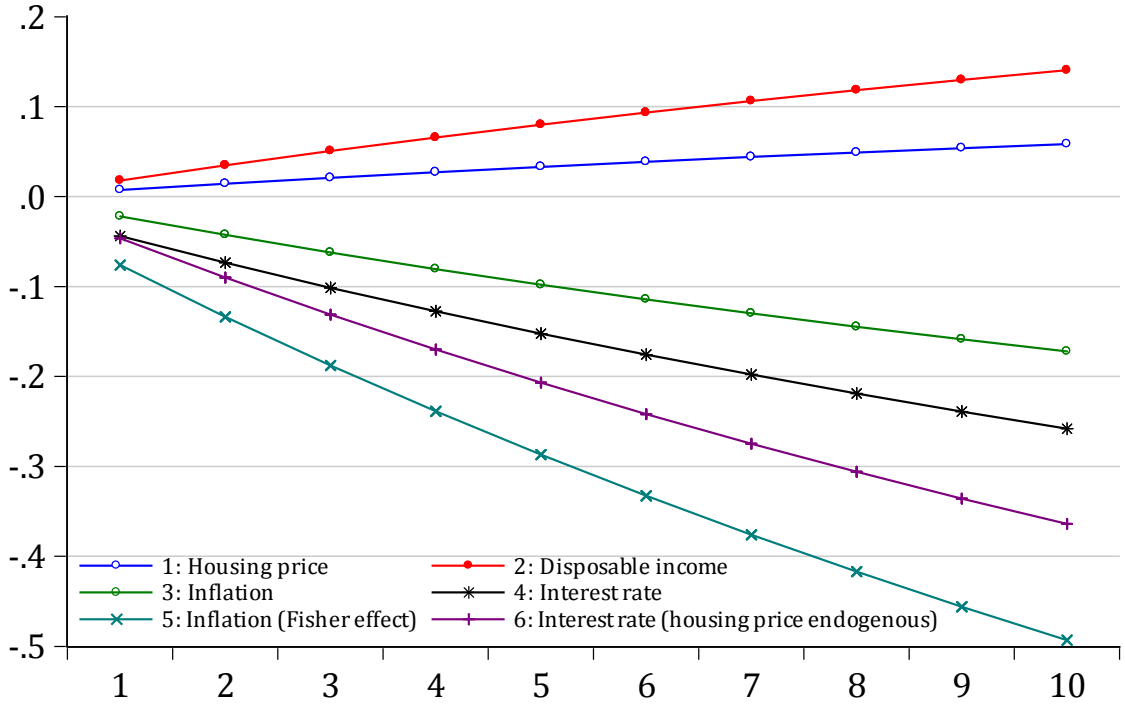
Scenario 1: Permanent change of 1 S.D. to housing price;
Scenario 2: Permanent change of 1 S.D. to personal disposable income;
Scenario 3: Permanent change of 1 S.D. to inflation (nominal interest rate constant);
Scenario 4: Permanent change of 1 S.D. to interest rate;
Scenario 5: Permanent change of 1 S.D. to inflation (real interest rate constant);
Scenario 6: Permanent change of 1 S.D. to interest rate with endogenous housing price reaction.

Scenarios 1 to 4 are but scenarios 5 and 6 involve a change occurring simultaneously in two variables. Unlike the scenario 4 in which the nominal interest rate remains constant when inflation changes, the 5th scenario assumes that the Fisher hypothesis is satisfied, that is to say, the nominal interest rate increases with inflation such that the real interest rate does not change. As to the 6th scenario, it combines a change in the interest rate that induces an endogenous response of housing price. The reason for considering this is that, although the model treats housing price as an exogenous variable, the nominal interest rate has been found significant in explaining changes in housing price in other studies (Fortin and Leclerc, 2002). The impact of a one percent increase in the interest rate on the

[23] Since 1991, the standard deviations have declined to 0.043, 0.018, 0.836 and 1.347 respectively. Therefore the shocks have become less important while their relative volatilities remained similar.

rate of change of housing price is supposed to be -0.016. Since one standard deviation of Δi_t is 1.33, the 6th scenario simulates the impact of a permanent increase in the interest rate of 1.33 percentage point accompanied by a fall of -2.12% in housing price. The impact of these simulations is presented in Figure 6.

Figure 6: Response of mortgage debt to a 1 S. D. shock to the exogenous variables.

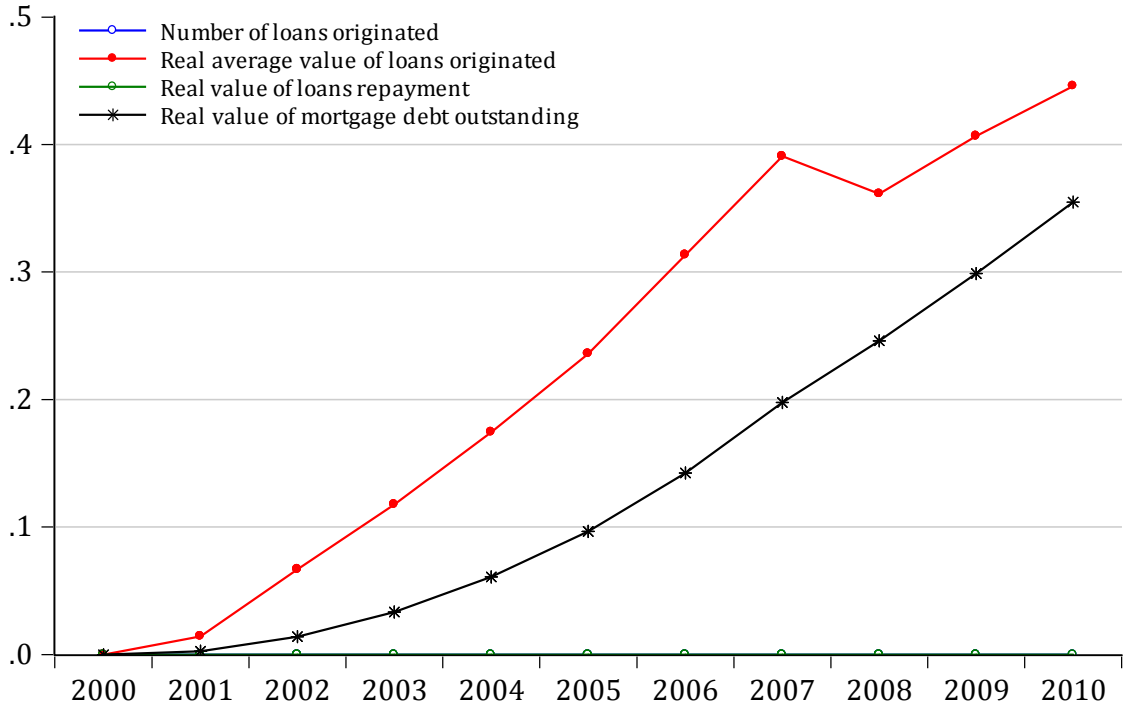


It is immediately apparent that a one standard deviation in housing price does not cause an important increase in the mortgage debt outstanding, the rise being less than 6% after 10 years. The reason for such a small response is that, although a price change increases permanently the average value of mortgages by 4.2%, it has no impact on the number of loans originated. A rise in disposable income has a stronger effect with a 14% increase in mortgage debt after 10 years. The strongest reactions of indebtedness occur when the inflation rate or the interest rate rises, lowering the debt after 10 years of 17% in the first case and 26% in the second. In the case of the interest rate, the strong impact is the consequence of two adjustments taking place simultaneously. The number of loans originated decreases by 10% while loan repayment increases by also 10%. Given this, it is hardly surprising that the 5th scenario, combining a simultaneous increase in the

inflation rate and the nominal interest rate, causes the most drastic reduction in mortgage debt, a 49% decrease after 10 years. As to the 6th scenario, which assumes that a higher interest rate causes a decline in housing prices, it predicts an important fall in indebtedness, a reduction of 36% after 10 years.

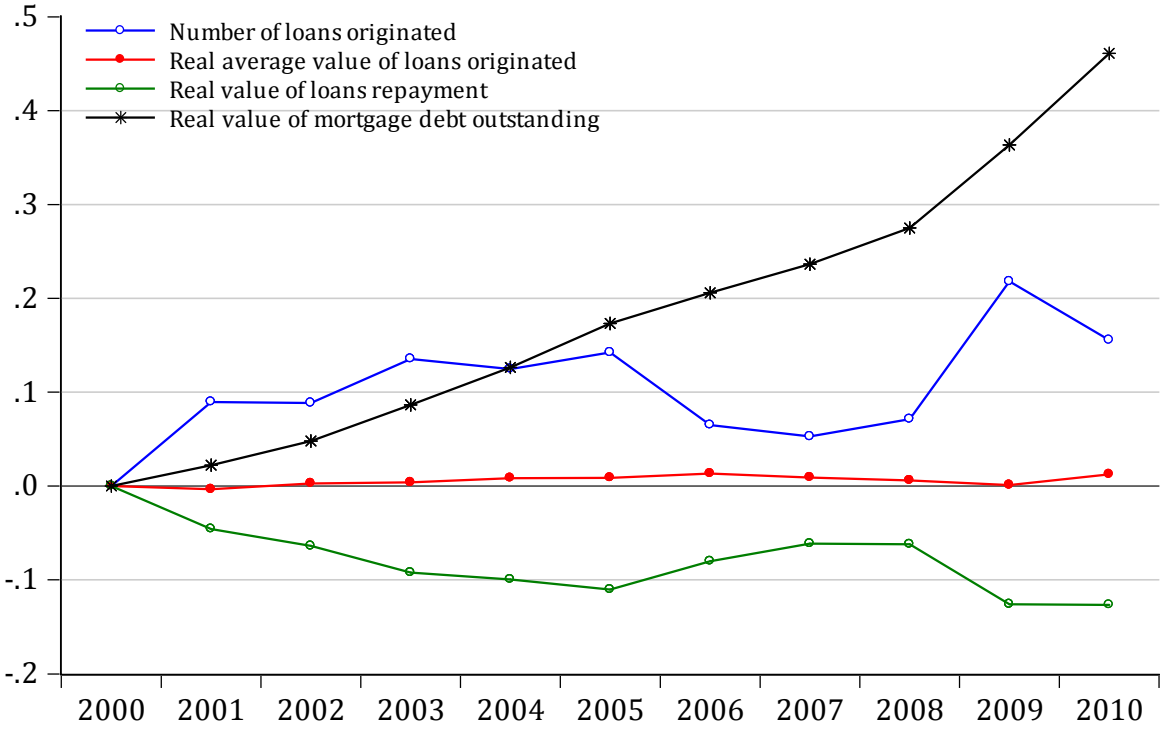
Although an average housing price shock has a relatively small impact on mortgage indebtedness, real housing price increased by 65% between 2001 and 2010, which is eleven times the one standard deviation shock simulated in Figure 6. As to the interest rate, it declined slowly by two percentage points between 2000 and 2006 before returning to its 2001 level by 2008. The interest rate fall of 2009 and 2010 was more important but this decline occurred so late that its impact on the total debt accumulated during this period was necessarily limited. In order to clarify the contribution of housing price and interest rate changes to the increased indebtedness since 2000, I simulated separately the response of mortgage indebtedness to the changes in the real housing price and the nominal interest rate observed during this period. The simulated impact of the change in housing price is shown in figure 7.

Figure 7: Response to real housing price changes observed between 2001 and 2010



Since housing price does not have an impact on the number of loans originated or on loans repayment, the only impact is through a change in the average real value of loans originated. It increased almost continuously during this 10-year period, so that the real value of the average loan was 45% higher in 2010. This has resulted in an increase of 35% in the real value of total mortgage debt. The impact of interest rate, shown in Figure 8, is more complex. The gradual decline in interest rates between 2001 and 2005 had a negligible impact on the average value of new loans but accelerated the number of new loans granted while at the same time reducing the repayment of existing loans. These two opposite reactions contributed almost evenly to increase the outstanding mortgage debt by almost 20%. These movements slowed when the interest rate rose in 2006 and 2007 but the sudden fall that followed the recession of 2008-2009 allowed the number of new loans granted to increase suddenly by over 20% in 2009 while the pace of reimbursement of existing loans felt. As a whole, the model predicts that the movements in interest rates during this period caused an increase in mortgage indebtedness of 27% until 2008, an impact that accelerated in 2009 and 2010 to reach 45% in 2010.

Figure 8: Response to interest rate changes observed between 2001 and 2010



CONCLUSION

This empirical investigation identifies the crucial roles played by four variables affecting mortgage demand in explaining the unprecedented increase in Canadian households' indebtedness over the last 40 years. Two variables stand out as the most closely related to the year-to-year change in loan origination but played differently in the dynamic of indebtedness. Housing price changes almost proportionately the average value of new mortgage loans while the nominal interest rate impact the number of mortgage loans originated. Given the intrinsic variability of these variables, mortgage debt is particularly responsive to a change in the nominal interest rate and especially sensitive when this fall occurs in reaction to a decline in the inflation rate. The impulse given by the fall in interest rate began in the middle of the 80s and continued throughout the 90s. This impact was as much the consequence of a slower repayment of existing loans as the fact that more loans have been originated. Total debt responds also significantly to a typical shock to the real per-capita disposable income. The weakest response follows a typical shock on housing price, since this kind of shock does not affect the number of loans origination.

As to the years 200s, the extremely large increase in real housing price observed until the great recession was the main reason why mortgage debt increased so much between 2000 and 2007. From 2008 however it is the fall in the mortgage interest rate that became the main source for the continuation of rising household debt. It does not appear that changes in credit supply conditions have played a significant role in the last 30 years besides of course the fact that the increased availability of savings lowered the rate of interest on mortgage loans. In particular, despite the fears expressed at the time it does not seem that the relaxation of standards for granting mortgage credit in 2006 has altered the level of indebtedness of Canadian households.

This article does not specifically examines the risk posed by this increased debt but still offers a perspective on the factors that may make it problematic. Given the sensitivities identified, the mortgage market is particularly exposed to a sudden and persistent rise in the inflation rate. Obviously, this is a highly unlikely scenario. The Canadian mortgage market seems more exposed to a sudden deterioration of the macroeconomic conditions originating from a fall in commodity prices. Given that this would negatively impact real

per capita disposable income and housing demand, that could trigger a reversal in housing price. Yet, given that housing equity remained around 50% of housing stock, a share that remained almost constant over the years, even such a deterioration of the macroeconomic conditions would not be sufficient to trigger a

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APPENDIX 1 Sources of the data

Housing prices are provided by the Canadian Real Estate Association. From 1974 to 2014, it is the average residential transaction price. Before 1974, I used the average transaction price, comprising both residential and non-residential transactions, with the level adjusted by a factor of 1.0288 to be consistent with the level of residential transactions in 1974. Note that residential transactions comprise over 95% of all real transactions. The result has been divided by the CPI.

The US interest rate is the market yield on U.S. Treasury securities at 5-year constant maturity, quoted on investment basis provided by the US reserve.

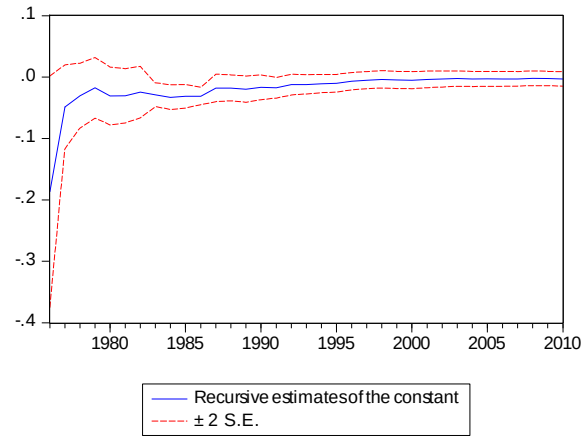
All other data were extracted from CANSIM.

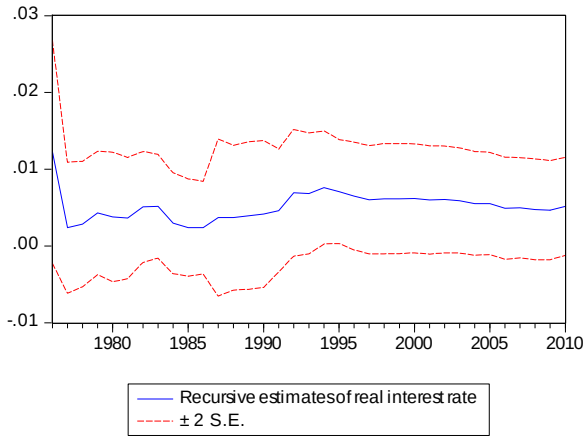
The CPI is the annual average of the series No v41690973. The number of new loans (n) and the total value of new loans (A) were extracted from the CANSIM matrix 270017. The total value is the sum of the series V733848 and V733855, corresponding to loans for new and existing units respectively. The respective numbers of new loans are V733834 and V733841 which have been added to get the total number of new loans. The average value of new loans (v) is equal to A_t/n_t. The result has been divided by the CPI.

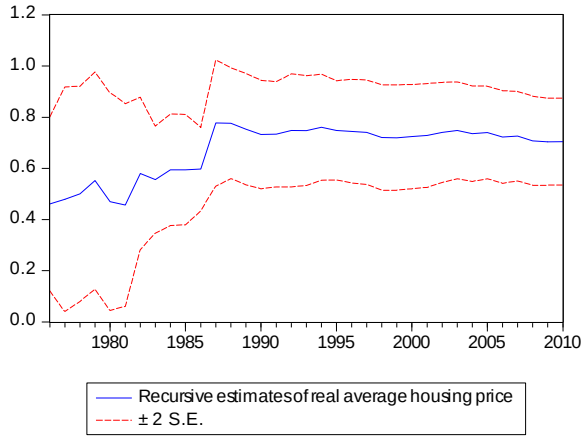
Data on mortgage debt (D) outstanding are the end of December value of the series B938 extracted from the matrix 176-0069. The result has been divided by the CPI to obtain the real value in 2002 dollars. The real repayment (Z)of existing loans was calculated by difference. Since $\Delta D/IPC \equiv A/IPC - Z$ then $Z \equiv A/IPC - \Delta D/IPC$.

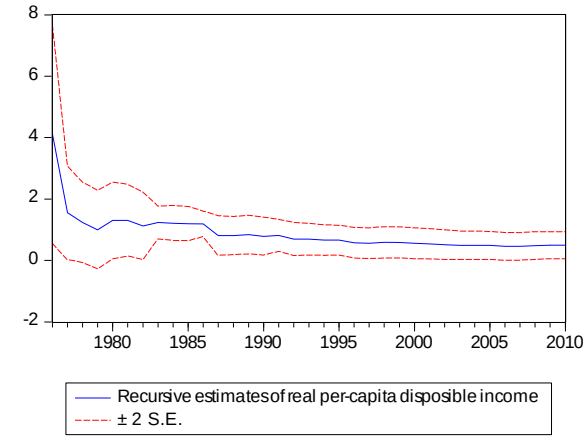
The per-capita disposable income is the annual average of the series V498186 (disposable income) divided by the series V1 (total Canadian population). Prior to 1971.3, the population has been multiplied by the factor 1.01688716 to adjust for a structural break in the estimates of the population at this time. This adjustment factor has been calculated by assuming that the rate of change of population between the second and the third semester of 1971 was equal to the average of the rate of population growth observed in the corresponding semester of 1970 and 1972. The result has been divided by the CPI.

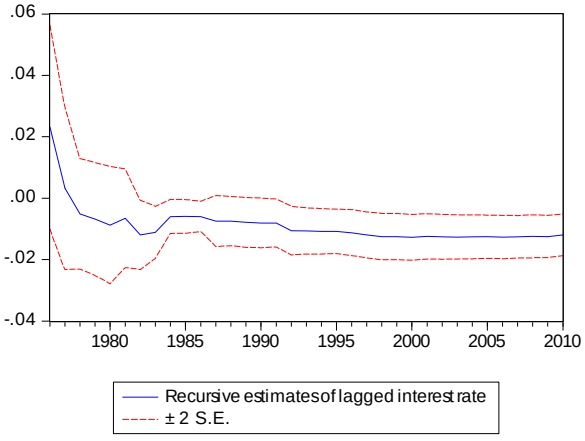
APPENDIX 2: Recursive estimates of model 5 for v_t











Appendix 3: Recursive estimates of model 4 for n_t.