GRÉDI

Groupe de Recherche en Économie et Développement International

Cahier de recherche / Working Paper
07-11

Determinants of mortgage indebtedness in Canada

Mario Fortin

André Leclerc

UNIVERSITÉ DE SHERBROOKE

Determinants of mortgage indebtedness in Canada

Mario Fortin[1] and André Leclerc[2]

April 2007

Abstract

Mortgage indebtedness has risen considerably in Canada in recent years, pushing households' debt-to-income ratio to an all time high. In order to identify what variables explains these changes in the stock of debt, we analyze the inflow and outflow of mortgage financing. We show that the number of new mortgage loans is mostly influenced by nominal interest rates while their average value reacts only to housing price. As to the outflow of debt repayment it is sensitive to more variables. Since housing price is also strongly influenced by nominal interest rate, we show that the main driving force towards higher Canadian households' mortgage debt is the reduction in nominal interest rate.

Keywords : mortgage demand, indebtedness, housing.
JEL : G21, R21

[1] Département d'économique and GREDI, Université de Sherbrooke, 2500 Boul. de l'Université, Québec, Canada, J1K 2R1, Email : mario.fortin@usherbrooke.ca.
[2] Faculté d'administration and Chaire des caisses populaires acadiennes en gestion des coopératives, Université de Moncton, 165, boul. Hébert, Edmundston, New Brunswick, Canada, E3V 2S8 and associate researcher, GREDI, Email: andre@umce.ca. Financing of an earlier version of this research by the Canada Mortgage and Housing Corporation is gratefully acknowledged. We express our thanks to Ian Melzer and Patrick Richard for their timely comments.

1. INTRODUCTION

Home mortgage loans are by far the largest cause to Canadian households indebtedness. In 2005, their outstanding mortgage loans totalled 626 billion of Canadian dollars ($C), over 60% of their total debts and more than forty times the amount owed in 1970. This is an impressive growth even when households' rising income is factored in since, from a low of 35% in 1970, the ratio of mortgage debt to disposable income reached the record level of 120% in 2005. Yet, despite the economy-wide importance of the Canadian mortgage market and the increased risks posed by possible consumers' over-indebtedness, the number of empirical studies devoted to explain the evolution of mortgage demand over time remains extremely rare. In fact, we have not been able to identify a single paper published in academic journals reporting econometric results on the determinants of aggregate mortgage indebtedness in Canada or in other countries as well. This absence of statistical analysis is puzzling but can possibly be explained by the long standing perception that mortgage debt is driven mostly by housing demand. As Jaffee and Rosen (1979) expressed:

> "On the demand side, most borrowers find mortgage credit necessary to finance their home purchase, and they seek the largest loan available based on their collateral. Thus mortgage demand is tied directly to the demand for housing."[1]

Linking mortgage debt and housing demand is frequent. As illustrated by McGibany and Nourzad (2004) or Tsatsaronis and Zhu (2004), there is a broad understanding in both academic and non-academic circles that low interest rates eases the burden of debt amortization, which in turn fuels both housing and mortgage demands. However, although the strong linkage story supports the fact that the initial amount borrowed at the time of home purchase is determined by housing demand, it does little to explain the borrowing needs of households in the following years of ownership. Empirically, researchers have mostly use micro-data to explain the variations in the loan-to-value (LTV) ratio amongst households, but with deceiving results initially.

[1] Jaffee, D. M. et K. T. Rosen (1979), "Mortgage Credit Availability and Residential construction", *Brookings Papers on Economic Activity* 2, , p.354.

> «Explaining variations in the loan-to-value ratios among households is difficult based upon my own experience. I have made attempts using several different surveys.... All of the work is unpublished because I have never found it easy to market papers that say, "Please publish my paper that shows I cannot explain what I set out to explain, especially with data that are questionable and omit some important variables." About the only variables I find to matter are length of stay, age and income. I usually find a modest positive relationship between income and LTV whereas the LTV decreases as age and length of stay increase.»[2]

Our paper takes a different perspective. Rather than giving attention to the individual variations in the LTV, we try to identify the causes to the evolution over time of the aggregate stock of mortgage debt observed in Canada. Approaching the problem in an aggregate time series perspective offers the opportunity to quantify the importance of each determinant of mortgage demand to overall indebtedness and its response dynamics. Carrying out such an analysis is of interest because even if the literature on the determinants of housing demand is better developed than that on mortgage demand, the causality between the former and the latter is not unidirectional, so that one cannot infer directly from housing demand parameters the impact on the mortgage market. Moreover, in light of the recent high households' indebtedness ratio, it becomes increasingly important to determine the households' reaction to overall economic conditions.

Our empirical approach analyzes the change in the real value of mortgage debt as the net difference between the inflow of mortgage loan approvals and the outflow of mortgage debt repayments. As explained earlier, although new loans are most likely to be closely related to home purchase, loan reimbursements may well be more sensitive to portfolio decisions. To better distinguish what drives mortgage demand, the value of loan approvals is further decomposed into the number of new loans and their average value, so that mortgage market activity is explained with three statistical relationships related to a few important macroeconomic variables. More precisely, we show that the growth in the number of new loans responds mostly to changes in the nominal fixed interest rate on 5-years mortgage loans and, to a lesser extent, to the growth rates in real per-capita disposable income and in the number of young adults. As to the average value

[2] Follain (1990), "Mortgage Choice", *Journal of the American Real Estate and Urban Economics Association* 18(2), p. 129.

of new loans, it is closely tied to that of housing as the strong linkage hypothesis suggests. However, since housing price responds also to the nominal mortgage interest rate, the real per-capita disposable income and to demography, that means that ultimately the number and the average value of new loans react to similar variables. It is also remarkable that measures of housing user-cost never appear as statistically significant determinants of new mortgage loans. As to debt repayment, it depends on the inflation rate and upon the value of new loan approvals, most obviously because part of new loans' proceeds is needed to repay existing ones.[3]

The paper is organized as followed. In the next section we review the main theoretical predictions identifiable in the literature. In section three, we describe the evolution of some indicators of the Canadian mortgage market. Section four is devoted to the presentation of the empirical model while section 5 shows the results of some simulations.

2. THEORY AND EVIDENCE ON MORTGAGE DEMAND

In a simplistic world with complete capital markets and no uncertainty, there is a total independence between home purchase and the debt-equity mix, so that mortgage demand is explained solely by the desire to minimize the user cost of housing capital. Indeed, house's value is chosen to maximize the expected present value of satisfaction under the single constraint of lifetime income, given the user cost of housing services. As to the financing mix, it depends on a simple comparison between the real after-tax rate of return on equity m and that on mortgage r. When $m < r$, the household uses all its equity before borrowing the remaining amount needed to buy the house, thus minimizing LTV. In the opposite situation when $m > r$ the household does not use its equity to purchase the house but instead borrows all the amount required by the real-estate purchase, so that LTV is maximized. Finally, LTV is indeterminate in case of equality between m and r. (See Jones, 1993).

Of course, the real world is more complex. Leaving aside the question of uncertainty helps to understand the consequence of the illiquid nature of a house. Ranney (1981) modelled the

[3] Although different in its scope, a flow approach to mortgage demand has been utilized by Greenspan and Kennedy (2005) to develop a working measure of home equity extraction.

decision to purchase a large illiquid asset in a life cycle framework with a down payment constraint. This constraint implies that LTV is upward bounded, either because it is limited by lenders or by legislation. In either case, Ranney shows that in this context a renter will, at the time of its first home purchase, borrows up to the limit sets on the LTV ratio and buys the most costly residence possible. Thus, at the time of home purchase LTV is maximized even when borrowed funds cost more than equity with the consequence that both mortgage debt and home price are strictly proportional to the household's equity. It is then clear that the initial mortgage debt is tied to residential real estate transaction prices. What happens to LTV after home purchase depends on the situation. If transaction costs are neglected, Ranney shows that a first stage follows the initial home purchase during which the progressive accumulation of wealth is entirely used by the household to borrow more in order to acquire a more costly home while keeping LTV at its maximum value. It is only later in life, when house's value is no longer limited by a binding borrowing constraint that the household starts repaying the mortgage loan. Finally, it is still later in life, and only after the mortgage debt has been entirely reimbursed, that the household begins to accumulate financial assets.

Although Ranney considers only the down payment constraint, borrowers' current income also imposes an upper limit to the mortgage debt since the debt-service ratio cannot exceed a certain value set by the lenders, typically more or less 30% of income. Thus, the amount that can be borrowed to purchase a house is, in effect, limited by the lowest value imposed by the down payment constraint or the current income constraint. Which one constitutes the effective limit depends on individual situations but also on macroeconomic conditions. Young households tend to have a lower equity and are then more likely to be limited by the down payment constraint. In a context of higher inflation and nominal interest rates however, an increased fraction of households will in effect be limited by their current income. Two possibilities are open to ease the impact of the constraint when borrowings are limited by income: buying a cheaper house or amortizing the mortgage over a longer time period.[4] Indeed, Breslaw, Irvine et Rahman (1996) found that Canadian households choose a longer amortization plan when they face higher house prices.

---

[4] See Kearl (1979) for the seminal works on how inflation increases the severity of the borrowing constraint imposed by current income on housing demand.

Empirical studies by Jones (1993, 1995) and Brueckner (1994) showed however that households hold financial assets well before the mortgage is entirely repaid, a situation described as excess mortgage by Jones. This may happen because the expected net rate of return on savings can exceed the interest rate on the mortgage loan. Indeed, a fixed-rate mortgage contracted earlier may carry an interest rate below the actual market conditions. Taxation is also a factor since households compare the net-of-tax interest rate on mortgage with those on financial assets. While in the U. S. mortgage interest payments are deductible only to the extent that the household itemizes its deductions, in Canada they are deductible when the taxpayer can link its mortgage borrowings to investments whose returns are fully taxable. The initial mortgage on the main residence is then never deductible in Canada but interests paid on a second mortgage contracted for investment purpose can become tax-deductible. Moreover, a significant proportion of Canadian households have unused contribution rights to a Registered Retirement Savings Plan (RRSP) allowing them to earn investment incomes while differing the taxation.[5] Whether or not households in this situation are better off in repaying their home mortgage or in contributing to their RRSP is a long debate amongst Canadian home finance specialists that is still unsettled. The bottom line is however that in Canada as well as in the US, determining whether or not the net-of-tax mortgage interest rate is higher or lower than that on equity is a complicated matter.

The reason for not repaying the mortgage as fast as possible may also be that households make risky investments to raise their portfolio's expected return. To properly address how risk modifies mortgage demand, Brueckner (1997) developed a model in a stochastic environment and shows that when building an efficient portfolio the household considers the fact that a home is both a consumption and an investment good.[6] While consumption demand for housing is determined by the household's permanent income, the investment demand depends on its current

[5] RRSPs goal is to encourage retirement savings by Canadian households. All the money put into this plan is, up to a certain limit, deductible from the taxable income while all the money taken out is taxable, offering the main advantage that investment incomes can be compounded at the pre-tax rate of return. In the theoretical model of Bruecker (1994), the case with $m > r$ was described as the US situation mostly because interests paid on mortgage loans are tax deductible while the reverse case was labelled the Canadian situation because of non-deductible mortgage interests. As seen in the text however, the distinction between both countries is in fact more blurred.

[6] The dual nature of housing, which is at the same time an investment and a consumption good, has been studied namely by Henderson and Ioannides (1983, 1987) and by Hendershott and Won (1992).

wealth. Brueckner shows that early in life, when the former commonly exceeds the later, the optimal portfolio is distorted and contains more housing and mortgage debt than an efficient portfolio. At a given risk, the reduction in the portfolio's rate of return imposed by these distortions acts as an implicit housing cost reducing both the consumption of housing services and 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 households to progressively rearrange their assets to reduce their portfolio's distortion and to gradually repay the mortgage debt while increasing the share of risky assets.

The empirical evidence on cross-sections data is weak but tends to corroborate this broad description. Brueckner's (1994) results are mixed since the link he finds between portfolio's composition and housing investment demand depends on the method of estimation. However, Ioannides (1989) and Ling and McGill (1998) both conclude that LTV is higher at the time of home purchase and decreases thereafter. Interestingly, Ling and McGill observe that LTV is significantly lower for American households claiming the standard deduction, a result consistent with the fact that mortgage demand is influenced by interest deductibility. Manchester and Poterba (1989) studied the second mortgage demand and concluded that it is mostly justified by non-housing consumption. As to Jones (1993, 1995), he finds that a sizable proportion of residential mortgage debts, a share estimated at 40% in Canada and as high as 73% in the U. S., is not justified by housing investments. The difference between both countries is once again consistent with the fact that the mortgage debt is higher when interests paid on mortgage loans are deductible. With UK data, Leece (2006) distinguished 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 reported that when the endogenously determined housing demand in taken into account, 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.[7]

3. DESCRIPTION OF THE CANADIAN MORTGAGE MARKET

The Canadian mortgage market is highly competitive. Historically, insurance companies, trust companies and financial cooperatives were the main mortgage lenders. However, due to legislation changes, Canadian chartered banks greatly developed their presence into this sector since the end of the 60s, first directly and later trough acquisitions of other financial institutions. This expansion was so successful that they now hold a 60% market share, with financial cooperatives still good seconds at around 14%, a share that did not change much over time.[8] Mortgages can be contracted at various conditions, such as at fixed or variable rate, with payments made usually monthly although options are open to choose instead a weekly frequency. The typical product is considered to be a 5-years fixed-term mortgage while maturities are commonly 25 years, but the choice between a fixed or a variable rate is conditioned by the importance of the spread between short and long rates. Lenders are authorized to make an unsecured mortgage loan for as much as 75% of the house's value, but LTV can be increased up to 95% when the mortgage loan is insured, mostly by the Canada Mortgage and Housing Corporation (CMHC).[9]

As indicated in the introduction, mortgage indebtedness has increased considerably in Canada in recent decades, a feature shared with most other developed countries (Debelle, 2004). Evaluated in 1992 Canadian dollars, the real value of mortgage loans outstanding rose from 65 billions in 1969 to 492 billions in 2005. The faster rate of growth was observed during the 70s, and

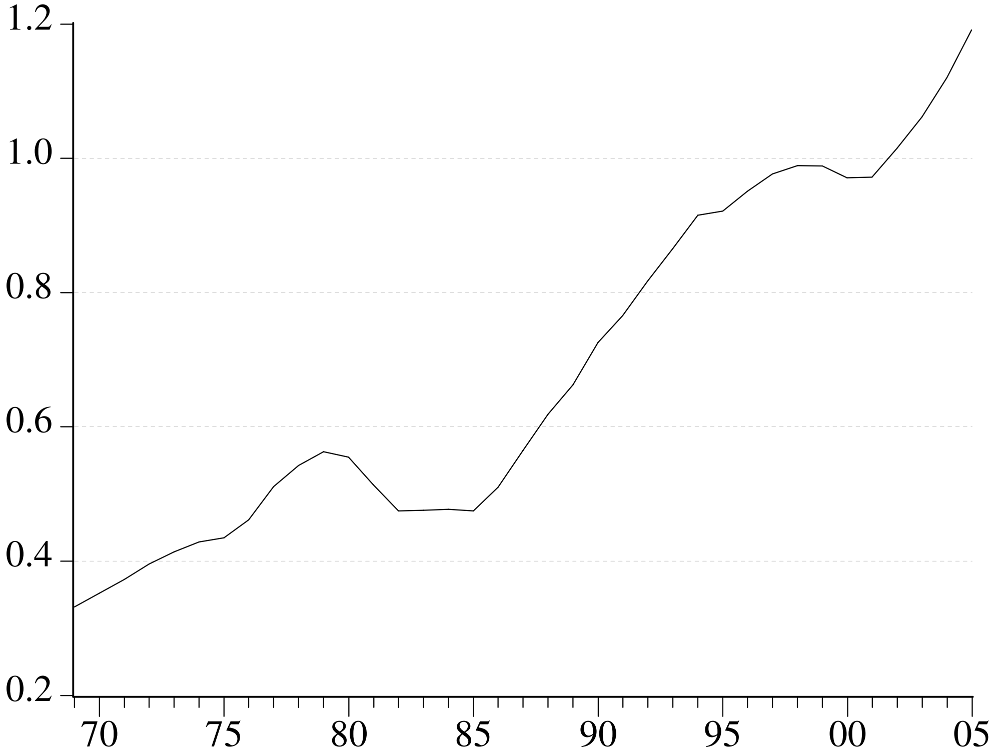
[7] Home equity extraction is a relatively recent concept presented by Greenspan and Kennedy (2005) in an attempt to estimate non-housing household expenditures financed by mortgage debt. It is different from the excess mortgage as defined by Jones (1993) which concerns the use of mortgages to finance assets hold in the portfolio.

[8] More recently, mortgage-backed securities (MBS) have taken a growing share of the Canadian mortgage market, reaching close to 15% in 2005. MBS consist in pools of residential mortgages insured by the CMHC and sold to interested investors. Since the issuers of MBS have to be approved mortgage lenders, most of these mortgages are initially authorized by the same financial institutions listed previously.

[9] Since 1992, the Home Buyer's Plan allows first-time home buyers to withdraw up to $20 000 from RRSP without incurring tax penalties if that amount is used to cover the down payment. By combining this option with personal loans, a household can in effect buys a house without having saved previously for the down payment. Despite these liberal arrangements, the sub-prime mortgage market did not develop in Canada as much as it did in the US in recent years, probably because of the obligation to insure a mortgage loan when LTV exceeds 75%.

particularly between 1970 and 1977 when the real mortgage debt was increasing at more than 10% a year. Besides the generally favourable economic conditions enjoyed in Canada during this period, the need to satisfy the demand expressed by the first wave of baby boomers and the liberalization of the mortgage market that was done as the end of the 60s probably also contributed to this dynamism. The record level of interest rates that prevailed in North America at the beginning of the 80s was accompanied by a violent contraction of economic activity in Canada and a steep fall in inflation. This was sufficient to induce a sudden reversal in the mortgage market, the real value of outstanding debt decreasing each year between 1980 and 1984. Starting in 1985 however, a new period of sustained growth in mortgage demand followed which still continues today. Although the recent growth rate has retreated to around 5% a year, it now applies to an accumulated amount vastly superior, so that between 2000 and 2005, the real value of mortgage debt has risen by more than $120 billions, an amount unprecedented in any 5-years period. As a consequence (see figure 1), the debt-to-income ratio now reaches record levels. It is interesting to observe that although the recession of 1981-82 and the slow growth in 2000 were accompanied by a substantial pause in the upward trend of the indebtedness ratio, the recession of 1990-91 and the slow recovery of the early 90s did not significantly alter the growth in the ratio of mortgage debt to disposable income.

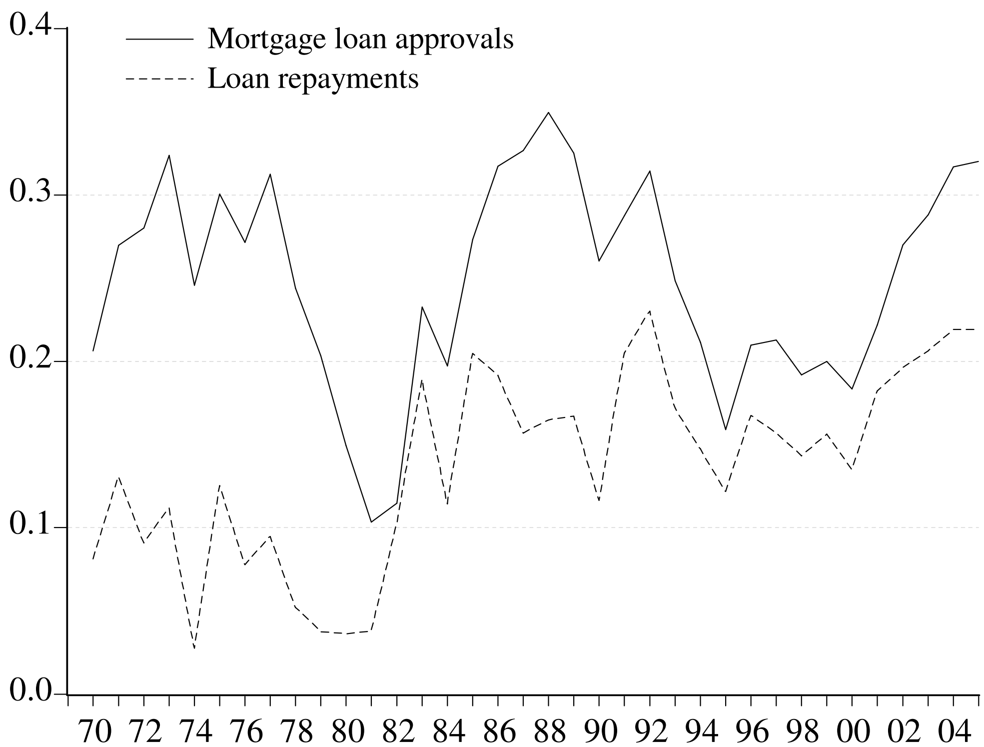
Figure 1 : Ratio of mortgage debt to disposable income in Canada, 1969 - 2005



Source : Statistics Canada and authors' calculation

The change in outstanding debt (ΔD) is the net difference between two opposite flows, increasing with the value of mortgage loan approvals (A) but decreasing with debt repayment (R). Data on both the value and the number of mortgage loan approvals are compiled separately for new and existing housing units by the CMHC and available in the CANSIM database of Statistics Canada. As to debt repayment, we calculated it from the identity R = A – ΔD, with the outstanding debt also extracted from CANSIM. Figure 2 presents the inflow of all mortgage loan approvals, for both existing and new units, and the outflow of debt repayment, both expressed in proportion to the previous year's outstanding debt. It is immediately apparent that year-to-year changes in these two series are closely related, reflecting the fact that at time of real-estate transactions, households need part of the new loan proceeds to repay the one previously contracted on the house they sell. However, given that R is calculated as the difference between A and ΔD, any stochastic component of A is reflected in R, an element that we will have to deal with in the statistical analysis. It is also apparent that new loan approvals display a pro-cyclical

Figure 2 : Inflow and outflow of mortgage loans
in proportion to loans outstanding



Source : Statistics Canada and authors' calculation behaviour, contracting in each of the recessions previously mentioned. It must also be noticed that the real depreciation of debt outstanding resulting from inflation is not considered in the figure. Inflation was particularly high in the seventies but declined from more than 10% a year to around 4% between 1982 and 1984. The sudden jump in repayment from an average value below 10% a year to around 15% at the time inflation felt, that is around 1982, can be interpreted as an indication that debt depreciation is a substitute to repaying the principal. Finally, net inflow narrowed in the early 80s when inflation was still rapidly depreciating the real value of existing debt. As a consequence, repayments in real terms exceeded mortgage loan approvals to such an extent that the real outstanding debt declined by almost 15% between 1980 and 1983.

New loan approvals are available both in aggregate value and in numbers so that their average value is easily found by dividing the former by the latter. Since the theory suggests that initial mortgage demand is closely tied to housing demand, it is instructive to compare the average value of new mortgage loans with housing price. Figure 3 shows the real loan value (left scale) and the national average price of real estate transactions sold trough the Multiple Listing Service and compiled by the Canadian Real Estate Association (right scale).[10] Since this average price makes no adjustment for quality, it is influenced by the variations in the price of constant-quality units as well as by quality changes and therefore reflects adequately the average financing needs of housing transactions.

The close relationship between these series is obvious. Both display a rapid rise between 1972 and 1974, a pronounced decline between 1981 and 1984 followed by a fast recovery in the following years, and a steep increase since 2001. While conserving a mean value of 56.6%, the lowest LTV occurred in 1991 at 49% and it peaked twice at 62%, once in 1979 and the other time in 1998, this second peak following two consecutive years when the average mortgage debt was rising at the same time home price was declining. After the 1998 peak, the debt-to-price ratio slightly declined to reach 58% in 2005. As well debt value as housing price trend upward at an average annual growth rate of 2%, a bit faster than the 1.6% average growth rate in real per-capita disposable income. Keeping these broad facts and theoretical predictions in mind, we now turn our attention to estimating the econometric model.

[10] See the appendix for details on data construction.

Figure 3 : Average housing price and
average value of loan approvals (constant 1992 $)

Source : Statistics Canada and Canadian Real Estate Association

3. THE ECONOMETRIC MODEL

We want to simultaneously estimate a set of three equations explaining the number of new mortgage loans, their average real value and the real value of debt repayment. The number of new loans and their average value being a decomposition of new loan approvals, they should be strongly influenced by housing demand and the financing mix. In the specification of these two equations, we then expect to find explanatory variables related to the cost of credit, the cost of purchasing and owning a home and the capacity of households to service the mortgage loan. The user cost is the product of the per-unit asset cost of home capital with house's quality, this one being taken here in the broad sense of the quantity of assets incorporated into an average home, which product is itself multiplied by the real financing cost of each dollar invested into a house.

Because of liquidity constraint, housing and mortgage demands are also potentially influenced by nominal interest rates trough their impact on the debt-service ratio. As to debt repayment, portfolio decisions should, in addition to the real value of new loan approvals, be considered.

Since housing demand is influenced by credit availability, entering home price as an independent variable directly to explain mortgage demand can produce a simultaneity bias. An instrumental variable estimator is then needed and to identify exogenous instruments for the asset price of housing we got guidance from an equation of Canadian housing demand estimated by Fortin and Leclerc (2002). They showed that the average housing transaction price can be explained by the real disposable income, the nominal interest rate on five-year mortgage loans, the lagged value of transaction price and demographic pressures as measured by the growth rate in population between the ages of 25 and 54.[11] Given the way real loan repayment has been calculated, a simultaneity bias is also present if the real value of new loan approvals is used to explain loan repayment. The identification of additional instruments for this variable was made by selecting exogenous variables having a high explanatory power of new loan approvals, which led us to retain the own lagged value of loan approvals as the sole exogenous instrument.[12]

The definition and symbol of each variable of the econometric model are indicated in table 1. For each of the endogenous explanatory variables, we submitted the instruments to the Sargan test for over-identifying restrictions and, in both cases, the null hypothesis that instruments are exogenous is not rejected. Moreover, the Hausman test decisively rejects the hypothesis that the potentially endogenous variables are exogenous, leading to the conclusion that OLS estimates are biased.[13] Additionally, we checked if the three-stage least squares would improve the

---

[11] The house price model of Fortin and Leclerc also contains the lagged stock of housing units, for a final equation very similar to that estimated by DiPasquale and Wheaton (1994) with US data. However, housing stock has last been published in 2000, limiting our list of explanatory variables only to the first four variables. Because housing stock is highly correlated with a growing time trend, we have added a time trend to the list of instruments, but it was not significant and caused only minor changes in the estimated coefficients. Therefore, we did not keep it in our final equation.

[12] Other variables such as the mortgage interest rate, the real home price and demographic pressures are also significant in explaining the real value of new loan approvals. However, since these variables are already present in other equations of the system or not exogenous in the case of house price, the only additional exogenous instrument is the lagged value of loan approvals.

[13] The Sargan test for over-identifying restrictions applied to D(LOG(VALUER) has a *p*-value of 0,11 while that of D(LOG(REPAYR)) is 0,43. As to the Hausman test, the null hypothesis that the residuals of OLS estimates has no impact on the endogenous variables when it is regressed on all instruments and exogenous variables has a *t*-statistics

efficiency of our estimates by calculating the Breusch-Pagan statistics for testing the absence of dependence between residuals of the system. Since we did not reject the independence of residuals, this led us to retain the method of two stage least squares to estimate the model.[14]

Table 1 : Variables of the model

DEFINITION	**SYMBOL**
Number of new mortgage loans	NBRE
Average real value of new loans	VALUER
Real average value of new loan approvals	APPROVR
Real value of debt repayment	REPAYR
Nominal interest rate on 5-year fixed term mortgage	R5Y
Real per-capita disposable income	YDPCR
Annual rate of change in the CPI	INF
Real average home price	PRICER
Population between ages 25 and 34	POP2534
Population between ages 25 and 54	POP2554

We have explored many possibilities to combine explanatory variables with various forms of variable dynamics. Before discussing these possible combinations let us first present in table 2 the estimated coefficients of the final model with *t*-statistics in brackets. All dependent variables are in logarithmic difference, a choice made necessary to avoid problems caused by nonstationary variables. All equations satisfy the usual specification tests, namely those regarding the absence of time-dependent of heteroscedastic residuals and the Ramsey test for non-linear functional forms.

Consider first the equation for the number of new loans (NBRE). In addition to the lagged dependent variable, only two exogenous variables are present which, together, explain 83% of

---

for D(LOG(VALUER)) of 16.88 while it is 9.46 for D(LOG(REPAYR)). The nullity of impact of the residuals is then strongly rejected.

[14] The Breusch-Pagan statistics, which follows a $\chi^2(3)$ distribution, has a calculated value of 3.72 with a *p*-value of 0.29.

the annual rate of change in NBRE. By far the most significant variable, both statistically and in importance, is the interest rate on five-year mortgage loans (R5Y) which indicates that an increase of one percentage point in interest rate reduces the number of new loans by 14.4%. Given that year-to-year changes in this interest rate range between a low of -4.6% in 1983 and a high of 3.8% in 1981, the estimated annual response of new loans to interest rate fluctuations has been as low as 55% and as high as 66%. The second significant variable is the population between the age of 25 and 34 (POP2534). The estimated elasticity of 2.88 implies that a one-percent increase in population in this age group raises the number of new loans by almost 3%. Finally, the negative coefficient of the lagged dependent variable indicates that the second year response is dampened before stabilizing to its long run value.

Table 2 : Estimation by two-stage least squares, 1972-2005 (t-value in brackets)
Instruments: C D(R5Y) D(LOG(POP2534)) D(LOG(NBRE(-1))) D(LOG(YDPCR)) D(INF) D(LOG(REPAYR(-1))) D(LOG(APPROVR(-1))) LOG(PRICER(-1)) D(LOG(POP2554)) LOG(YDPHR)

Variable	**D(LOG(NBRE))**	**D(LOG(VALUER))**	**D(LOG(REPAYR))**
CONSTANT	0.0069 (0.3806)	-0.0074 (0.9777)	0.0752 (1.3800)
D(R5Y)	-0.1440 (11.9569)	-	-
D(LOG(POP2534))	2.8765 (3.7924)	-	-
D(LOG(NBRE(-1))	-0.3200 (4.1489)	-	-
D(LOG(PRICER))	-	0.8832 (6.7031)	-
D(LOG(YDPCR))	-	0.6400 (2.0112)	-
D(INF)	-	-0.0081 (2.0441)	-0.1101 (2.9731)
D(LOG(REPAYR(-1))	-	-	-0.6346 (5.4545)
D(LOG(APPROVR))	-	-	0.7839 (2.5853)
R^2	0.8280	0.7292	0.6733
D.W. Statistic	1.7140	2.0334	2.0704

A number of alternative specifications have been tested and rejected for this equation. First, we wanted to test if mortgage demand depends on the nominal or the real interest rate. We constructed the real interest rate on two different assumptions regarding inflation expectations. Assuming a perfect one-year foresight, the real interest rate is the difference between the nominal mortgage rate and the realized inflation rate. However, when the annual inflation rate follows a random walk, as is the case in our sample, last year inflation becomes the optimal inflation forecast so that the real expected rate is equal to the nominal rate minus the inflation rate lagged one period. We then add to the model the real interest rate, one version of it at a time, and it was never close to be significant. This pinpoint to the fact that the binding constraint on mortgage demand is the debt-service ratio and that the user cost of housing capital does not influence significantly mortgage demand. We also had the expectations that the real per-capita disposable income (YDPCR) might have a positive impact on NBRE because higher income could lead more households to qualify for a mortgage loan. We also expected that the real price of home (PRICER) could have a deterrent effect, since it would raise the user cost of housing. However, these variables were never significant.[15]

The second equation explaining the real average value of new loans (VALUER) still has a relatively high explanatory power for a difference equation, with a R^2 of 0.73. Not surprisingly, the average transaction price of home has a significant positive impact and its coefficient of 0.88 not statistically different from one, so that one cannot reject the hypothesis that LTV does not change when home price varies.[16] Also significant are the real YDPCR, with an elasticity of 0.64, and the inflation rate with a semi elasticity of -0.008 indicating that a one percentage point increase in inflation reduces the average LTV ratio by 0.8%. It is noteworthy that in this equation no dynamic is present and we failed to identify other variables having an impact on VALUER, such as the real interest rate for instance.

---

[15] We have also checked if a quadratic or a logarithmic change in interest rate was significant and these possibilities were rejected. The fact that no abnormal residuals were noticeable when interest rates reached 18% in 1981-82 comfort us in the specification retained. The only small instability that the recursive OLS estimates identify is the impact of population growth at the beginning of the 90s. Otherwise, the coefficients rapidly reach their value estimated on the whole sample.

[16] Although presenting all the results obtained with OLS would be irrelevant, it is interesting to note that the OLS estimate of the impact of PRICER on VALUER is only 0.77, confirming the importance of the simultaneity bias.

The final equation explains 67% of the logarithmic variations in real repayment (REPAYR). Once again two variables are significant. As expected, new loan approvals (APPROVR) directly influences debt repayment with an estimated elasticity of 0.78. The other variable is the inflation rate. Its semi-elasticity of -0.11 implies a substantial reaction of debt repayment to annual changes in inflation. For example, the brutal deceleration in inflation in 1983 (-4.9 percentage point) increased debt repayment by 54%. The intuitive reason for this is that households were better off in repaying their debts than in investing because mortgages already contracted at high nominal rates, which reached 18% in the previous two years, forced them to pay a record real rate in 1983 given the current inflation rate of around 5%. A change of the same order of magnitude occurred, but with an opposite sign, between 1972 and 1974. Finally, the lagged value of REPAYR has a coefficient of -0.63 indicating, as in the case of NBRE, that the second year response is smaller than the immediate reaction. As to interest rates, either real or nominal, disposable income or home price, they do not affect REPAYR. Also, since portfolio decisions are expected to be important in the decision to hold excess mortgage, we tried to link REPAYR to a measure of expected returns on savings. Since interest rate on savings is so highly correlated with the mortgage rate, which was not significant, it is not surprising that we failed to relate REPAYR with these measures of savings return. We then turned our attention to the aggregate annual rate of return on the Canadian stock market. Once again we have considered the possibilities of perfect foresight or optimal forecast based on last year return, since stock return follows a random walk with drift. However, any attempt to relate REPAYR to either the current or lagged stock market rate of return has been unsuccessful.

4. DYNAMIC RESPONSES TO EXOGENOUS VARIABLES

The estimated equations allow studying how the system dynamically responds to variations in the exogenous variables. The goal here is not to give a precise description of a long run reaction but rather to identify the different channels trough which the mortgage market is influenced. It is particularly useful to see the impact of changes in the mortgage interest rate and the real per-capita disposable income, the two most important external influences. Since these simulations also take into account the endogenous response of PRICER, we first present in table 3 the estimated coefficients of this first stage equation with the t-values. Just following the constant at

Table 3 : OLS estimates, Real home price equation, 1972-2005

Dependent variable : D(LOG(PRICER)), R2 = 0.689		
Variable	**Coefficient**	**t-value**
C	-0.6427	-0.376
LOG(PRICER(-1))	-0.3611	-3.904
R5Y	-0.0317	-3.789
LOG(YDPCR)	0.5266	3.400
D(LOG(POP2554))	7.5703	2.533
D(LOG(POP2534))	1.7460	2.679
D(LOG(NBRE(-1)))	-0.3291	-1.721
D(INF)	-0.0020	0.280
D(LOG(REPAYR(-1)))	0.0373	1.457
D(LOG(AUTORR(-1)))	0.2472	1.245
D(R5Y)	0.0207	1.779
D(LOG(YDPCR))	-0.8783	-1.108

the top of the table are the four exogenous instruments. Note that the nullity of the joint significance of these four variables is rejected at the 1% level, confirming that these are relevant instruments. Note also that among the other exogenous variables, only D(LOG(POP2534)) is significant, a conclusion that holds as well in an individual test as in a joint test of exclusion of the last six variables. Yet, all the variables must be conserved for simulation purposes given their presence in the two stage estimation.[17] We observe that the real home price reacts to three important types of influence: real income, mortgage interest rate and demographic pressures, which come mostly from population growth between ages 25 and 54 and, to a lesser extent, to the growth rate in the young adults, that is, those between 25 and 34. The point estimate shows that a one percentage point rise in the nominal interest rate leads to an immediate reduction of 3.2% in real home price while a one percent rise in the real per-capita disposable income

[17] Since the lagged value of LOG(PRICER) is an explanatory variables, this equation could as well be estimated to explain the level of LOG(PRICER) rather than its 1st difference. In such a case, the only coefficient that would change is that of LOG(PRICER(-1)) which would become 1-0.3611= 0,6389. Looking at the equation in level makes it easier to understand why real income and interest rate appear in level, particularly since Fortin and Leclerc (2002) showed that LOG(PRICER) and LOG(YDPHR) are cointegrated series.

increases PRICER by 0.53%. As to demography, an acceleration of one percent in the growth rate of POP2554 pushes up home price by 7.57%, an impact that it compounded by 1.75% when POP2534 rises by one percent.

Leaving aside demography, we now simulate the dynamic response of the system to three kinds of shocks. The simulations were conducted by first calculating the value taken by the endogenous variables if all exogenous variables remain constant to their 2005 values. Then we change the time path of the pertinent exogenous variables and compare the difference in percentage that result over time in the endogenous variables.

We first compare two different scenarios for a change in interest rate. In the first simulation, we analyze the effect of the nominal interest rate while keeping the real rate constant, which would correspond to a perfectly anticipated increase in inflation in which the Fisher equation holds. To do that, we then increase both the interest rate and the inflation rate by one percentage point. The second simulation looks only to the impact of interest rate, keeping the inflation rate constant, so that the nominal rate changed is due to a rise in the real rate of interest of one percentage point. The results of both simulations are shown on the figures 4a and 4b respectively, with the shocks arriving in year 2.

The figures clearly show that, notwithstanding inflation, the most important reaction to the interest rate rise is a substantial drop in the number of new loans accompanied by a more modest decrease in the real home price, the latter leading to an almost concomitant reduction in the average value of new mortgage loans. After 6 years, the number of new loans is permanently reduced by 10.3% in both cases, while the value of new loans is lowered by 3.5% when the real interest rate is stable and by 2.7% when the inflation rate is constant. There is however a big difference in the behaviour of loan repayment, since they decrease in almost the same proportion as the number of new loans when inflation follows interest rate changes, but remain unaffected when inflation is constant. All combined, the concomitant rise in interest rate and inflation leads to a permanent reduction of 13.4% in the real value of new loans approvals and of 10.4% in loan repayment, the net result being a slowly falling mortgage debt outstanding (DEBT). We observe however that DEBT stops declining after seven years at a value lowered by 1.4% with respect to

Figure 4a: Response in percentage to a one percentage point increase in the nominal interest rate

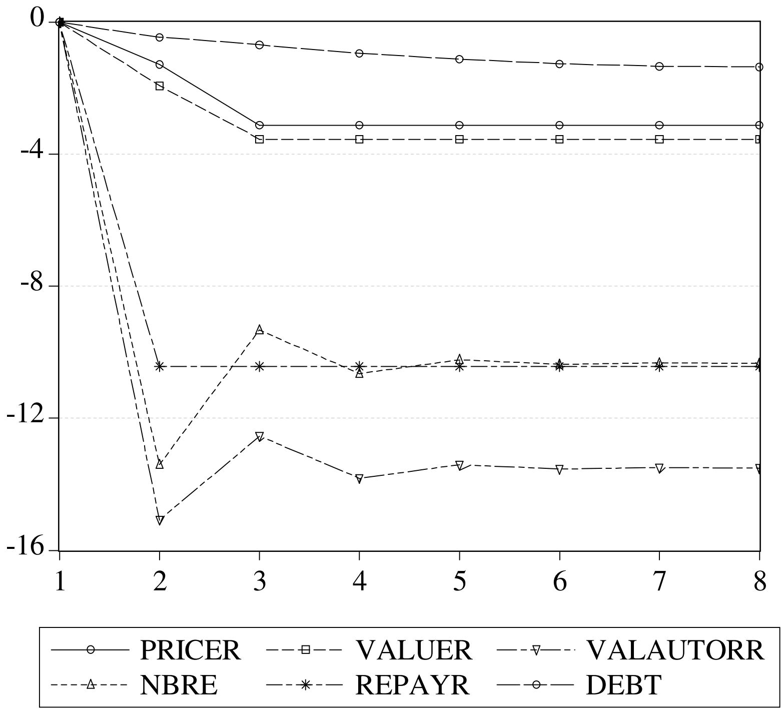
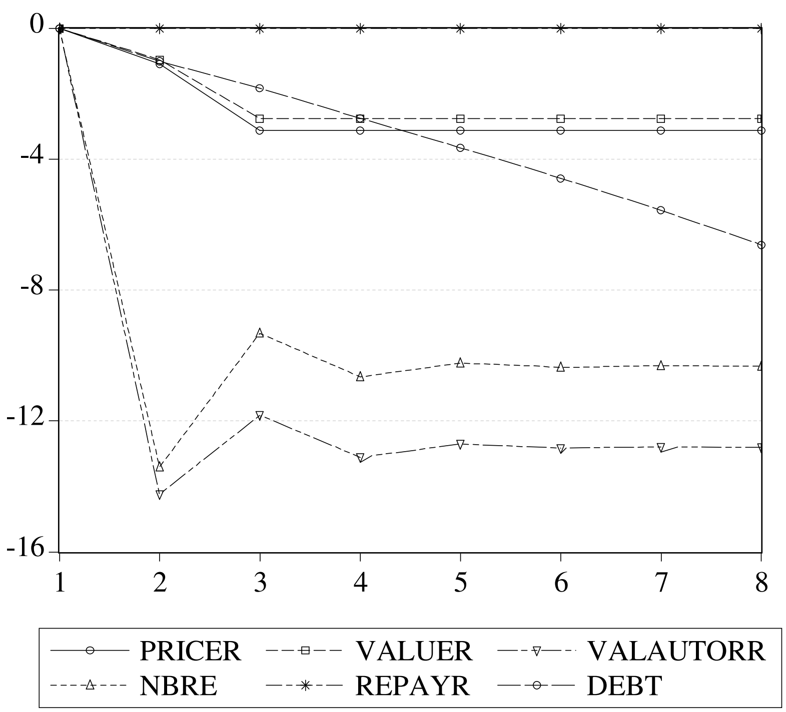


Figure 4b : Response in percentage to a one percentage point increase in the real interest rate

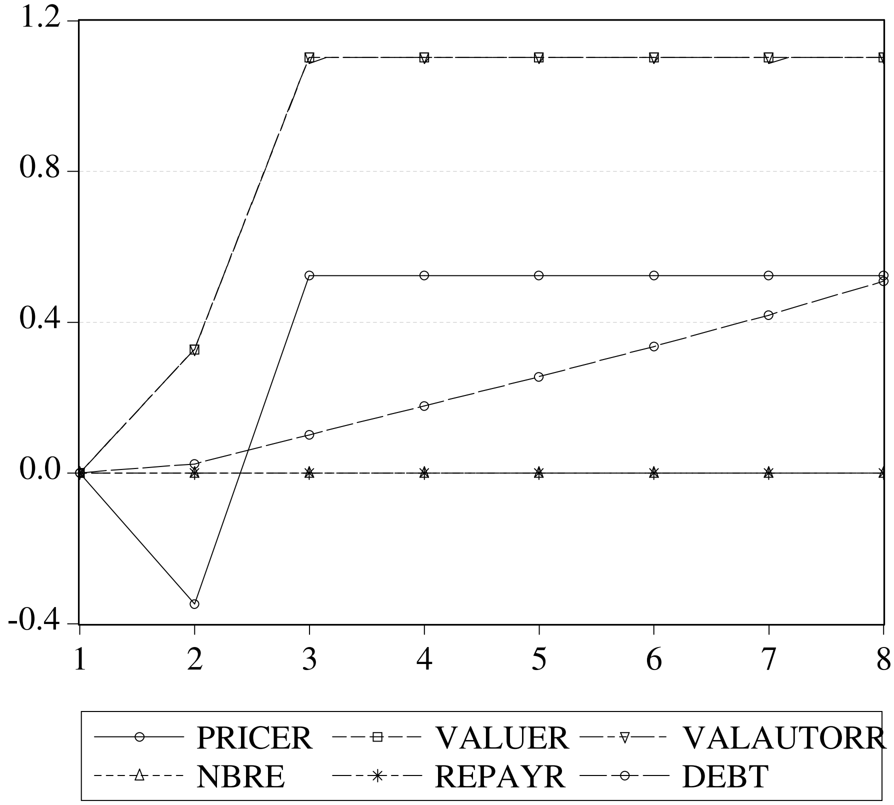


the reference case. Also, since PRICER falls a bit less than VALUER (-3.1% vs -3.5%), there is a small reduction in LTV. But when only interest rate changes, the reduction in the value of new loans is slightly less important (12.8% vs 13.4%). But since loan repayment do not change, DEBT falls much more rapidly, initially at a rate of almost 1% a year but it keeps going down year after year to that the reduction in DEBT totalled -6.7% seven years after the shock.

The third simulation, shown in figure 4c, analyses the system's response to a one percent permanent increase in the real per-capita disposable income. The situation here is simpler since the number of new loans and debt repayment are not affected and the main driver to the increased indebtedness is the positive reaction of home price.[18] Since VALUER rises permanently by 1.1% and PRICER by 0.5%, there is a slight increase in LTV. The impact on DEBT is very small however with a cumulative increase of only 0.5% seven years after the rise in income. Comparing this with the previous impacts it is clear that substantial changes in indebtedness are mostly related to fluctuations in interest rates.

[18] The initial reduction in home price is caused by the negative, albeit not significant, coefficient associated to D(LOG(YDPCR)) in the PRICER equation. This temporary effect disappears at subsequent period and should not be regarded as a true structural response if only statistically significant variables were considered, like if we had adopted an instrumental variable estimator instead of TSLS.

Figure 4c : Response in percentage to a one percent increase in real per-capita disposable income



CONCLUSION

Our goal was to understand the factors behind the increased mortgage indebtedness in Canada. The theoretical literature focuses on housing demand to explain mortgage demand at time of home purchase but indicate that a more complex interaction with the entire household's portfolio plays a role in subsequent years. We used annual aggregate time series data to try to identify the main exogenous factors that are statistically related to the change in mortgage indebtedness. Our method decomposes the change in mortgage debt into an inflow of new mortgage loans, decomposed in average value and in number of new loans, and an outflow of mortgage repayment.

We showed that the value of new loans is mostly related to housing price, as the theory suggested it should at time of home purchase. However, we point out that housing price is not exogenous and that three macroeconomic variables, the nominal interest rate on mortgage, the real per-capita income and the inflation rate play a role in the evolution of mortgage indebtedness. The interest rate stands out at the most important external factor, causing mostly a change in the number of new loans and, to a lesser extent, modifying the housing price and the average value of new loans. As to debt repayment, if we put aside the important impact of new loan approvals on it, the only external factor we identify is the inflation rate, which we believe is an indication that the depreciation of outstanding debt caused by inflation is a substitute to the nominal repayment of debt. Other portfolio considerations do not seem to have an important role in the overall mortgage indebtedness of Canadian households. Personal disposable income plays also a role, although our simulations tend to indicate a more moderate reaction than to interest rate fluctuations.

Overall, all the results corroborate the importance of nominal constraints related to current income in mortgage demand. The fact that the nominal interest rate has so much importance while the real rate is not significant shows that housing user cost do not receive much consideration in mortgage decisions. Rather, the story that lies behind our results is that Canadian households borrow as much at their current income allows considering the constraint based on the fraction of income devoted to repay the debt, to buy as costly a house as possible. When interest rate rises, a significant number of would-be borrowers are disqualified and reduce the vigour of the mortgage market.

REFERENCE

Breslaw, J., I. Irvine and A. Rahman (1996), "Instrument Choice: The Demand for Mortgages in Canada", *Journal of Urban Economics* 39(3), 282-302.

Brueckner, J. K. (1994), "The Demand for Mortgage Debt: Some Basic Results", *Journal of Housing Economics* 3, 251-262.

Brueckner, J. K. (1997), "Consumption and Investment Motives and the Portfolio Choices of Homeowners", *Journal of Real Estate Finance and Economics* 15(2), 159-180.

Debelle, G (2004), "Household debt and the macroeconomy", *BIS Quarterly Review*, March 2004, 51-64.

Di Pasquale, D. and W. C. Wheaton (1994), "Housing Market Dynamics and the Future of Housing Prices", *Journal of Urban Economics* 35, 1-27.

Follain, J. R., (1990), "Mortgage Choice", *EREUEA Journal* 18(2), 125-144.

Fortin, M. and A. Leclerc (2002), "Déterminants du Prix Réel des Logements au Canada", *L'Actualité économique : Revue d'analyse économique* 78(3), 293-318.

Greenspan, A. and J. Kennedy (2005), "Estimates of Home Mortgage Originations, Repayments, and Debt On One-to-Four-Family Residences", Working paper 2005-41, Finance and Economics Discussion Series, Federal Reserve Board, 83p.

Hendershott, P. H. and Y. Won (1992), "Introducing Risky Housing and Endogenous Tenure Choice into a Portfolio-Based General Equilibrium Model", *Journal of Public Economics* 48(3), 293-316.

Henderson, J. V. and Y. M. Ioannides (1983), “A Model of Housing Tenure Choice”, *American Economic Review* 73(1), p. 98-113.

Henderson, J. V. and Y. M. Ioannides (1987), “Owner Occupancy: Investment vs Consumption Demand”, *Journal of Urban Economics* 21, p. 228-241.

Ioannides, Y. M. (1989), “Housing, Other Real Estate, and Wealth Portfolios: An Empirical Investigation Based on the 1983 Survey of Consumer”, *Regional Science and Urban Economics* 19, 259-280.

Jaffee, D. M. and K. T. Rosen (1979), “Mortgage Credit Availability and Residential construction”, *Brookings Papers on Economic Activity* 2, 333-386.

Jones, L. D. (1995), “New Wealth, Marginal Tax Rates and the Demand for Home Mortgage Debt”, *Journal of Regional Science and Urban Economics* 25, 297-322.

Jones, L. D. (1993), “The Demand for Home Mortgage Debt”, *Journal of Urban Economics* 33(1), 10-28.

Kearl, J. R. (1979), “Inflation, Mortgage, and Housing”**,** *The Journal of Political Economy* 87(5), 1115-1138.

Leece, D. (2006), “Testing a Theorandical Model of Mortgage Demand on UK Data”, *Applied Economics* 38, 2037-2051.

Ling, D. C. and G. A. McGill (1998), “Evidence on the Demand for Mortgage Debt by Owner-Occupants”, *Journal of Urban Economics* 44, 391-414.

Manchester, J. M. and J. M. Poterba (1989), “Second Mortgages and Household Saving”, *Journal of Regional science and urban Economics* 19, 325-346.

McGibany, J. M and F. Nourzad (2004), "Do lower mortgage rates mean higher housing prices?", *Applied Economics* 36, 305-313.

Ranney, S. I. (1981), "The Future Price of Houses, Mortgage Market Conditions and the Return to Homeownership", *American Economic Review* 71(3), 323-333.

Tsatsaronis, K. and H. Zhu (2004), "What Drives Housing Prices Dynamics: Cross-Country Evidence", *BIS Quarterly Review*, March 2004, 65-78.

APPENDIX 1: DATA SOURCES

Consumer price index (CPI): CANSIM, series V735319.

Housing prices: *Canadian Real Estate Association*. From 1975 to 2005, we used the average residential transaction price while for the 1969-1974 period we used the average (residential and non-residential) transaction price multiplied by 1,0288. This adjustment corresponds to the ratio of residential to total transaction price in 1975. The result has been divided by the CPI.

New mortgage loans : Their total real value is the sum of the CANSIM series V733848 and V733855, corresponding to loans for new and existing units respectively divided by the CPI to The respective numbers of new loans are V733834 and V733841 which have been added to get the total number of new loans.

Real value of mortgage loans outstanding : CANSIM series V33495 divided by the CPI.

Population : Built from the CANSIM series for 10 years age-groups : V2461077, V2461078, V2461087, V2461088, V2461089, V2461090, V2461091, V2461092, V2461093, V2461094. These have been added to estimation of the same age groups for the period 1969 to 1976 coming from now obsolete series of CANSIM which have been made consistent with current population estimates by Richard Archambault from *Human Resources Development Canada*.

Real disposable income : CANSIM series V498186 divided by the CPI.

Five-year mortgage interest rate: CANSIM series V733833.

Stock price data : Annual series built from CANSIM series V122620 giving the closure composite index of the Toronto Stock Exchange.