BANK OF CANADA
BANQUE DU CANADA

Discussion Paper/Document d'analyse
2012-9

How Important Are Liquidity Constraints for Canadian Households? Evidence from Micro-Data

by Umar Faruqui and Samah Torchani

www.bank-banque-canada.ca

Bank of Canada Discussion Paper 2012-9

December 2012

How Important Are Liquidity Constraints for Canadian Households? Evidence from Micro-Data

by

Umar Faruqui[1] and Samah Torchani[2]

[1]Financial Stability Department
[2]Canadian Economic Analysis Department
Bank of Canada
Ottawa, Ontario, Canada K1A 0G9
ufaruqui@bankofcanada.ca
storchani@bankofcanada.ca

ISSN 1914-0568

Acknowledgements

We thank Danny Leung, Jeannine Bailliu, Ben Tomlin, Allan Crawford, Yasuo Terajima, Greg Bauer and Alexander Ueberfeldt for their comments and suggestions. All remaining errors and omissions are our own.

Abstract

Using a unique micro-dataset containing real and financial information on Canadian households for 2000–07, the authors address two questions: (1) What is the proportion of households whose consumption displays excess sensitivity to income, and who are likely liquidity constrained? (2) Do house prices affect the ability of Canadian households to smooth their consumption? The authors find that, on average (over the 2000–07 period), about 23 per cent of households in Canada were constrained. Their results suggest that young households with fewer liquid assets, higher education and lower home equity, as well as those that are unmarried, are more likely to be liquidity constrained than other households. The authors' results also suggest that larger housing equity tends to facilitate consumption smoothing for households in Canada. This provides empirical evidence of a collateral channel linking house prices and consumption.

JEL classification: C35, D12, D30
Bank classification: Economic models; Sectoral balance sheet

Résumé

À l'aide d'une base de microdonnées contenant des informations aussi bien réelles que financières sur les ménages canadiens pour la période 2000-2007, les auteurs tentent de déterminer : 1) la proportion des ménages dont la consommation affiche une sensibilité excessive aux variations de leur revenu et qui sont probablement soumis à une contrainte de liquidité; 2) l'importance de l'impact du prix des maisons sur leur capacité à lisser leur consommation dans le temps. Les auteurs constatent qu'en moyenne, sur la période étudiée, environ 23 % des ménages canadiens sont assujettis à une contrainte de liquidité. D'après leurs résultats, les jeunes ménages plus scolarisés et possédant moins d'actifs liquides et un actif immobilier net moins important, tout comme les personnes non mariées, sont plus susceptibles d'être soumis à une contrainte de liquidité. La détention d'un actif immobilier net plus important tendrait aussi à faciliter le lissage de la consommation des ménages au Canada. Ces observations empiriques donnent à penser qu'il existe un « canal des garanties immobilières » liant le prix des maisons et la consommation.

Classification JEL : C35, D12, D30
Classification de la Banque : Modèles économiques; Bilan sectoriel

1. Introduction

Given the importance of household spending for aggregate real activity in Canada, understanding consumption behavior is quite important for the conduct of monetary policy. Conventional thinking about how households form their consumption plans is based on the life-cycle/permanent income hypothesis, whereby consumers are assumed to smooth spending over their lifetime.[1] One objective of this paper is to estimate the proportion of Canadian consumers who do *not* engage in consumption smoothing.[2] This is important for understanding how households might adjust their spending in reaction to shocks that affect their income.

Another objective is to determine the role of housing in consumption smoothing for Canadian households. One way in which housing can affect consumption is through the amount of available collateral.[3] This so-called "collateral channel" operates as follows: an increase in housing wealth increases available collateral that households can use to secure loans, allowing them to obtain credit on more favourable terms and to smooth their consumption. The housing collateral channel thus has a different impact on households that are liquidity constrained than on those that are not constrained. Our study examines the effect that housing equity has on the likelihood of excess sensitivity of consumption to income through changing the degree to which liquidity constraints are binding. This is relevant since, in recent years, Canada has experienced a rapid increase in both home lines of credit and traditional home equity loans, augmenting the availability of credit.

An important prerequisite for any empirical analysis of the collateral channel is a framework for identifying liquidity constraints in the data. The micro literature on liquidity constraints generally uses a priori information about individuals to divide them into groups of constrained and unconstrained households (e.g., Zeldes 1989; Runkle 1991; Japelli 1990).[4] For empirical analysis, this literature assumes that the Euler equation implied by the permanent income hypothesis is likely to hold for constrained households, but not for unconstrained households. However, misclassification of

[1] The life-cycle/permanent income hypothesis stipulates that consumers make their decisions based on their longer-term income expectations, rather than on their current income. As a result, fluctuations in income that are perceived to be temporary have little effect on their current consumption spending.
[2] These households may be liquidity constrained or saving for other precautionary reasons.
[3] Housing is thought to affect consumption through three channels: (i) the wealth effect (Campbell and Cocco 2007; Bostic, Gabriel and Painter 2008); (ii) common factors (King 1990; Attanasio et al. 2005); and (iii) the collateral effect (Aoki, Proudman and Vlieghe 2001; Iacoviello 2005; Disney and Gathergood 2009).
[4] Zeldes (1989) and Runkle (1991) use the amount of liquid assets and home-ownership status as proxies for whether individuals are likely to be liquidity constrained. Japelli (1990) split their sample into constrained and unconstrained consumers based on a direct question of whether households had been rejected or discouraged from applying for credit.

households can be significant when simple single-factor criteria are used. Such misclassification would tend to bias estimation results and reduce the power of the tests of the permanent income hypothesis.

Work by Benito and Mumtaz (2006) using data from the British Household Panel Survey marks an important improvement in that it moves away from an arbitrary classification of households as liquidity constrained or unconstrained. Instead, the authors estimate the share of constrained households using a switching regression framework (with ex-ante unknown regimes), which allows for the ex-post identification of constrained and unconstrained households. We follow the approach used by Benito and Mumtaz (2006) to estimate the proportion of Canadian households that are liquidity constrained. Our analysis is based on a micro-dataset for Canadian households, which includes real and financial information for the 2000–07 period.[5] The main contributions of our study to the existing literature are that it provides an estimate of the share of constrained households in Canada and empirical evidence on the importance of the collateral channel for Canada based on micro-data analysis. Our regression results suggest that young households with fewer liquid assets, higher education and lower home equity, as well as those that are unmarried, are more likely to be constrained than other households. We also find that, on average, over the 2000–07 period, about 23 per cent of households in Canada were liquidity constrained. Finally, our results also suggest that larger housing equity tends to facilitate consumption smoothing for households in Canada. To our knowledge, these results represent the first quantification of the importance of liquidity constraints for households in Canada based on micro-data analysis.

A number of insights can be drawn from our results. First, a relaxation in liquidity constraints for households over the 2000–07 period likely played a non-trivial role in the strong observed credit growth over this period. Second, the relaxation of liquidity constraints, combined with the rise in popularity of variable-rate home equity lines of credit, may have increased the sensitivity of households' spending to monetary policy decisions.

The remainder of this paper is organized as follows. The next section provides a selected review of the existing literature on the housing collateral channel. Section 3 describes the data used in our analysis. Section 4 outlines the methodology, and section 5 describes the results. Section 6 concludes with a summary of the main findings.

[5] The dataset is constructed by merging data from two Canadian household surveys: the *Canadian Financial Monitor* survey and the Survey of Household Spending (Faruqui 2010).

2. Literature Review

The links between house prices, credit and consumer spending have been widely discussed in the literature; a comprehensive review of these studies is beyond the scope of our paper. Instead, we review selected empirical studies that examine the collateral channel linking house prices to consumer expenditures using micro-data.

According to the collateral channel, an increase in housing prices increases the collateral value against which households can secure their loans, allowing them to obtain credit on more favourable terms, which can facilitate consumption smoothing. This channel affects two types of households. The first are homeowners who are liquidity constrained; i.e., they are not able to borrow their desired loan quantity given their current collateral. A rise in house prices would relax liquidity constraints for these households, allowing them to approach their desired level of borrowing and spending. The second group of affected households are homeowners who are not currently liquidity constrained but for whom an increase in their house price relaxes their budget constraints. For these households, an increase in house prices can lower the cost of existing debt if they decide to restructure, thereby impacting their consumption decisions. The collateral channel effects are likely more pronounced for households that are liquidity constrained than for households that are unconstrained. For this reason, the identification of constrained and unconstrained households in the data plays an important role in the empirical analyses of the collateral channel.

Most studies use a priori assumptions to identify liquidity constrained and unconstrained households.[6] Campbell and Cocco (2007) use U.K. household-level micro-data for 1988–2000 to study the impact of house-price movements on the consumption growth of different groups of households. The authors estimate a large positive effect of house prices on consumption for older homeowners, and an effect that is close to zero for young households who are renters. Their finding is consistent with wealth effects, and provides limited evidence supporting the existence of the collateral channel for U.K. households. Disney and Gathergood (2009) use panel micro-data for the United States and the United Kingdom to study the impact of house-price changes on constrained and unconstrained households. The results show that constrained households increase their indebtedness more than unconstrained households, in response to changes in house prices. This is interpreted by the authors as indicative of the existence of a collateral channel. Bostic,

[6] In the literature, the distinction between "credit" and "liquidity" constraints is often fuzzy. In this paper we consider the term liquidity constraints to be a subset of credit constraints (as in Zeldes 1989).

Gabriel and Painter (2008) merge the U.S. Survey of Consumer Finance data with the Consumer Expenditure Survey to study the collateral and wealth effects among U.S. households. They find that consumption propensities are markedly different for constrained and unconstrained households. In addition, Bostic, Gabriel and Painter find evidence that collateral constraints are symmetric: a decline in house prices has a large negative effect on households' consumption, comparable in magnitude to how an increase in house prices boosts consumption.

Work by Benito and Mumtaz (2006) marks an important improvement in identifying constrained and unconstrained households. Using data from the British Household Panel Survey (BHPS) for the years 1992–2002, Benito and Mumtaz (2006) jointly estimate the likelihood function for a household being constrained vs. unconstrained and the household Euler equations. The innovation in this approach is that it moves away from an arbitrary classification of households into constrained and unconstrained groups. In addition, the results are easier to interpret, since they are derived from traditional Euler equations rather than from reduced-form estimations. Benito and Mumtaz find that about 40 per cent of U.K. households display excess sensitivity of consumption to income (i.e., are liquidity constrained). Households without liquid assets, with negative home equity, young, unmarried, non-white and with higher education are more likely to be identified as constrained. The authors also find that changes in house prices tend to primarily affect the consumption behaviour of constrained households, indicating the presence of a significant collateral channel linking house prices to household spending. We follow the methodology used by Benito and Mumtaz (2006) in our work to examine the importance of the collateral channel for Canadian households.

3. The Data

This study uses a combined real-financial household micro-dataset for Canada. It is constructed by merging information from two Canadian household surveys: the *Canadian Financial Monitor* (CFM) survey and the Survey of Household Spending (SHS).[7] The dataset spans the 2000–07 period and comprises roughly 11,000 records (households) per year.

The CFM survey is conducted by Ipsos Reid Canada and collects detailed household balance-sheet information.[8] The survey has a sample size of approximately 12,000 households per year; the survey information is collected via a mail-in questionnaire. The SHS survey is a cross-sectional survey conducted by Statistics Canada, and provides

[7] For more details regarding the merging methodology, see Faruqui (2010).
[8] See Ipsos Reid Canada's website for more information, at http://www.ipsos.ca/pdf/ipsos_canFinMon.pdf.

information on household spending and dwelling characteristics.[9] The effective sample size (i.e., the number of respondents to the survey) of the SHS varies each year, ranging from 14,000 to 17,000 households. The survey data are collected via personal interviews.

The combined real-financial dataset contains detailed information on the debt and asset holdings of households, as well as on their consumption behaviour. In addition, each record contains information on demographic characteristics pertaining to the household.

3.1 Constructing the pseudo panel dataset

Our dataset is primarily cross-sectional in nature, which presents some challenges when using these data for econometric analysis. Notably, temporal changes in variables cannot be calculated, since specific households are not tracked over the sample period, as in a panel dataset.

Panel data on household spending and balance sheets are rare. Among the few that exist are the British Household Panel Survey[10] and the U.S. Consumer Expenditure Survey.[11] For Canada, there are no panel data that cover both the financial and spending behaviour of households. Given this constraint, we use a statistical technique pioneered by Deaton (1985) to create a synthetic panel (or pseudo panel) dataset from our cross-sectional combined real-financial dataset. Deaton's approach consists of grouping individuals into cohorts using key socio-demographic characteristics and treating the averages within those cohorts as observations in a panel.

To construct the pseudo panel dataset, we group households along six key socio-demographic dimensions: housing tenure, household size, household income, age of household head, province of residence and marital status (see Appendix A for details). Those cohorts are also used to merge CFM and SHS data, since they represent the common set of household demographic variables. We opted not to reduce the number of characteristics for constructing our pseudo panel, to ensure large cross-sectional heterogeneity.[12]

[9] More information about the SHS dataset, including a discussion of imputation, estimation and the survey's design, is available on Statistics Canada's website at http://www.statcan.gc.ca.
[10] The British Household Panel Survey, which started in 1991, tracks the assets, liabilities and spending patterns of approximately 5,500 households in Britain.
[11] The Consumer Expenditures Survey is a U.S. (nationwide) household survey that records both a wide variety of household expenditures and the households' balance sheets. Although it contains some information on household liabilities, its main purpose lies in revising the consumer price index market basket of goods and services and their relative importance.
[12] By reducing the number of characteristics, our observations would drop substantially.

Once households sharing common characteristics are grouped into cohorts, weighted averages are calculated within these cohorts for the various balance-sheet and consumption variables. Consider the case of low-income, young, single households, who are renters and live in Ontario. This group of households is treated as one observation and the values of the variables for that observation are calculated using a weighted average for all households with the identified characteristics; the behaviour of this group is then tracked over the sample period. Given the sampling variations in the underlying micro-data, the resulting pseudo panel dataset is not balanced (i.e., some groups are in the panel in one year but not in subsequent years). To contain the complexity of the empirical estimation, we choose to work with a balanced pseudo panel dataset, dropping all panel groups that do not have an observation for all years of the sample. Our final balanced pseudo panel has 533 observations (groups) per year. This results in a total of 4,700 observations for the full sample period. Our pseudo panel (Table 1) reports the number of records by year in the original, the unbalanced and the balanced pseudo panel datasets.

Table 1: Total observations in dataset by year

	Original dataset	Pseudo panel	Balanced panel
1999	11644	1377	535
2000	10700	1300	535
2001	11174	1311	535
2002	11213	1297	535
2003	11437	1269	535
2004	11957	1272	535
2005	10903	1213	535
2006	10834	1248	535
2007	10586	1147	535

While balanced pseudo panels have been used by a number of studies for econometric analysis (for example, Attanasio et al. 2005), there are some drawbacks associated with this approach. The main disadvantages are a loss of some of the heterogeneity at the household level and a reduction in the effective sample size available for econometric analysis (Table 1). Even so, an important check of the data is to verify that the adjustments did not change the overall demographic properties of the merged dataset. Table 2 shows that summary statistics for the main variables are broadly maintained in moving from the original dataset to the balanced panel.[13]

[13] Appendix B provides additional comparisons of the original and balanced panel datasets.

Table 2: Summary statistics

	Mean		St. dev.	
	Original dataset	**Balanced panel**	**Original dataset**	**Balanced panel**
Non-durable consumption (level, $)	$8,870	$8,362	$17,360	$13,116
Income (gross, $)	$59,436	$51,182	$37,731	$29,459
Liquid assets-to-income ratio	0.49	0.56	1.27	0.85
Housing equity-to-income ratio	2.60	2.68	2.60	2.57
Age of the household head	48.35	49.81	15.79	15.23

Notes: All statistics account for sampling weights. Sample period is 1999–2007. All figures are based on nominal values of the variables.

4. Methodology

The traditional view of household spending behaviour is embodied in the life-cycle/permanent income hypothesis (LC-PIH) framework. This framework suggests that household spending decisions are based on expected total lifetime income over the planning horizon, rather than on current income. The LC-PIH asserts that if households perceive an increase in income or wealth to be temporary, they may not increase consumption as much as if they perceive the gain to be permanent. However, it is possible that household spending could be more sensitive to current income than posited by the LC-PIH framework. One explanation for this "excessive" movement in household spending is the presence of liquidity constraints impeding consumption smoothing. There are, however, other possible reasons why consumption may display excess sensitivity to income. In particular, precautionary savings by households may lead their current consumption away from its desired optimal path. Carroll (2004) argues that, in the presence of income uncertainty, it is extremely difficult to distinguish households that are liquidity constrained from those saving for precautionary reasons. In fact, liquidity constraints increase the precautionary saving motive around levels of wealth where the constraint becomes binding; that is, households who are not currently liquidity constrained may engage in precautionary saving if they believe there is some risk that constraints may bind in the future. Our analysis assumes that the primary reason for excess sensitivity of consumption to income is the presence of liquidity constraints.

In our paper, we seek to partition households into two groups: the unconstrained group, whose actions are in line with the permanent income theory, and the constrained group, who display excess sensitivity to current revenue changes. For the empirical analysis we

specify three equations, consisting of two Euler equations related to constrained and unconstrained groups and a selection equation that includes the set of instruments that help to identify the two groups of households.

Following Benito and Mumtaz (2006), we use a switching endogenous regressions estimator for unknown regimes, estimated by maximum likelihood.[14] This approach is based on a standard consumption Euler equation for both liquidity unconstrained (Group A) and constrained households (Group B):

$$\Delta \ln c_{i,t+1} = a_c + \alpha_a \Delta \ln y_{i,t} + Z'_{i,t+1}\gamma + \sigma_t + v_{i,t+1} \text{ if } \emptyset\left(X'_{i,t+1}\,\delta + \epsilon_{i,t+1} > 0\right) \quad \text{Group A,} \qquad (1)$$

$$\Delta \ln c_{i,t+1} = a_{uc} + \alpha_b \Delta \ln y_{i,t} + Z'_{i,t+1}\rho + \sigma_t + \varepsilon_{i,t+1} \text{ if } \emptyset\left(X'_{i,t+1}\,\delta + \epsilon_{i,t+1} \leq 0\right) \quad \text{Group B,} \qquad (2)$$

where the subscript i denotes the cohorts from the pseudo panel, t indicates the time period (i.e., 2000–07), c is household consumption, y is income, Z is a set of control variables, and σ_t are sets of time effects and common factors across households in the two different groups. Explanatory variables in our estimation include educational attainment, marital status, liquid assets and housing equity. Liquid assets are defined as all funds in chequing and savings accounts plus any government bonds. Housing equity is calculated as the value of housing assets (self reported) from which we subtract the mortgage outstanding. The time effect is implemented as year dummies in our regressions. This would pick up, among other things, the impact from the general level of interest rates on consumption. The dependent variable in the estimation is the change in the log of household non-durable expenditures.[15] We use non-durable consumption instead of durable or total consumption for two reasons. First, the LC-PIH assumes that the utility function is time-separable, and durable-goods consumption tends to violate this property. Second, durable consumption is lumpy and it is difficult to extract the flows of services underlying the purchase of the durable goods.

As noted in section 2, the main advantage of using a switching endogenous regression model (summarized in equation (4)) is that it circumvents having to subjectively identify households as being constrained or unconstrained and acknowledges that there is uncertainty in the classification system. The framework also allows us to make a number of inferences about household behaviour. First, we can gauge the sensitivity of household consumption to income. Second, we can make statements about what factors determine

[14] The idea of using switching regressions to split the sample is not new; the econometrics of it can be found in Maddala (1983). Endogenous switching models have been used by Hu and Schiantarelli (1994), among others, to assess the importance of liquidity constraints.

[15] Total non-durable consumption is calculated in our data as the sum of the expenditure on food, tobacco products and alcoholic beverages, transportation, clothing, health care, education, recreation, and other non-durable expenditures (see Appendix C for details).

the propensity of a household to be liquidity constrained. Finally, we can estimate the proportion of households that are constrained. The split between constrained and unconstrained households is determined according to a probabilistic (*Probit*) model that allocates a household to one group or the other, according to the following relationship:

$$\Pr\left(X'_{i,t+1}\delta + \epsilon_{i,t+1} > 0\right) = \emptyset\left(X'_{i,t+1}\delta\right), \tag{3}$$

where $\emptyset$ is the normal cumulative density function, and X is a vector of household characteristics that help classify households as constrained or unconstrained. Equations (1)–(3) are estimated jointly by maximizing the log-likelihood as described in Maddala (1983). An important goal of our paper is to explore the collateral effect between house prices and consumption spending in Canada; we investigate this effect by adding a housing equity variable in the probability equation (equation (3)). Ex ante we expect that a rise in house prices, and therefore in home equity, would improve the terms on which credit can be obtained, facilitating consumption smoothing.[16]

$$\begin{aligned}\text{Log(L)} = \sum_{\text{NT}} \ln \Bigg\lfloor \frac{1}{\sigma_{v_{i,t+1}}}\left(\frac{v_{i,t+1}\left|X'_{i,t+1}\delta + \epsilon_{i,t+1} > 0\right.}{\sigma_{v_{i,t+1}}}\right)\emptyset\left(X'_{i,t+1}\delta + \epsilon_{i,t+1} > 0\right)\Bigg\rfloor \\ + \Bigg\lfloor \frac{1}{\sigma_{v_{i,t+1}}}\left(\frac{\varepsilon_{i,t+1}\left|X'_{i,t+1} + \epsilon_{i,t+1} \le 0\right.}{\sigma_{\varepsilon_{i,t+1}}}\right)\emptyset\left(X'_{i,t+1}\delta + \epsilon_{i,t+1} \le 0\right)\Bigg\rfloor,\end{aligned} \tag{4}$$

where $\sigma = var(z)$.

The estimation is done in Stata (v. 9.2) using the Broyden–Fletcher–Goldfarb–Shanno (BFGS) algorithm for maximum likelihood estimation on annual data over the 2000–07 period.[17] The proportion of constrained households in the population can be computed from our estimation results using two approaches. Under the first approach, a household is classified as liquidity constrained if the predicted probability of being constrained is higher than a pre-specified threshold. The proportion of constrained households in the population is then the sum of all households identified as collateral constrained divided by the population of households. A second approach calculates the proportion of the constrained households as the mean of the predicted probabilities of being collateral constrained over all households in the sample.

[16] See Benito and Mumtaz (2006) for more details on the characteristics of maximum likelihood estimations.

[17] We use the BFGS algorithm combined with the likelihood function (LF) method. Using the LF method circumvents the need to code in the first and second derivatives of the likelihood function.

Given the use of pseudo panels in our estimation, the second approach is arguably more appropriate in our case. Each observation in the pseudo panel represents a group of households that share some common characteristics. The estimated probability of being liquidity constrained for each pseudo panel observation can be viewed as the mean for the group of households represented by that observation. Using a threshold approach to calculate the proportion of constrained households may provide a misleading estimate because it implicitly assumes that all households represented by a given pseudo panel observation have the same probability of being constrained. For this reason, our analysis uses the mean of predicted probabilities (second approach) to estimate the proportion of constrained households.

5. Results

In this section, we outline the key results from our regressions, compare our findings with other studies and use our results to offer an explanation for credit growth in Canada over the mid-2000s.

5.1 Key estimation results

Table 3 reports the joint estimation results for the Euler equations pertaining to the two regimes (equations (1) and (2)) and the selection equation (equation (3)).

First, our estimation partitions households into two distinct groups, without any a priori hypothesis being imposed on the estimation. We find that only one group of households fails to smooth its consumption, and the coefficient on lagged income growth for this group of households is negative and statistically significant (Group B in Table 3). These results are consistent with the rejection of the LC-PIH that states that if the borrowing constraints exist, then the lagged income difference should enter significantly (with a negative sign) for constrained households. The negative coefficient on lagged income growth for the constrained group is consistent with earlier findings (e.g., Hall and Mishkin 1982). For individuals facing a binding liquidity constraint, if disposable income increases at time t (ceteris paribus), then the constraint will be relaxed. Thus, current consumption will rise, but as income normalizes in time $t+1$, consumption in the future will decrease relative to its currently elevated level.[18] The consumption growth of the other group does not respond to movements in their past income growth, and in the estimation results the coefficient on income growth is not significant (Group A in Table

[18] For a more detailed description of the test of the LC-PIH, see Zeldes (1989).

3). The former group, therefore, contains the liquidity constrained households, while the latter group comprises the unconstrained households.

Second, our analysis identifies a number of socio-economic factors that influence the propensity of a household to be liquidity constrained. In general, the probability that a household is constrained (i.e., households for whom consumption displays excess sensitivity to income) is greater for households with less liquid assets, higher education and less home equity, as well as for those who are single. We report in the bottom panel the marginal effects, providing the effects on the probability of being unconstrained for a unit change in the explanatory variable (or a discrete change for the dummy variables). Our key results are as follows:

- As one might expect, we find that the level of liquid asset holdings is proportionally related to the likelihood that a household would be liquidity unconstrained; i.e., households with more liquid assets tend to have a higher probability of being unconstrained, and vice versa (Table 3). Our result suggests that having liquid assets increases the probability of being unconstrained by 3 per cent.

- The estimations show a negative coefficient on educational attainment, implying that higher levels of education are associated with a lower likelihood of being unconstrained. This may reflect a stronger desire by younger educated households to borrow against their higher expected future income. A complementary explanation could be that young educated households are limited by their capacity to take on additional debt, since they are already highly leveraged (e.g., student loans).

- Single and divorced households are more likely to be constrained than married households. This finding is not surprising, since married households are more likely to have a dual income and thus less likely to be credit constrained than other households. Married households are 22 per cent less likely to be unconstrained.

Table 3: Endogenous switching regression model

	Specification 1	Specification 2
	Group A households	
Consumption growth (t)	*(Unconstrained)*	
Lagged income growth $(t-1)$	-0.12 (0.35)	-0.13 (0.36)
Year effects	-0.03 (0.01)**	-0.03 (0.01)*
Constant	0.07 (0.02)**	0.06 (0.02)
Household controls (*ln(age(t)))*	-----	yes
	Group B households	
Consumption growth (t)	*(Constrained)*	
Lagged income growth $(t-1)$	-1.20 (0.36)***	-1.18 (0.37)***
Year effect	-0.08 (0.06)	-0.08 (0.06)
Constant	0.13 (0.14)	0.13 (0.15)
Household controls *(ln(age (t)))*	------	yes
Marginal effects	*Probability of being unconstrained*	
Liquid assets	0.03 (0.12)***	0.03 (0.01)***
Education	-0.11 (0.05)**	-0.11 (0.05)**
Housing tenure (owner-renter)	-0.14 (0.07)**	-0.21 (0.09)***
Marital status (married-unmarried)	-0.22 (0.04)***	-0.22 (0.04)***
Age	0.06 (0.03)*	------
Age tenure	-----	0.01 (0.01)*
Constant	1.58 (0.25)***	1.60 (0.00)***
Proportion of constrained households (in %)	22	23
Observations	3730	3730

Notes: The dependent variable is the log change in non-durable consumption in all specifications at time *t*. The time period for estimation is 2000–07. Figures in parentheses are standard errors. The symbols *, **, and *** represent significance levels of 10 per cent, 5 per cent and 1 per cent, respectively. The bottom panel reports the marginal effects at the means of each variable on the probability of falling into Group A (or a discrete change for the dummy variable).

Table 4: Endogenous switching regression model with housing

	Coefficient (p-value)
	Group A households
Consumption growth (t)	*(Unconstrained)*
Lagged income growth $(t-1)$	-0.05 (0.37)
Year effects	-0.28 (0.01)**
Constant	0.06 (0.02)**
Household controls	-----
	Group B households
Consumption growth (t)	*(Constrained)*
Lagged income growth $(t-1)$	-1.20 (0.34)***
Year effect	-0.08 (0.06)
Constant	0.16 (0.13)
Household controls	------
Marginal effects	
	Probability of being unconstrained
he1 (house equity/rev≤ 0)	0.02 (0.12)
he2 (he2=0)	-----
he3 (0<house equity/rev≤ 0.5)	-0.01 (0.06)
he4 (0.5<house equity/rev≤ 1)	0.08 (0.04)*
he5 (1<house equity/rev≤ 2)	0.16 (0.05)***
he6 (2<house equity/rev≤ 5)	0.08 (0.04)**
constant	1.58 (0.00)***
Probability weighted (% of constrained consumers)	23
Observations	3730

Notes: The dependent variable is the log change in non-durable consumption in all specifications. In addition to the variables shown, the probability equation includes liquid assets, age, marital status, educational attainment and housing tenure dummies. The time period for estimation is 2000–07. Figures in parentheses are standard errors. The symbols *, **, and *** represent significance levels of 10 per cent, 5 per cent and 1 per cent, respectively. The bottom panel reports the marginal effects at the means of each variable on the probability of falling into Group A (or a discrete change for the dummy variable).

- To capture the impact of housing prices on consumption, we include the ratio of housing equity to income in the probability equation. Estimation results suggest that having larger amounts of housing equity raises the probability of being unconstrained (Table 4). The term for negative equity-to-income ratio (house equity/rev≤ 0) is not significant. However, having a positive equity-to-income ratio between one and five increases the probability of being unconstrained by 16 per cent compared to having zero equity (Table 4). This finding is in line with the collateral effect hypothesis, which asserts that house prices influence consumption via the relaxation of household borrowing constraints. If house prices (and thus housing equity) increase, this raises the value of housing collateral and makes borrowing cheaper. Households with larger amounts of home equity would likely be more able to smooth consumption according to the permanent income hypothesis.[19]

Third, we find that, on average, over the 2000–07 period, about 23 per cent of households in Canada can be classified as liquidity constrained. This is based on the weighted mean predicted probability of being constrained for households in our sample (see section 4).

Finally, we find that the estimated share of constrained households in Canada has declined from 24 per cent in 2000 to 22 per cent in 2007. This period was characterized by significant increases in house prices, deregulation of the housing market and the increased use of home equity withdrawal in Canada. Given this context, the decrease in the share of constrained households is consistent with ex-ante expectations.

5.2 Comparison with other empirical studies

In this section, we compare our findings with those of Benito and Mumtaz (2006) and a set of other studies that provide estimates of the proportion of liquidity constrained households.

The results from our empirical analysis are broadly consistent with the main findings of Benito and Mumtaz (2006). Both studies are able to successfully partition households into two distinct groups that are either liquidity constrained or unconstrained without imposing any ex-ante classification of households into two different groups. In addition, the signs on the key demographic variables that are common between our studies are similar.

[19] Estimation results are robust to the inclusion of an age and home ownership interaction variable in equation (3) (Table 3, column 2).

Table 5: Estimated share of constrained households

(Selected studies, sorted by country)

	Country	Type of data used	Sample period	Share of constrained households (%)
Benito and Mumtaz (2006)	U.K.	Micro	1992–2002	40[1]
Grant (2007)	U.S.	Micro	1988–93	26–31
Garcia, Lusardi and Ng (1997)	U.S.	Micro	1980–87	16
Jappelli (1990)	U.S.	Micro	1983	19
Hall and Mishkin (1982)	U.S.	Aggregate	1969–75	20

[1]In their paper, Benito and Mumtaz also report the estimated share of constrained households based on the threshold approach (20 per cent).

However, the estimated share of households that are liquidity constrained varies across the two studies. Whereas our results suggest that roughly 23 per cent of Canadian households are liquidity constrained, Benito and Mumtaz (2006) find that about 40 per cent of British households are constrained (based on the mean of predicted probabilities). This discrepancy can reflect a number of factors, including the differences in the characteristics and behaviour of households between countries. Our results are, nonetheless, broadly comparable to the estimated share of credit constrained households found by some studies based on U.S. data (Table 5).

5.3 Explaining the growth in household credit in Canada over 2000–07

As in other developed countries, household credit in Canada expanded sharply in the early-to-mid 2000s. This period was also characterized by strong growth in house prices, which allowed Canadian homeowners to be better positioned to borrow against their rising home equity.[20] Indeed, the 2000–07 period saw a very rapid expansion in housing-backed borrowing by Canadians: borrowing via home equity lines of credit more than tripled between 2000 and 2007, and was an important driver of aggregate credit growth over this period.

Over the same period, our model suggests that liquidity constraints for households in Canada eased, since the share of constrained households declined from 24 per cent in 2000 to 22 per cent in 2007. This relaxation in liquidity constraints could be one of the potential explanations of the rapid growth in household credit. In particular, stronger house-price growth probably allowed homeowners to increase borrowing (most likely via

[20]By either easing credit terms on which credit could be taken or raising the amount of credit that they can access.

home equity lines of credit (HELOCs)) to smooth their consumption. Unconstrained households were probably also affected by the increase in house prices over this period. For these households, the terms of credit may have improved following an increase in their housing collateral, thus increasing their incentive to borrow more. Both of these effects likely played a non-trivial role in the rapid rise in household borrowing over the mid-2000s.

The relaxation of liquidity constraints may have also increased the sensitivity of households' behaviour to changes in the policy rate. The share of HELOCs in total household credit increased from 5 per cent in 2000 to about 14 per cent by 2007. A majority of HELOCs (about 75 per cent) tend to be at variable rates. The relaxation of liquidity constraints was likely one of the factors contributing to the rise in popularity of HELOCs. Taken together, these observations suggest that changes in the policy rate might have had a larger impact on households' budget constraints (and thus consumption decisions) in 2007 than at the start of the decade.[21]

6. Conclusions

Our study empirically examines two questions: (i) what is the proportion of households that are liquidity constrained in Canada, and (ii) what (if any) is the role of house prices in facilitating consumption smoothing?

Our main results are as follows. First, we find that over the 2000–07 period 23 per cent of households in Canada were likely collateral constrained. Our estimate is broadly consistent with results from a number of similar studies, but lower than that by Benito and Mumtaz (2006) for U.K. households. This difference may reflect a number of factors, including differences in the characteristics and behaviour of U.K. and Canadian households.

Second, our regression analysis suggests that households with fewer liquid assets, higher education, less home equity, unmarried, young and renters are more likely to be liquidity constrained than other households. These findings are broadly in line with those of Benito and Mumtaz (2006), who find similar traits for constrained households in the United Kingdom.

Third, we find empirical evidence of a collateral channel linking house prices and consumer spending. This is a noteworthy result, because previous studies for Canada

[21] In our regression, the interest rate's effect on consumption is captured by year dummies.

(e.g., Pichette and Tremblay 2003) have not been able to quantify the size of the collateral channel.

References

Aoki, K., J. Proudman and G. Vlieghe. 2001. "Why House Prices Matter." Bank of England *Quarterly Bulletin* (Winter): 460–68.

Attanasio, O., L. Blow, R. Hamilton and A. Leicester. 2005. "Consumption, House Prices and Expectations." Bank of England Working Paper No. 271.

Benito, A. and H. Mumtaz. 2006. "Consumption Excess Sensitivity, Liquidity Constraints and the Collateral Role of Housing." Bank of England Working Paper No. 306.

Bostic, R., S. Gabriel and G. Painter. 2008. "Housing Wealth, Financial Wealth, and Consumption: New Evidence from Micro Data." University of Southern California Working Paper.

Campbell, J. Y. and J. F. Cocco. 2007. "How Do House Prices Affect Consumption? Evidence from Micro Data." *Journal of Monetary Economics* 54 (3): 591–621.

Carroll, C. 2004. "Housing Wealth and Consumption Expenditure." Paper prepared for the Academic Consultants Meeting of the Board of Governors of the Federal Reserve System, January.

Deaton, A. 1985. "Panel Data from Time Series of Cross-Sections." *Journal of Econometrics* 30: 109–26.

Disney, R. and J. Gathergood. 2009. "House Price Volatility and Household Indebtedness in the United States and the United Kingdom." University of Nottingham Working Paper.

Faruqui, U. 2010. "Assembling a Real-Financial Micro-Dataset for Canadian Households." *Journal of Economic and Social Measurement* 35 (1–2): 63–84.

Garcia, R., A. Lusardi and S. Ng. 1997. "Excess Sensitivity and Asymmetries in Consumption: An Empirical Investigation." *Journal of Money, Credit, and Banking* 29 (2): 165–76.

Grant, C. 2007. "Estimating Credit Constraints among U.S. Households." *Oxford Economic Paper*s 59 (4): 583–605.

Hall, R. E. and F. S. Mishkin. 1982. "The Sensitivity of Consumption to Transitory Income: Estimates from Panel Data on Households." *Econometrica* 50 (2): 461–81.

Hu, X. and F. Schiantarelli. 1994. "Investment and Financing Constraints: A Switching Regression Approach Using U.S. Firm Panel Data." Boston College Working Papers in Economics No. 284.

Iacoviello, M. 2005. "House Prices, Borrowing Constraints, and Monetary Policy in the Business Cycle." *American Economic Review* 95 (3): 739–64.

Jappelli, T. 1990. "Who Is Credit Constrained in the US Economy?" *Quarterly Journal of Economics* 105 (1): 219–34.

King, M. 1990. "Discussion of 'Is the UK Balance of Payments Sustainable,' by J. Muellbauer and A. Murphy." *Economic Policy* 5 (11): 383–87.

Maddala, G. S. 1983. *Limited Dependent and Qualitative Variables in Econometrics.* Cambridge: Cambridge University Press.

Pichette, L. and D. Tremblay. 2003. "Are Wealth Effects Important for Canada?" Bank of Canada Working Paper No. 2003-30.

Runkle, D. E. 1991. "Liquidity Constraints and the Permanent Income Hypothesis: Evidence from Panel Data." *Journal of Monetary Economics* 27 (1): 73–98.

Zeldes, S. P. 1989. "Consumption and Liquidity Constraints: An Empirical Investigation." *Journal of Political Economy* 97 (2): 305–46.

Appendix A: Common Groupings for Key Demographic Variables

Demographic variable	New common grouping
Housing tenure	1==own 2==rent 0==not specified / mixed tenure
Total household income	1==under $15000 2==15000-19999 3==20000-24999 4==25000-29999 5==30000-34999 6==35000-44999 7==45000-54999 8==55000-59999 9==60000-69999 0==70000+
Household size	1==1 person 2==2 people 3==3 people 4==4 people 5==5 people 6== 6+ people
Age (of household head)	1== less than 35 2==35-50 3==50-64 4==65+
Area of residence	1==BC, AB, SK, MB 2==ON, QC 3==NB, PE, NS, NL
Marital status	1==married or common law 2==never married 3==other (widowed/ divorced/ separated)

Appendix B: Comparison of Selected Demographic Characteristics —Original Dataset and Balanced Panel

Chart B-1

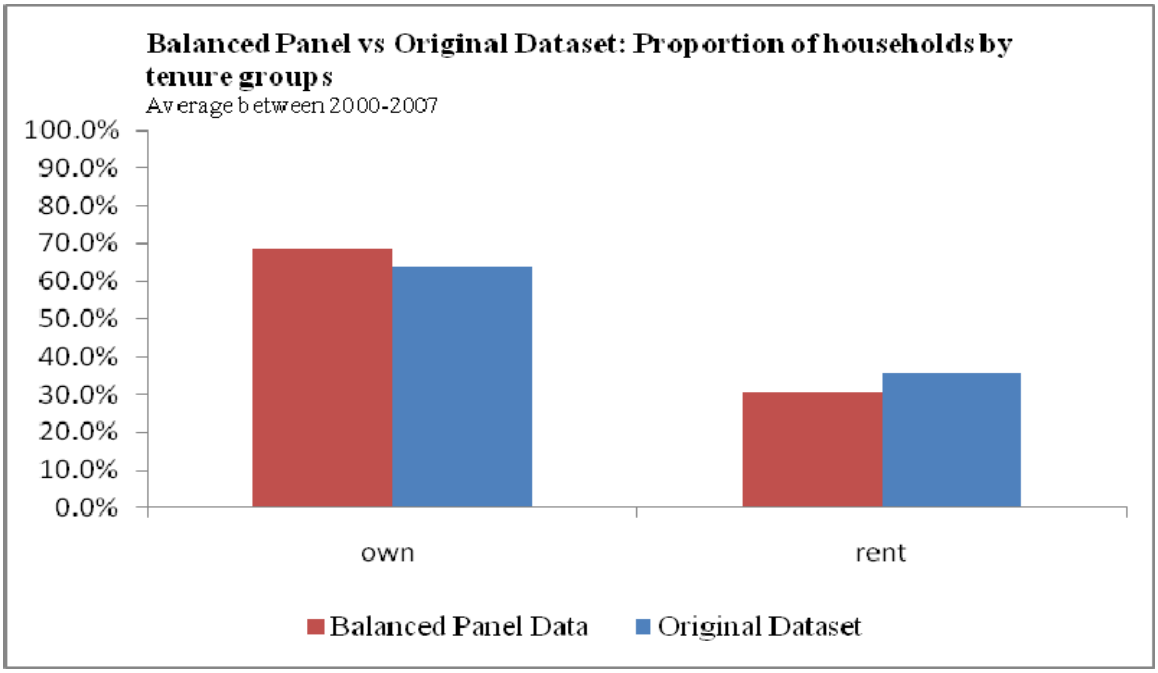
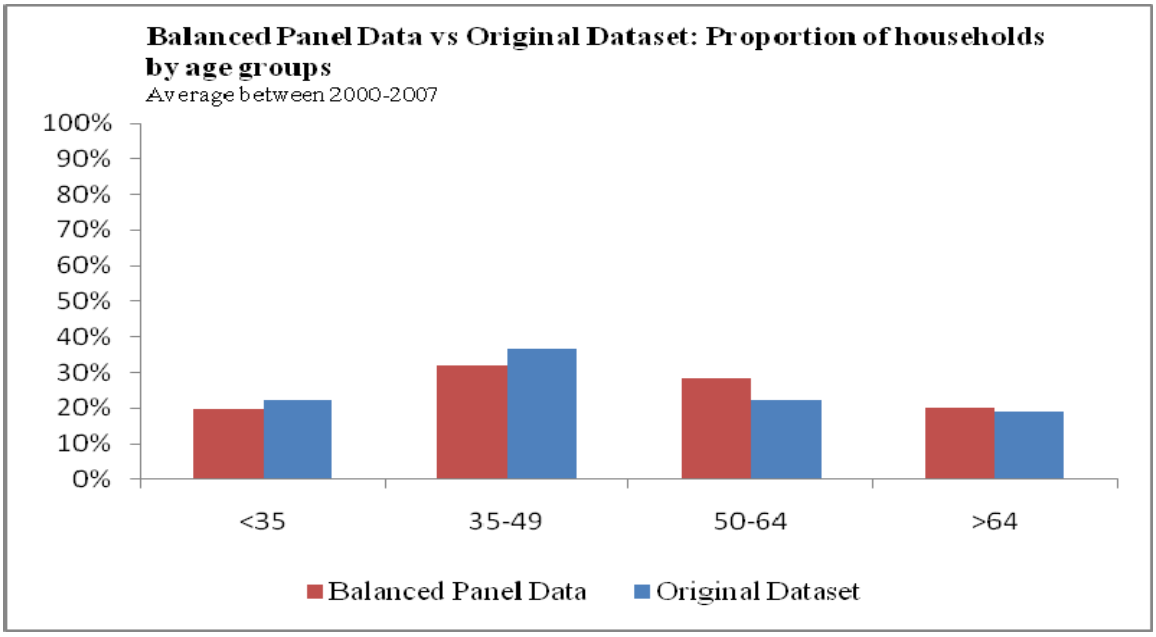


Chart B-2



Appendix C: SHS (Donor Dataset) Variables used to Build Consumption Variables

Variables	Definitions
Non-durables	
F002	Food purchased from stores
H022	Household cleaning supplies
H023	Paper, plastic and foil household supplies
H026	Garden supplies and services
L103	Health care supplies
L104	Medicinal and pharmaceutical products
L108	Eye-care goods and services
L202	Personal care supplies and equipment
N101	Tobacco