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House prices, consumption and the role of non-Mortgage debt☆

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ABSTRACT

This paper evaluates the strength of the relationship between house prices and consumption, through the use of debt. Whereas the existing literature has largely studied the effects of house prices on homeowner total or mortgage debt, we focus on the non-mortgage component of household borrowing, using Canadian household-level data for 1999–2007. We rely on variation in regional house prices, homeownership status and age to establish the relationship between house prices and non-mortgage debt. Then, using direct information on debt uses, we determine that house price growth was associated with a non-trivial fraction of concurrent aggregate non-housing consumption growth.

1. Introduction

In the last two decades, many developed countries experienced prolonged increases in house prices and household debt. At the same time, aggregate real and financial flows also expanded, including consumption, new housing construction, home renovation, and net acquisition of financial assets. While the levels of real debt and house prices have continued to rise largely uninterrupted after the crisis in a small number of countries, the concurrent increases experienced in other countries have been reversed, accompanied by a host of negative influences on their economies. Because of this, we now have more information about the role of the financial sector in overall economic stability—nevertheless, the furthering of our understanding of the links between real and financial variables remains an important issue.

Within this context, the goal of this paper is to examine the relationship between house prices, household debt and consumption. The last few years have seen a growing number of studies that have looked into different parts of the interrelationship between housing markets, debt and consumption. Some have explored the connection between house prices and debt (Dynan and Kohn (2007); and Disney and Gathergood (2011)) and linked it to consumption using indirect inference about the uses of debt (Mian and Sufi (2011); Mian et al. (2013)), while some have studied the relationship between house price and consumption directly (Campbell and Cocco (2007); Attanasio et al. (2009); and Bostic et al. (2009)). Other papers have looked at how policy reforms that influence the ability of households to access home equity affect household debt and expenditures (Leth-Peterson (2010); and Agarwal and Qian (2017)), as well as the role of interest rates in home equity extraction and other household real and financial decisions (Keys et al. (2014); Di Maggio et al. (2015); and Bhutta and Keys, 2016).[1]

Our paper is distinguishable from the existing literature in three important respects. First, we undertake an empirical analysis that focuses on the *non-mortgage* component of household debt (including both secured and unsecured debt), which has not been fully explored in the literature. Second, we make use of direct information on the many uses of debt to explore the connection between house prices, debt and consumption. Finally, we have economy-wide results that allow us to gage the aggregate effects of house price booms. While each of these aspects have been explored previously to some extent, it is the fact that we combine all three in one unifying framework that makes our study unique.

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[1] Other relevant papers that look at different parts of the housing market, debt and consumption relationship include: Cooper (2010), who links home equity extraction to consumption in an environment of rising house prices; Greenspan and Kennedy (2008), who link the home-secured component of debt to consumption, but do not formally assess the role of house prices in this relationship; and Besley et al. (2010), who relate household access to external financing to consumption. Di Maggio and Kermani (2014) consider the relationship in the reverse direction: the effect a credit expansion on house prices. There is also a vast literature using structural models to explore the factors behind the increases in household debt in the U.S. and other countries in the last few decades.

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We focus on non-mortgage household debt in an effort to establish a more straightforward relationship between house prices, debt and consumption. We say that this relationship is more straightforward because the connection between house prices and non-mortgage debt—which, in our study, includes all unsecured debt, as well as auto loans and home-secured debt instruments, such as home equity lines of credit—is less likely to be subject to reverse causality.[2] Moreover, the relationship between non-mortgage debt and consumption is more direct. That is, the uses of non-mortgage debt are usually clearer than those of home purchase mortgage debt (where the amount borrowed is determined endogenously and can be used to finance consumption as well).[3]

It is important to note, however, that King (1990), Pagano (1990) and Attanasio et al. (2009), among others, have pointed out that findings of a high correlation between house prices and consumption do not necessarily imply causality. There is a strong possibility that shocks to expected future incomes (resulting from productivity gains) lead to simultaneous changes in house prices and consumption (and in our case, non-mortgage debt, too). Similarly, while we establish a link from house prices to consumption through non-mortgage debt, we cannot claim that the link is causal. Therefore, our empirical results are best interpreted as a novel set of empirical associations that suggest the possibility of some causal link running from house prices to consumption, through non-mortgage debt.

Movements in house prices can be linked to non-mortgage related borrowing through several channels. In order to characterize this relationship and identify it in the data, it is important to make some key demarcations across households. First, house price shocks may lead to distinctly different borrowing behavior depending on homeownership status. While an increase in house prices is generally associated with a wealth effect for homeowners, the effect is absent for renters who do not hold the appreciating asset. Second, perceived wealth effects for homeowners may vary across districts given different beliefs relating to the persistence of house price shocks, and other factors. Finally, both the size and direction of the wealth effect for homeowners will depend on a number of homeowner characteristics, such as housing tenure, future housing needs and bequest motives. Moreover, higher house prices may also relax credit constraints for some households, enabling them to take on additional debt. These latter mechanisms will be closely related to the age of a homeowner, and we therefore rely on variation across homeowners and renters, homeowners across districts, and homeowners of different ages to establish the relationship between house prices and non-mortgage debt.

If all of the co-movement between house prices, non-mortgage debt and consumption is driven by some common cause (such as an upward revision to expected future incomes), we would expect to find a positive relationship between house prices and non-mortgage debt for all households. If, however, exogenous shocks to house prices result in wealth effects and relaxed credit constraints—that, in turn, lead to increases in borrowing and consumption—we would expect to find evidence of a stronger relationship between house prices and debt for homeowners than for renters, and possibly for older homeowners relative to younger ones.

To explore these mechanisms empirically, we exploit a unique, survey-based micro data set on Canadian households, that provides detailed information on balances outstanding on different debt instruments and, importantly, how this debt was used. Respondents to the survey are able to list multiple leases, loans, lines of credit, and mortgages, allowing us to distinguish between the mortgage and non-mortgage components of household debt.[4] The primary purposes of non-mortgage debt instruments in the data include: consumption, home improvement, acquisition of financial assets, and debt repayment. These data enable us to not only explore the relationship of house prices and debt, but also that of house prices and consumption directly through the use of debt.[5]

Using pre-recession data, we first estimate the relationship between house prices and household-level non-mortgage debt. As mentioned above, house price shocks may lead to different borrowing behavior depending on household type. Therefore, in our empirical work, we regress non-mortgage debt on house prices and use variation in homeownership status, regional home prices and age of household head to establish the relationship. We use a difference-in-difference framework and what we call an embedded triple-difference framework to explore the house price and debt connection. In addition, because we focus only on households with positive debt balances, we also control for the censored data by using a "two-part" model (that treats the decision to take on debt as being independent from the decision of how much debt to take on), a double-hurdle model (that simultaneously estimates debt participation and debt quantity equations, allowing for the errors to be correlated), and the Heckman sample selection correction model. A key characteristic of the data, which also include household-level mortgage debt outstanding, is that there is very low cross-sectional correlation between household non-mortgage and mortgage debt, which means there is independent variation in non-mortgage debt that allows us to separate this relationship from the (endogenous) house price and mortgage debt relationship.

We find little evidence of a connection between house prices and non-mortgage debt for renters, but establish a positive and statistically significant relationship for homeowners. More specifically, a one percent increase in house prices is associated with a 0.10 to 0.36 percent (depending on the estimation model) increase in homeowner non-mortgage debt outstanding. We also find some evidence that this relationship is stronger for middle-aged and older homeowners than it is for younger homeowners. These findings do not rule out the possibility that the connection between house prices and non-mortgage debt is driven, to some extent, by a common cause. However, they do provide some evidence in favor of wealth effects and relaxed credit constraints associated with house price increases through higher non-mortgage debt outstanding.

Finally, we combine the results from the non-mortgage debt regressions with the reported uses of this debt, focusing on non-housing consumption.[6] On average, between 1999 and 2007, home-

[2] Mian and Sufi (2011) address possible endogeneity by using a land topology based measure of housing supply elasticity as an instrument for house prices, whereas Leth-Peterson (2010) and Agarwal and Qian (2017) use unanticipated policy reforms in the housing market for identification.

[3] In other words, there is an issue of fungibility of resources. For example, the mortgage debt we associate with the purchase of a home can also be used indirectly for other purposes through the choice of the amount of downpayment.

[4] A number of papers (for example, Bhutta and Keys, 2016, Cooper (2010), Mian and Sufi (2011), and Mian et al. (2013)) have included mortgage refinancing as an important source of debt accumulation associated with house prices. Our dataset has only one year of data on mortgage refinancing together with the uses of extracted equity.

[5] For comparison, Mian and Sufi (2011) lack direct information on the uses of debt and can therefore only make indirect inferences—by looking at changes in household real and financial positions—on the relationship between house prices and consumption through the use of debt. A number of other papers, such as Leth-Peterson (2010) and Hurst and Stafford (2004) impute or back-out consumption measures using wealth and income measures, while Agarwal and Qian (2017) proxy consumption spending with transaction amounts associated with debit and credit cards.

[6] The nature of the data drives, in part, our decision to establish an indirect link between house prices and consumption through the use of non-mortgage debt. Our data refer to debt balances outstanding, and do not detail when, exactly, the debt was taken out and when it was used for consumption. The lack of this information

owners used about 40 percent of their non-mortgage debt (across all instruments) for non-housing consumption. Together with an increase in national house prices of 52 percent over the same period, this implies that up to 25 percent of net non-mortgage debt increases were associated with house prices and used for non-housing consumption. This means that 18 percent of the increase in aggregate non-housing consumption was associated with the increase in house prices through the use of non-mortgage debt.

The paper proceeds as follows. Section 2 describes the data and outlines the empirical strategy for connecting house prices to non-mortgage debt accumulation. Section 3 begins by providing some summary statistics and preliminary analysis, and then presents the detailed empirical results for the house price–non-mortgage debt relationship. Section 4 examines how debt is used, and then links house price increases, through non-mortgage debt, to consumption expenditures. Section 5 concludes.

2. Data and empirical framework

The objective of this paper is to explore empirically different mechanisms that could give rise to a connection between house prices, non-mortgage debt and consumption. This association could arise both due to common drivers as well as wealth and credit constraint effects of exogenous shocks to house prices. While not mutually exclusive, the latter effects would be expected to produce a stronger relationship between house prices and debt (and subsequently consumption) for homeowners than for renters, and possibly for older homeowners relative to younger ones.

In this section, we discuss the relationship between house prices and non-mortgage debt. We begin by introducing the household-level data used in the analysis, and then outline the empirical framework for measuring the association between the house prices and non-mortgage debt. The framework is determined, in part, by the nature of the available data, and captures the different mechanisms associated with household debt decisions in the face of house price fluctuations.

2.1. Data

Household-level data

We use household-level data from the Canadian Financial Monitor (CFM) survey conducted by the marketing research firm Ipsos Reid. The data set contains demographic characteristics of households, as well as detailed information on liabilities and some assets. The survey had originally been launched with the purpose of distributing information on a representative sample of households to banking and financial institutions in Canada for marketing purposes. However, more recently it has been used by researchers for the analysis of issues that require detailed household financial data (see Dey et al. (2008); Faruqui (2008) and 2010; Damar et al. (2014); Allen et al. (2016); Foerster et al. (2017); and Chen et al. (2017)).

The sampling frame for the CFM is built using names purchased from targeted mailing lists. As respondents to these mailing lists confirm their participation, they are added to the database from which the CFM sample is drawn. The CFM employs a quota sample with targeted sample sizes—that is, sampling is done until a specific sample size has been achieved.[7] The survey provides household weights that are calibrated using data from the Census to fit seven dimensions: geographical region, homeownership status, employment status of the household head, household size, city size, the age of the household head, and household income. These weights can be used to average sample quantities to their population counterparts, and in what follows, all reported statistics and empirical results will be population weighted values unless otherwise stated.

We make use of CFM data from 1999 to 2007. The survey is conducted at a monthly frequency, with about 1000 households interviewed each month—thus, each year in the sample consists of approximately 12,000 households. The CFM is a repeated cross-sectional survey, where no household is interviewed more than once within any calendar year in our sample period, and adjustments are made to ensure that the annual sample of households is representative of the Canadian population.[8] Sampled households are drawn from a pool of approximately 60,000 units each year that indicate in advance their participation interest. Due to high attrition rates, the survey company recruits new participants in order to maintain a nationally representative survey in each year.

In order to reduce non-response, households are asked to report most monetary values within ranges, rather than supplying exact values. For our analysis, we replace the reported ranges with their mid-points. While the ranges for reported values of debt are relatively narrow for the most part, they do become wider at higher values. The highest level of debt that may be reported for a single instrument is "$500,000 or more", and we set it to $500,000. This can be an issue for getting an accurate measure of outstanding mortgage balances, if they exceed $500,000. This top coding likely truncates the upper end of the total debt distribution and therefore affects measured moments in the data—particularly averages. This should be kept in mind when considering summary statistics. However, for our purposes, the other debt categories (outside mortgages) very rarely have a single debt instrument with a balance exceeding $500,000. For this reason, top coding is not a significant issue for the analysis of non-mortgage debt.

The survey asks households to report outstanding balances on a number of debt instruments, including mortgages (on primary residence as well as on second/vacation homes and investment properties), personal loans (including home equity loans), lines of credit (including home equity lines of credit and credit cards), and leases.[9] For each of these instruments, respondents are able to list multiple debt contracts. We use the mid-points of the reported ranges and deflate them by the consumer price index to measure the real debt levels. Non-mortgage debt for each household is calculated as the sum of real balances on personal loans, lines of credit (excluding credit cards) and leases.

The CFM also contains information on household income and other demographic variables. Like debt, income is reported within ranges. However, we choose not to construct a continuous income variable, and instead use income dummy variables as controls in the empirical analysis (the income ranges are broader than the debt categories and are top coded at $150,000). Included among

is important because consumption is a flow and therefore it is critical to know its timing. Thus, the only way we can ultimately connect house prices to consumption is through the changes in debt stocks and the assumption that the proportion of debt used for consumption is relatively constant over time.

[7] For comparison, the Canadian Survey of Financial Security and the U.S. Survey of Consumer Finances are two-stage probability samples.

[8] However, some households do complete the survey more than once, usually in consecutive years. In our sample, only about 18 percent of households participated twice, and about 9 percent participated in three consecutive years. We do not exploit the panel component in the data as this would require analysis and discussion beyond the scope of the paper—such as adjusting the weights to account for the panel observations. See Allen et al. (2008), Damar et al. (2014), and Chen et al. (2017) for papers that make use of the panel component.

[9] Note that while in the U.S. over this period it was increasingly common to take out second mortgages, this practice was restricted in Canada. Second mortgages in the U.S. were taken out at home purchase to cover part of the down payment, and thus would have been directly affected by house price increases. As discussed in MacGee (2009), the strict and more unified nature of mortgage insurance requirements in Canada would have made this practice an exception, rather than a rule. Therefore, home equity loans in our data likely do not include second mortgages taken out at purchase.

demographic characteristics are the age and level of education of the household head, as well as the number of adults and children in the household. To control for differences in household size, we construct a measure of adult equivalents by adding up all individuals in the household, assigning a weight of 1.0 to each adult and 0.5 to each child (below the age of 14). We also use information about home and business ownership in the survey. Finally, in order to match the household data with aggregate quarterly data, we stack monthly household observations for each quarter.

House price data

While the CFM does ask respondents to report the value of their real estate properties, only a few do. Also, these answers are provided within the same ranges as the other monetary fields, and so are top-coded at $500,000. In the case of real estate this becomes an important issue since in the final years in our sample period, respondents are only asked to report the total market value of all of their real estate properties (primary residence plus any vacation and investment properties).

Given the problems with the reported household-specific measures of housing value, we use regional house prices instead. Using respondent postal codes, we group households into sixteen distinct regions, and for each region use data on average house prices from the Canadian Real Estate Association (CREA).[10] These are resale prices of existing homes from the CREA's Multiple Listing Services system. The regions are based on the first letter of the respondent's postal code and are: Newfoundland and Labrador, Nova Scotia, Prince Edward Island, New Brunswick, Eastern Quebec, Metropolitan Montreal, Western Quebec, Eastern Ontario, Central Ontario, Metropolitan Toronto, Southwestern Ontario, Northern Ontario, Manitoba, Saskatchewan, Alberta, and British Columbia. Eight of these regions are entire provinces, but that Ontario and Quebec—Canada's two largest provinces both in terms of population and land mass—are divided into five and three regions, respectively.

House prices are deflated using the consumer price index (CPI). Real house prices rose steadily in every region throughout the sample period, with Alberta experiencing the largest cumulative growth (110 percent) and Southwestern Ontario experiencing the least cumulative growth (24 percent). With this house price variable, we not only have time variation, but also cross-sectional variation. Allen et al. (2009) show that house prices across cities in Canada are only weakly correlated in the long run. It follows then that there is likely little correlation across the provinces and the sub-regions identified above. This is useful for establishing the relationship between house prices and non-mortgage debt, as the cross-sectional variation in our house price data will likely be driven by region-specific shocks, rather than some common factor.

2.2. Empirical framework

We now examine the relationship between house prices and household non-mortgage debt. As summarized above, a number of studies have attempted to establish a connection between house prices and debt, but the difficulty in finding instruments or clean policy experiments has limited assertions of causality.[11] In line with this literature, we do not claim to identify a causal relationship, but provide refined estimates of housing price effects using detailed household-level data.

Non-mortgage debt can be used directly for a number of purposes, such as consumption and portfolio rebalancing. The idea is that if we can establish a relationship between house prices and non-mortgage debt, then, through the uses of non-mortgage debt, we can say something meaningful about the link between consumption and house prices.

We consider the following baseline regression model:

$$debt_{ikt}^{nm} = \beta_0 + \beta_r r_t + \beta_p p_{kt} + \beta_y y_{it} + \beta_x X_{it} + \beta_z Z_{kt} + \sum_{t=2}^{T} \beta_t d_t + \epsilon_{ikt} \quad (1)$$

where $debt_{ikt}^{nm}$ is the log of outstanding non-mortgage debt of household i in region k at time t, r_t is the real interest rate (we use the Bank of Canada overnight rate minus CPI inflation), p_{kt} is the logarithm of real regional house prices, and y_{it} is a dummy for income group (nominal and before taxes). We use three income groups: one for households with reported income in the previous year between $35,000 and $49,999, one for those with incomes between $50,000 and $99,999, and one for those with incomes exceeding $100,000. The reference group for income includes households who earned less than $35,000 in the previous year. X_{it} is a vector of household characteristics including the age of the household head, as well as its squared and cubed terms, dummies for whether the head of the household has a high school diploma or a university degree (the reference group here being those that do not have a high school diploma), whether anyone in the household owns a business, the equivalent number of adults in the household, and a dummy for homeownership.[12] Z_{kt} is a vector of region-specific control variables, which includes labor productivity and the unemployment rate (proxies for income differences).[13] We also include a set of quarterly time dummies, d_t, to pick up any common macroeconomic factors, including regulatory changes in the mortgage market that could indirectly affect non-mortgage borrowing behavior.[14] Finally, ϵ_{ikt} is an error term.

As noted in the introduction, we would expect the relationship between house price and non-mortgage debt to differ for homeowners and renters, and for homeowners of different ages. Building on the baseline specification, we test this in both difference-in-difference and "embedded" triple-difference frameworks that are

[10] More disaggregated data for house prices are not available. Even if they were, it is not entirely clear that these measures would be desirable for our analysis. Because the true value of a house can only be realized upon the sale of the property, households extrapolate the value of their home from regional average resale values. While some anecdotal information may be available to homeowners about transaction prices of recently traded properties in their neighborhood, they are more likely to rely on published aggregates that are usually available at the city and broader regional levels. For this reason, we believe that our regional house price measures are suitable for our analysis.

[11] Mian and Sufi (2011), who use land topology-based housing supply elasticity as an instrument for house prices, make no claims of causality. We do not have the data necessary to create a similar instrument for Canada. Leth-Peterson (2010), Agarwal and Qian (2017), and Keys et al. (2014) are recent papers that rely on policy reforms and variation in mortgage reset timing to examine a closely related topic—the relationship between credit constraints and consumption. These papers are able to make causal inferences.

[12] A homeowner here is defined as anyone who owns real estate. We use this broader definition of a homeowner because it is likely that someone who owns real estate, but rents their home, will share similar borrowing behavior to someone who owns their home. The proportion of households under this definition of a homeowner is only slightly higher than the proportion of homeowners that own their primary residence.

[13] Of note, labor productivity and unemployment rates are reported at the provincial level, and therefore there is no variation in these variables across the different regions in Quebec and Ontario, as there is for house prices. Labor productivity is defined as total output (deflated by CPI) per hour worked in the business sector and has an annual frequency. Unemployment rates are used at a quarterly frequency.

[14] From 1999 to 2007, there were a number of regulatory changes and product innovations in the mortgage market affecting the ability of households to take on mortgage debt. A time line for these changes is provided in Appendix A. We have run our regressions for non-mortgage debt with dummy variables for the regulatory changes and product innovations in place of time dummies and found that this has little effect on the coefficients of interest. We also experimented with year-region fixed effects and the main results changed very little.

generalized in the following form:

$$debt_{ikt}^{nm} = \beta_0 + \beta_r r_t + f(\cdot;\gamma) + \beta_y y_{it} + \beta_x X_{it} + \beta_z Z_{kt} + \sum_{t=2}^{T} \beta_t d_t + \epsilon_{ikt}. \quad (2)$$

This is similar to (1), except that we introduce the function $f(\cdot;\gamma)$, which can include as its arguments regional house prices p_{kt}, a homeownership dummy, ho_{it}, and a set of age dummy variables, D_{it}^{age}, that signify whether a household head is between the ages of 36 and 55 (D_{it}^{36}), or is older than 55 (D_{it}^{56+}). We will refer to these households as middle-aged and older households, respectively. The reference group for the age variable are those households whose head is between the ages of 18 and 35 (young households). The set of household characteristics X_{it} in this framework would exclude variables that are part of the $f(\cdot;\gamma)$ function.

In the difference-in-difference setup, $f(\cdot;\gamma)$ includes only regional house prices and homeownership status:

$$f(p_{kt}, ho_{it};\gamma) = \gamma_1 p_{kt} + \gamma_2 ho_{it} + \gamma_3 (p_{kt} \cdot ho_{it}). \quad (3)$$

We would expect γ_1 (the effect of house prices on the non-mortgage debt of renters) to be significantly lower than $\gamma_1 + \gamma_3$ (the effect of house prices on the non-mortage debt of homeowners).

For the "embedded" triple-difference framework, $f(\cdot;\gamma)$ is also a function of age dummies. We call it an "embedded" triple-difference framework because we focus only on home owners of different ages, rather than all households of different ages (so the age factors are "embedded" in the homeowner estimates). More specifically, we include the house price and homeownership variables on their own, their interaction, the interaction between the age indicators and homeownership, and the triple interaction terms between house prices, homeownership and the age indicators.[15] That is:

$$\begin{aligned} f(p_{kt}, ho_{it}, D_{it}^{age};\gamma) = {} & \gamma_1 p_{kt} + \gamma_2 ho_{it} + \gamma_3 (ho_{it} \cdot D_{it}^{36}) \\ & + \gamma_4 (ho_{it} \cdot D_{it}^{56+}) \\ & + \gamma_5 (p_{kt} \cdot ho_{it}) + \gamma_6 (p_{kt} \cdot ho_{it} \cdot D_{it}^{36}) \\ & + \gamma_7 (p_{kt} \cdot ho_{it} \cdot D_{it}^{56+}). \end{aligned} \quad (4)$$

Here, we would expect that the effect of house prices on the non-mortgage debt of homeowners is the lowest for young households, who have limited ability to withdraw equity from their homes or accumulate large amounts of other non-mortgage debt, and higher for middle-aged and older households:

$$\underbrace{(\gamma_1 + \gamma_5)}_{\text{Young homeowners}} < \Big[\underbrace{(\gamma_1 + \gamma_5 + \gamma_6)}_{\text{Middle-aged homeowners}} \lessgtr \underbrace{(\gamma_1 + \gamma_5 + \gamma_7)}_{\text{Older homeowners}} \Big]. \quad (5)$$

The $\lessgtr$ sign between the last two terms reflects the fact that the magnitudes of the effects for middle-aged and older homeowners depend on the relative strengths of different channels. For example, if the bequest motive is particularly strong for older homeowners, we would expect the house price effect for them to be weaker relative to middle-aged homeowners. This is necessarily an empirical question that can only be addressed by the data.

Because a significant number of households in our sample report having zero non-mortgage debt (see Table 1 in Section 3.1) we have a censoring issue in our data. To address this, we estimate our empirical model using three different approaches. The first approach is a "two-part" model (Jones, 2000) where we assume that the decision to take on any debt is independent of the decision of how much debt is assumed. The application of the two-part model is straightforward in our case in that a linear regression of debt on house prices (with all the other controls set out in Eqs. (1) and (2) is run only on those households with positive non-mortgage debt (we do not estimate the "first-part" participation model). The two-part model is based on a conditional mean independence assumption, which is a very strong assumption given that many of the same factors that affect the debt-quantity decision will affect the debt-participation decision. If, in fact, the two decisions are closely connected, we would expect the estimate on house prices in the two-part model to have a downward bias. That is, an increase in house prices may induce increased borrowing for those that already have debt, but may also result in entry into the debt market (likely with below-mean levels of debt). If not properly controlled for, this would dampen the estimate on house prices.

The second approach is a double-hurdle model (Cragg, 1971) where we simultaneously estimate both the debt-quantity equation (Eqs. (1) and (2) and a non-mortgage debt participation equation, and allow for correlation in the errors in the two equations (Jones, 1992). In this setup, the set of explanatory variables is the same in both the debt participation and debt quantity regressions. Finally, we use a standard Heckman (1979) sample selection model, where we first estimate a non-mortgage debt participation equation and then include the inverse Mills ratio as an explanatory variable in the debt-quantity regression. In each instance, we report the unadjusted point estimates—that is, the estimates apply only to households with positive debt.

In estimating this Heckman selection model, we do make use of an exclusion restriction. The CFM asks households whether or not they have group life and/or health insurance, which usually covers all employees of an employer that offers it. So, within the organization, this choice is exogenous for the household. We believe that households with life/health insurance are more likely to take on debt (as it affects their view of risk), but having this insurance is not likely to influence the amount of non-mortgage debt taken. This assumption is supported by the data, as the coefficient on a dummy for having life/health insurance is positive and significant in a probit regression where the dependent variable is a dummy for having positive non-mortgage debt (and all the explanatory variables in Eq. (1) are included—this is the first stage of the Heckman selection model). Moreover, the coefficient on the same life/health insurance dummy is statistically insignificant (and near zero) in an OLS regression where the amount of non-mortgage debt for those with positive debt is the dependent variable (the second stage of the model).[16] This suggests that having life/health insurance is correlated with the choice to take on debt, but not with the choice of how much debt to incur.

It is possible to think that while the choice to have group life and/or health insurance is exogenous within an organization, it may not be exogenous in terms of an employee's choice of employer, thus invalidating it as an exclusion restriction variable. However, in the institutional context of the Canadian health care system, the role of employers' health insurance provision may be less important in the employment decisions of employees than could be expected otherwise. This is the case given that private health insurance finances only about 12 percent of health care ex-

[15] We have also run the full triple-difference model, where the age indicator variables enter on their own and are interacted with house prices, and the point estimates on homeowners of different ages (our estimates of interest) are almost identical. We have no theoretical priors for the relationship between house prices and non-mortgage debt for renters of different ages, and therefore we opt to estimate a more parsimonious model that captures the overall relationship for renters in a single parameter.

[16] We also conduct a likelihood ratio test to compare the just-identified model (without the exclusion restriction) to the one with the exclusion restriction and find that it suggests the model with the exclusion restriction is a better fit for the data. That is, we reject the null model (just-identified) for the model with the exclusion restriction.

Table 1
Household Summary Statistics in CFM, by year.

	Homeownership	Total debt			Non-mortgage debt		
Year	Rate (%)	Partic.(%)	Mean	St dev.	Partic.(%)	Mean	St dev.
1999	64.4	71.8	43,393	(65,333)	48.4	9,097	(20,987)
2000	64.2	73.4	43,310	(64,294)	52.1	10,087	(26,002)
2001	65.7	72.0	44,648	(64,102)	50.6	9,982	(21,247)
2002	65.8	70.8	46,422	(67,849)	50.0	10,556	(24,402)
2003	71.9	69.2	45,954	(67,068)	49.1	10,129	(20,404)
2004	69.0	69.1	45,520	(69,717)	48.5	10,956	(26,317)
2005	67.2	69.2	48,189	(75,316)	48.3	11,747	(29,467)
2006	66.1	69.5	46,412	(75,330)	47.8	11,711	(27,835)
2007	66.2	69.5	47,774	(79,625)	48.3	11,408	(26,366)

Note: All dollar values are in 2002 quarter 1 dollars. Population weights are used to calculate population values for each variable. The participation rates (Partic.(%)) are defined as the fraction of all households with non-zero total and non-mortgage debt. The mean and standard deviation statistics for total and non-mortgage debt are for all households, including those with zero debt. Due to top coding (the highest debt level a household can report for a single debt instrument is $500,000) our estimates for average household total debt likely underestimate the true values.

penditures in Canada, with the rest covered by public insurance programs available to everyone (Hurley and Guidon, 2008). Life and health insurance can also be purchased on an individual basis with competitive packages as compared to group plans, and these private plans can often be better tailored to meet the needs of the plan holder. Accordingly, the offering of group life and/or health insurance by an employer in Canada is much less of a benefit than, say, in the U.S., where these plans can account for a significant portion of health-related expenditures.[17] Therefore, it is reasonable to believe that the offering (or not) of group life and/or health insurance by an employer has little impact on employment decisions. For this reason, we believe the life and/or group insurance variable is less problematic than might first appear without taking the institutional context into account.

Finally, although private insurance is readily available in Canada, having life and/or health insurance offered by an employer increases the probability that a household has this type of insurance. Without it, households have to actively undertake a search for a private plan. Therefore, those households with group life and/or health insurance are more likely than other households to have insurance, which, in turn, affects their view of risk and the probability that they take on debt.

3. Results: House prices and non-Mortgage debt

In this section, we provide summary statistics from the CFM dataset and report our regression results based on the framework discussed in the previous section.

3.1. Household-level data: CFM summary statistics

Table 1 presents some relevant statistics built from the household data, including the homeownership rate, debt participation rate and average balances outstanding of household total and non-mortgage debt, computed across all households. The CFM homeownership rate increased from 64.2 percent in 1999 to 66.2 percent in 2007. Over the same period, mean total debt grew by ten percent (this could be affected by the top-coding issue detailed above), while non-mortgage debt grew by 25 percent.

In Table 2 we present summary household characteristics for quartiles of the total debt distribution or households with non-zero debt holdings. These data are available for all intervening years in the sample, but for clarity of exposition we only report statistics for the first and last year of the sample. In both years, those at the top end of the debt distribution tend to be younger and more educated. They are also much more likely to be homeowners and have significantly higher mortgage debt balances, which likely reflects their status as recent homebuyers (either first-time buyers or repeat buyers moving up). Finally, these households at the top end of the debt distribution also have higher non-mortgage debt.

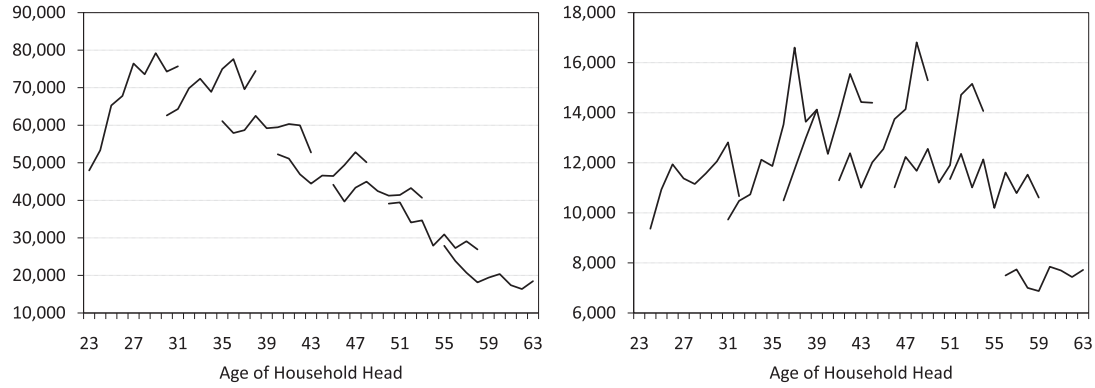
Table 2
Household characteristics by quartile of the total debt distribution .

	Quartile of the debt distribution			
1999	1	2	3	4
Age of household head	47	44	42	39
University degree (%)	21	27	32	42
Homeownership rate (%)	38	57	96	99
Non-mortgage debt	1360	12,227	13,296	23,757
Mortgage debt	79	4373	49,872	126,374
Total debt	2838	19,289	65,481	154,127
	Quartile of the debt distribution			
2007	1	2	3	4
Age of household head	50	49	46	41
University degree (%)	25	32	34	43
Homeownership rate (%)	43	58	93	99
Non-mortgagedebt	1,647	13,051	19,350	31,510
Mortgage debt	97	3,249	44,001	149,789
Total debt	2,926	19,009	67,049	186,424

Note: All dollar values are in 2002 quarter 1 dollars. Due to top coding (the highest debt level a household can report for a single debt instrument is $500,000), our estimates of total debt and mortgage debt at the top end of the debt distribution likely underestimate the true values, but this would not likely matter for the direction of debt comparisons over time. Note that the difference between total debt and the sum of mortgage and non-mortgage debt equals balances outstanding on credit cards.

A natural concern for our estimation framework is that there is a high correlation between non-mortgage and mortgage debt at the household level, and as a result we may be picking up the (endogenous) relationship between house prices and mortgage debt. However, the cross-sectional correlation between non-mortgage and mortgage debt is actually quite low at 0.167. If we adjust this number to account for possible top-coding issues in mortgage debt by dropping all those households that report a single mortgage of "$500,000 or more", the correlation drops to 0.156. If we just look at households that have positive non-mortgage and mortgage debt, the correlation is 0.121. We therefore believe that there is enough independent variation in household non-mortgage debt to be able to analyze its relationship to house prices separately from mortgage debt.

[17] As reported by the Centers for Disease Control and Prevention, the share of health care covered by private insurance in the U.S. was approximately 53 percent in 2000 and 54 percent in 2012 for those under 65, for whom the search of employment and conditions offered by employers would be of relevance (see http://www.cdc.gov/nchs/data/hus/2015/098.pdf).



(a) Total Debt (b) Non-Mortgage Debt

Fig. 1. Life-cycle patterns in household debt. *Note:* The figures plot the mean cohort-year values of household total and non-mortgage debt (including those households with zero balances), which are the coefficient estimates (plus the constant) on year-cohort dummies in a regression of each type of debt on 63 year-cohort dummy variables. Due to top coding (the highest debt level a household can report for a single debt instrument is $500,000), our estimates for total debt likely underestimate the true values, but would not affect the hump shape of the life-cycle debt profile.

Finally, debt holdings are expected to exhibit some life cycle effects. In order to check that this pattern is present in the data, we separately regress household total debt and non-mortgage debt on 63 cohort-year dummies, which combine seven age cohorts and nine years of data. Our seven age cohorts are defined by the age of the head of the household in 1999 and the age groups are: 23–29, 30–34, 35–39, 40–44, 45–49, 50–54 and 55–59.[18] The estimated coefficients on the cohort-year dummies in the two regressions capture either the cohort-year mean total or non-mortgage debt. Fig. 1 plots the evolution of total and non-mortgage debt over the life cycle, where each line corresponds to a different cohort.

While total debt exhibits a clear life-cycle pattern, this is not the case for non-mortgage debt. For total debt, the age profile is hump shaped over the life cycle—it increases early on in life, but then declines over time. Since mortgage debt constitutes the main source of household total debt, the results from the total debt regressions are in line with the story of young households buying homes and paying off their mortgages as they age. A similar profile for total debt over the life cycle is predicted in Iacoviello and Pavan (2013). For non-mortgage debt, the age profile is relatively flat along the life cycle. We do observe, however, significant growth over time in non-mortgage debt within all cohorts, except the two oldest ones. It is also the case that non-mortgage debt is lower in each year for the oldest cohort.

3.2. Empirical results

We begin by estimating (1) to examine the overall relationship between house prices and non-mortgage debt (for those with positive debt).[19] The coefficient of interest is β_p, and as indicated above we estimate this equation using the two-part, double-hurdle and Heckman models. The estimates for β_p for the three models are 0.038 (not significantly different from zero), 0.264 (significant at the 1% level) and 0.262 (significant at the 1% level), respectively (note that we do not present all the parameter estimates as they are very similar to what is presented in detail below). This implies that a one percent increase in house prices is associated with a (≈)0 to 0.264 percent increase in non-mortgage debt. These point estimates for house prices capture the overall association between house prices and non-mortgage debt for homeowners and renters, alike.

However, we know that there are different channels through which house prices affect homeowners and renters. Therefore, we present the estimates of (2) in Table 3. Columns I, III and V show the results for the difference-in-difference model for the three estimation techniques.[20] In this setup, the estimate on the house price term captures the effect of house prices on the non-mortgage debt of renters, and we see that the coefficient estimate in the two-part model is negative and significant at the 5%. In the double-hurdle and Heckman models, the point estimate on house prices is close to zero and statistically insignificant. As discussed, the theoretical relationship between house prices and the non-mortgage debt of renters is expected to be smaller (in absolute value) than that of homeowners, and these results suggest that this is true.

Columns I, III and V also show the effect of house prices on the non-mortgage debt of homeowners (the coefficient estimates on house prices and the house price–homeownership interaction term). Column I suggest that a one percent increase in house prices is associated with a 0.099 (-0.129 + 0.228) percent increase in non-mortgage debt (an F-test confirms that the house price and interaction terms are jointly significant at the 1% level). The estimates from the double-hurdle model suggest a combined point estimate of 0.362 (0.017 + 0.345), which is significant at the 1% level. Finally, with the Heckman model, the combined point estimate is 0.359 (0.016 + 0.343), which is also significant at the 1% level.

Homeowners are heterogeneous and the interaction term groups together at least two distinct types of homeowners—established homeowners with enough equity in their homes to access HELOCs, and recent homeowners who have less capacity to do so and may rely more on other types of secured and unsecured borrowing. We address this heterogeneity in columns II, IV and VI by interacting house prices and dummies for homeowners of different ages—the triple-difference model. In analyzing the combined point estimates for the effects of house prices for all three age groups, in the case of the two-part model we find that the coefficient on young homeowners ($\gamma_1 + \gamma_5$) is -0.064 and is not significant different from zero. The same estimates for middle-aged ($\gamma_1 + \gamma_5 + \gamma_6$) and older ($\gamma_1 + \gamma_5 + \gamma_7$) homeowners are 0.142 and

[18] The first cohort (23–29) has a wider age bracket to increase the number of observations in the group.

[19] In Appendix B, we explore the relationship between house prices and household total debt using quantile regression. However, without a valid instrument, it is difficult for us to say anything concrete about this relationship. Therefore we present this analysis to provide the reader with a sense of the household total debt data, rather than to provide material evidence of the effect of house prices on total debt.

[20] Note that there are slightly fewer observations for the Heckman model estimates due to a small number of missing observations for the group life and/or health insurance variable, which is used as an exclusion restriction.

Table 3
Non-mortgage debt regression results.

	Two-part model		Double-hurdle model		Heckman model	
	I	II	III	IV	V	VI
Interest rate	−0.009	−0.006	0.213*	0.221*	0.031	0.035
	(0.02)	(0.02)	(0.12)	(0.12)	(0.03)	(0.03)
Income 1	0.481***	0.483***	0.021	0.022	0.033	0.035
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Income 2	0.817***	0.814***	0.292***	0.289***	0.308***	0.305***
	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
Income 3	1.097***	1.089***	0.718***	0.713***	0.732***	0.727***
	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)	(0.06)
Age	−0.086***	−0.079***	−0.032	−0.030	−0.031	−0.028
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Age^2	0.002***	0.002***	0.001	0.001	0.001	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Age^3	−0.000***	−0.000***	−0.000	−0.000	−0.000	−0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Education (High School)	−0.051**	−0.047**	−0.053*	−0.057**	−0.051*	−0.055**
	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Education (University)	0.091***	0.091***	0.109***	0.108***	0.108***	0.106***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)
Business owner	0.146***	0.144***	0.078***	0.078***	0.076***	0.075***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Adults	0.069***	0.066***	−0.008	−0.009	−0.007	−0.008
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Labor productivity	0.255	0.263*	0.143	0.151	0.135	0.143
	(0.16)	(0.16)	(0.15)	(0.15)	(0.15)	(0.15)
Unemployment	−0.020**	−0.019**	−0.025***	−0.025***	−0.025***	−0.025***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
House price	−0.129**	−0.119**	0.017	0.025	0.016	0.024
	(0.06)	(0.06)	(0.07)	(0.07)	(0.07)	(0.07)
Homeowner	−2.467***	−0.476	−4.080***	−3.404***	−4.049***	−3.317***
	(0.78)	(0.03)	(0.84)	(1.04)	(0.83)	(1.04)
House price*Homeowner	0.228***		0.345***		0.343***	
	(0.06)		(0.07)		(0.07)	
Constant	10.621***	10.447***	8.679***		9.653***	9.513***
	(0.91)	(0.90)	(1.15)		(0.90)	(0.88)
Combined effects of house prices on homeowners of different age groups						
Age 18–35		-0.064		0.310***		0.302***
		(0.06)		(0.08)		(0.08)
Age 36–55		0.142***		0.407***		0.408***
		(0.05)		(0.06)		(0.05)
Age 56+		0.158**		0.340***		0.332***
		(0.06)		(0.07)		(0.07)
Obs.	54,970	54,970	110,253	110,253	107,843	107,843
Uncensored Obs.			54,970	54,970	54,043	54,043

Note: Income 1 is a dummy variable for those households whose income the previous year was between $35,000 and $49,999. Income 2 is a dummy for those with incomes between $50,000 and $99,999, and Income 3 is a dummy for those with incomes exceeding $100,000. The reference group for income are those households who earned less than $35,000 in the previous year. Education (High School) is a dummy for those who have a high school diploma, and Education (University) is a dummy for those who have a university degree. The reference group for education are those who have not completed high school. Each specification includes quarterly time dummies, month dummies, and age cohort dummies. The errors are clustered at the first two digits of the area code—with this, there are 142 clusters. The *combined effects of house prices on homeowners of different age groups* are determined by adding up all the interaction terms pertaining to house prices. The reported point estimates are unadjusted, meaning they apply only to those with positive non-mortgage debt. *** Significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.

0.158, and are significant at the 1% and 5% levels, respectively. For the double-hurdle model, the analogous estimates are 0.310, 0.407 and 0.340, all significant at the 1% level. Finally, the Heckman estimates are 0.302 for young homeowners, 0.408 for middle-aged homeowners, and 0.332 for older homeowners, all significant at the 1% level.

While the magnitude and significance levels vary across the three sets of estimates, a general pattern is clear: the relationship between house prices and the non-mortgage debt of homeowners is stronger for older households. For the two-part model, the coefficients on middle-aged and older homeowners are significantly different from the younger homeowner estimates at the 1% level. For the double-hurdle and Heckman estimates, while the estimates for middle-aged and older homeowners are larger than for young homeowners, none are statistically different from each other when we cluster the errors at the first two digits of the household's area code (142 clusters). However, increasing the size of the clusters to the level of the first digit of the area code (16 clusters) results in the estimates for young and middle-aged homeowners being statistically different from each other at the 5% level. While we have determined that clustering at the two-digit area code is optimal (the more disaggregated level of clustering at the three-digit area code level results in very little change in the standard errors and includes many clusters with only one observation), the results with the single digit area code clusters provide some evidence of differential responses by age group of homeowners in the double-hurdle and Heckman results.

Table 4
Non-mortgage debt use categories.

Consumption	Home Renovation	Debt repayment	Investment	Other uses
· Purchase of motor vehicle · Purchase of computer · Vacation · Student loan · Living expenses · Other current spending · Other not for current spending · Purchase of a big ticket item · 0.3*Home improvement	· 0.7*Home improvement	· Pay off another loan · Pay off general debt	· General investment · Purchase of residence/business · Purchase of RRSP · Other investments	· Other

Note: We assign thirty percent of home improvement to consumption and seventy percent to home renovation based on the findings in the Renovation and Home Purchase Report by the Canadian Mortgage and Housing Corporation (CMHC). The items listed under the five categories encompass the list of possible purposes provided in the CFM.

Without valid instruments to address the possibility of endogeneity, we are unable to identify an exact causal relationship between house prices and non-mortgage debt. It is possible that causality runs from debt to house prices, as the ability of households to take on more debt over the sample period could bid up house prices. We analyze this possibility in further detail in Appendix C and determine that the effect of non-mortgage debt on house prices was likely relatively small. It is also possible that house prices and debt are both driven by some common factor, such as upward revisions to expected income. However, our findings of no relationship between house prices and the non-mortgage debt of renters, and a positive relationship for homeowners—with a differential response of homeowners across age groups—suggest that some common factor is not the only driver of the relationship between house prices and non-mortgage debt.[21]

4. House prices and real outlays

In this section, we begin by analyzing how debt is used, with a focus on the behavior of different types of households. We then examine the relationship between house prices and consumption using the estimates for house prices and non-mortgage debt from the previous section.

4.1. Uses of household debt

For households with debt (both homeowners and renters), the CFM provides information on the purposes of the non-mortgage debt, with details for each debt instrument and debt contract.[22] Survey respondents are asked to choose from an extensive list of debt uses, which we group into five categories: consumption, home renovation, investment, debt repayment, and other uses. Table 4 provides a detailed list of what is included in each of these categories. In the discussion that follows, it will be convenient to group home renovation, financial and other investment, as well as debt repayment into a single category called portfolio rebalancing. Theory predicts that households who use debt for consumption are either liquidity constrained, or unconstrained, but do not have a bequest motive and want to consume unexpected house price increases. Households who use debt for portfolio rebalancing purposes are also more likely to be unconstrained.

We first characterize average amounts of non-mortgage debt used for different purposes in Tables 5 and 6. The data are available for all years in the sample, but we focus on selected years for clarity of exposition. Over the entire sample period, among all households with non-mortgage debt, an average share of 44.4 percent was used for consumption—the largest debt-use category. And while the percentage of non-mortgage debt used to finance consumption decreased from 48.4 percent in 1999 to 43.9 percent in 2007, outstanding non-mortgage debt increased by $2,311 ($11,408 - $9,097). As a result the amount of debt outstanding used to finance consumption increased by almost fourteen percent (to $5,008 from $4,405). Similar patterns exist for the non-mortgage debt of homeowners.

As suggested by the results in the previous section, the amount of debt outstanding and its uses vary across homeowners of different ages. Table 6 presents the uses of outstanding non-mortgage debt by age of homeowner for 1999 and 2007. The non-mortgage debt of homeowners is highest for the middle-aged group in both 1999 and 2007. At the same time, the proportion of outstanding non-mortgage debt used for consumption declines as homeowners age. In 2007, young homeowners report using an average of 51 percent of outstanding non-mortgage debt for consumption. In the same year, older homeowners report using 33 percent of non-mortgage debt for consumption with the rest used largely for portfolio improvement purposes.

Here, the high proportion of non-mortgage debt used for consumption in combination with homeowner age can serve as an additional indicator of constraint. For young households who are recent homebuyers, taking any equity out of their homes to smooth consumption may be costly (as in the case of minimum equity requirement of twenty percent in a home). However, house price increases may lower these costs, allowing otherwise liquidity constrained households to take out equity and consume. At the same time, middle-aged and older households with large amounts of home equity, who are unconstrained, may choose to consume unexpected house price increases if they do not value bequests.

[21] In Appendix D we briefly explore the results with house price growth as the explanatory variable. We present these results for comparison purposes, but urge caution in their interpretation. Our data consist of repeated cross-sections and therefore we cannot track changes in individual household homeownership status over the period spanned by the growth in house prices, which may affect our parameter estimates. Furthermore, Attanasio et al. (2009) point out that the use of the level of house prices might be expected to better capture any pure wealth effects, since under the permanent income hypothesis theory, it should be the level of resources that affects the level of consumption.

[22] Much of non-mortgage debt in this exercise is home equity debt consisting of home equity lines of credit and home equity loans. For our purposes it would be useful to have information on mortgage refinancing for this period as well. However, it should be noted that given the short-term nature of mortgages in Canada, most refinancing takes place at the renewal of the mortgage contract to avoid heavy penalties for terminating the contract. As a result, the timing of mortgage refinancing is, to some extent, exogenous to household decisions, which is not the case for HELOCs and HELs. Unfortunately, our data do not allow us to separate mortgage refinancing from other mortgage debt for most of our sample period, with the exception of 2007. In Appendix E, we briefly analyze what we can learn from this one year of mortgage refinancing data.

Table 5
Uses of Outstanding Non-Mortgage Debt by Homeowners and All Households.

	1999		2003		2007		1999–2007	
	Owners	Total	Owners	Total	Owners	Total	Owners	Total
% of Non-mortgage debt used for:								
Consumption	44.1	48.4	43.2	45.5	40.1	43.9	40.4	44.4
($ value)	(4,946)	(4,405)	(5,187)	(4,605)	(5,663)	(5,008)	(5,262)	(4,697)
Home renovation	4.5	3.8	5.1	4.6	6.2	5.3	5.2	4.6
Debt repayment	19.3	18.7	19.9	19.6	19.7	19.0	20.1	19.7
Investment	17.5	15.3	16.5	15.4	20.9	18.4	18.9	16.9
Other	14.7	13.7	15.3	14.9	14.4	13.3	15.1	14.4
Non-mortgage debt	11,208	9097	12,004	10,129	14,138	11,408	13,089	10,631
Mortgage debt	48,290	32,427	45,162	33,851	49,796	34,191	47,723	33,056
Total debt	61,466	43,393	59,244	45,954	66,401	47,774	62,979	45,736

Note: All dollar values are in 2002 quarter 1 dollars. Homeowners are households reporting ownership of any real estate. Due to top coding (the highest debt level a household can report for a single debt instrument is $500,000) our estimates for total and mortgage debt likely underestimate the true values and changes over time.

Table 6
Uses of outstanding non-mortgage debt of homeowners by Age.

1999	Young	Middle-aged	Older
% of Non-Mortgage Debt used for:			
Consumption	53.1	42.0	35.3
Home renovation	3.8	5.0	3.2
Debt repayment	21.4	18.6	17.8
Investment	10.3	18.6	26.8
Other	11.3	15.7	16.8
Non-mortgage debt	12,208	13,975	5758
Credit/Charge card debt	2365	2199	1228
Mortgage debt	79,516	51,437	15,042
Total debt	94,090	67,613	22,029
2007	Young	Middle-Aged	Older
% of non-mortgage debt used for:			
Consumption	51.0	39.4	33.1
Home renovation	5.0	6.3	6.5
Debt repayment	25.6	19.0	16.8
Investment	9.1	21.8	24.7
Other	9.3	13.5	18.9
Non-mortgage debt	13,510	18,698	9443
Credit/Charge card debt	2753	2919	1335
Mortgage debt	103,440	60,594	14,389
Total debt	119,705	82,212	25,168

Note: All dollar values are in 2002 quarter 1 dollars. Young households are those whose household head is between the ages of 18 and 35 (inclusive). Middle-aged households have a household head between 36 and 55 (inclusive), and older households have heads that are 56 and older. Due to top coding (the highest debt level a household can report for a single debt instrument is $500,000), our estimates for total debt likely underestimate the true values.

4.2. House prices, non-Mortgage debt and consumption

In what follows, we measure the link between house prices, debt and consumption at the aggregate level over the 1999 to 2007 period. We do so by combining national house price increases with our estimates of the relationship between house prices and non-mortgage debt, and information about the uses of non-mortgage debt for consumption purposes from the CFM.[23] The calculations are done using the estimates presented in column III of Table 3. While they represent the upper end of our house price–debt estimates (compared to the two-part model estimates), we use them to show the maximum possible effect of house prices on consumption through the use of non-mortgage debt. Moreover, the key parameter estimates are identical to those from the Heckman model in column V of Table 3 when rounded to the second decimal. The calculations below can easily be scaled to reflect two-part model estimates, and we do this at the end of this subsection.

Over the sample period, real national house prices in Canada increased by 52 percent. As shown in the previous section, these increases were positively associated only with non-mortgage debt of homeowners—column III (and column V) of Table 3 suggests that a one percent increase in house prices was accompanied by a 0.36 percent increase in the outstanding non-mortgage debt of homeowners. Together these numbers translate into about a 18.72 percent (52×0.36) increase in outstanding non-mortgage debt of homeowners. In 1999, the average homeowner had $11,208 in outstanding non-mortgage debt (Table 5).[24] If we were to predict homeowner outstanding non-mortgage debt for 2007 based on house prices only, expected non-mortgage debt would be $13,306 ($11,208 x 1.1872), an increase of $2,098. From Table 5, we also know that homeowners consumption share was, on average, 40.4 percent, implying that roughly $848 out of the $2,098 increase in outstanding non-mortgage debt was used for consumption. The $2,098 and $848 figures represent 71.6 and 28.9 percent, respectively, of the overall increase in homeowner non-mortgage debt of $2,930 ($14,138–$11,208) over the sample period.

The numbers reported for homeowners can also be extended to the entire Canadian household sector. In the CFM, homeowners (defined as anyone who owns real estate) account for 67 percent of households in 1999 and 69 percent in 2007 (take 68 percent as the sample average). Therefore, the increase in average non-mortgage debt across all households, stemming from house price increases, was approximately $1,427 ($2,098 $\times$ 0.68 + $0 x 0.32), representing 61.7 percent of the overall net change in non-mortgage debt for all households, which was $2,311 ($11,408 – $9,097) over the sample period (see Tables 1 and 5). And again, applying the consumption share for homeowners of 40.4 percent, $577 of the $1,427 debt increase associated with house prices was used for consumption, which constitutes 25.0 percent of the total net increase in

[23] While information on the uses of debt in the CFM contains several consumption categories (see Table 4), which could potentially be classified as durable and non-durable, we do not analyze the groups separately, and deal with a single consumption category instead, for two reasons. First, the categories presented do not correspond cleanly to the non-durable and durable (and semi-durable) consumption categories used in national accounts statistics, so our comparison with the aggregate data could only be suggestive, at best. Second, since we implicitly assume no variation in the elasticities of different debt uses to house prices, any change in the share of durable consumption in total consumption uses over time would mechanically result in those changes being attributed to house prices.

[24] Note that this number, $11,208, includes homeowners with zero non-mortgage debt. Homeowners with positive non-mortgage debt account for about 36 percent of households and have an average outstanding non-mortgage debt balance of $20,666 in 1999 and $27,567 in 2007.

non-mortgage debt.[25] To measure the proportion of aggregate consumption increase financed with debt, we compare this number to data on household non-housing consumption from the Survey of Household Spending.[26] From 1999 to 2007, real average household non-housing consumption increased by $3,206, and therefore, the increase associated with house prices represents 18.0 percent ($577/$3,206) of the total.

It is important to qualify these results in two ways. First, the percentage of non-mortgage debt used for consumption may have been underestimated since some of the debt used for debt repayment could have been used originally for consumption, and therefore should be counted in the consumption category. To address this concern, we could eliminate the "debt repayment" category and then determine the new set of shares, assuming that debt in the "debt repayment" category was originally allocated in the same proportions as other reported purposes. If we were to do this, consumption would account for 50.8 percent of homeowner debt usage. For the entire Canadian household sector, the increase in house prices from 1999 to 2007 would be associated with a $725 (as opposed to $577) increase in non-mortgage debt used for consumption, which represents 31.4 percent of the net flow of non-mortgage debt.

The second qualification pertains to the connection between house prices and aggregate consumption (as defined in the Canadian System of National Accounts), which also includes housing consumption. It is normally calculated by adding together total rents paid by non-homeowners and imputed rents of homeowners. We do not have the data to create a household-level total consumption variable (which would include housing consumption) and therefore refer to our measure of consumption as non-housing consumption. Thus our results can be thought of as a conservative lower bound for the relationship between house prices and aggregate consumption.

Finally, it is easy to adjust these numbers to reflect the estimates derived from the two-part model. For homeowners, all relevant calculations can simply be scaled by the ratio of the two-part-model estimate to the baseline estimate used above. That is, the increase in homeowner consumption associated with house price growth over the sample period would be $236 (0.10/0.36*$848), which represents about 8.1 percent of the overall increase in homeowner non-mortgage debt ($236/$2,930). However, the estimated overall (for both homeowners and renters) relationship between house prices and non-mortgage debt in the two-part model is essentially zero (0.036 and statistically insignificant), which implies that based on our methodology, there was no consumption response to house prices increases in the aggregate.

[25] Up to this point, the literature has focused on the connection between house prices and consumption. However, the focus on consumption will understate the total impact of the financial accelerator channel since it does not consider home renovations, and hence overall household spending. If we combine consumption and home renovation from the debt uses table, we see that these categories together account for 45.6 percent of debt usage for homeowners, meaning $957 of the $2,098 increase in non-mortgage debt associated with house prices increases was used for consumption and housing investment (the number for consumption alone is $848).

[26] Data from the Survey of Household Spending serve as an input into the measure of aggregate household consumption spending in the Canadian System of National Accounts. We derive a measure of real average non-housing consumption by subtracting shelter expenditures from total consumption, and deflating by the CPI.

5. Conclusions

In this paper, we have used Canadian household-level data to estimate the relationship between house prices and household non-mortgage debt, and between house prices and non-housing consumption in the aggregate. We find that house prices are positively associated with the non-mortgage debt of homeowners. More specifically, the point estimates for homeowners range from 0.10 to 0.36, controlling for interest rates, household income, and other demographic and region-specific variables. We also find a positive and statistically significant relationship between house prices and non-mortgage debt for homeowners of all ages, with some evidence that the relationship is stronger for middle-aged and older households compared to young households. Based on our estimates, we determine that increases in house prices over the 1999–2007 period were associated with up to 61.7 percent of the net change in non-mortgage debt.

Our survey data used in the estimation of the relationship between house prices and debt also provide information about the uses debt. With these data, we are able to connect non-mortgage debt to non-housing consumption at the aggregate level, and thus house prices to non-housing consumption. In the data, we find that about forty percent of homeowners' non-mortgage debt is used for non-housing consumption, which implies that up to 25.0 percent of the net increase of non-mortgage debt was related to house prices and used for non-housing consumption (across all households). A comparison of this number to data from the Survey of Household Spending suggests that house prices were associated with up to 18.0 percent of non-housing consumption growth over the sample period. Due to the fact that our definition of consumption does not include the housing component and we limit our analysis to non-mortgage debt, our results can be thought of as establishing a conservative lower bound for the relationship between house prices and aggregate consumption.

Appendix A. Relevant changes in the mortgage market

Table A1 provides a timeline for important changes in the Canadian mortgage market that occurred from 1999 to 2007.

Table A1
Changes in the Canadian mortgage market.

Year	**Regulatory change/Product innovation**
2001	CMHC introduces Canadian mortgage bonds, enabling the securitization of mortgage debt
2005	Reduction in insurance premia for households with LTV ratios greater than 0.9
2006	Increases in the maximum amortization period eligible for mortgage insurance to 30, 35, and 40 years
2007	Maximum LTV for insured mortgages increased to 100% Maximum LTV for refinancing increased to 95% New products introduced for self-employed borrowers Mortgage insurance for 100% financed rental properties introduced

Note: CMHC refers to the Canadian Mortgage and Housing Corporation, which is the main mortgage insurer and housing agency in Canada.

Appendix B. Household total debt

We use quantile regression to map out the total debt distribution, conditional on house prices. The regression model is given by:

$$debt_{ikt} = \beta_0 + \beta_r r_t + \beta_p p_{kt} + \beta_y y_{it} + \beta_x X_{it} + \beta_z Z_{kt} + \sum_{t=2}^{T} \beta_t d_t + \epsilon_{ikt}. \quad \text{(B.1)}$$

The model is similar to (1) and to that in Dynan and Kohn (2007), except that their dependent variable is household total debt over income. Because their debt-to-income variable has large outliers, they use median regression. Our debt data do not have the same extreme outliers, due to top coding of individual debt contracts at $500,000. However, this cap on the maximum amount of debt that can be held by an individual household in the data could pose a new problem when examining the conditional distribution of debt. Namely, if the area around the quantile of interest includes individuals with reported debt categories at $500,000, the true quantile will not be observed. The top quantile we look at in our analysis is the 90th percentile, and at no point in time does its value exceed $500,000. This means that no individual around this point reports a single debt contract at $500,000. Consequently, since quantile regression estimates are not affected by the distribution of the dependent variable around that point, our results are robust to top coding issues.

We run the regressions on house prices at the 10th, 25th, 50th, 75th and 90th percentiles, and present the results in Table B1. To control for selection (about thirty percent of households have no debt) we use a methodology similar to the one outlined in Buchinsky and Hahn (1998). More specifically, we first estimate a selection equation where the dependent variable is a positive debt indicator and the explanatory variables are the same as in (B.1). We then calculate an inverse Mill's ratio, and include it, along with its squared value, as explanatory variables in the quantile regressions. We estimate the selection model using the semiparametric maximum likelihood estimator developed in Klein and Spady (1993).

We make no adjustment to the standard errors in the quantile regressions. We also estimate a mean regression model using the standard Heckman (1979) sample selection correction and report the unadjusted point estimates—that is, these estimates apply only to households with positive debt. For both the quantile and mean selection models, we do not have an exclusion restriction. Our efforts to find an appropriate variable that could be related to the decision to take on debt in the selection equation, but not the total amount of debt taken on in the outcome equation, were not successful (the life/health insurance indicator used in the non-mortgage debt regression was not valid in this setup).

The mean regression point estimate on house prices is significant at the 1% level and indicates that a one percent increase in house prices is associated with a 0.322 percent increase in total debt. The quantile regression estimates show that the coefficient on the house price variable generally increases along the conditional total debt distribution. More specifically, a one percent in-

Table B1
Total debt quantile regression results.

	0.1	0.25	0.5	0.75	0.9	Mean
House price	0.125*	0.384***	0.487***	0.498***	0.461***	0.322***
	(0.06)	(0.03)	(0.02)	(0.01)	(0.01)	(0.02)
Homeowner	3.558***	2.390***	1.749***	1.445***	1.369***	1.838***
	(0.22)	(0.10)	(0.06)	(0.05)	(0.05)	(0.01)
Interest pate	0.036	0.031	0.002	−0.002	−0.015	−0.027*
	(0.04)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Income 1	2.156***	0.944***	0.368***	0.236***	0.239***	0.666***
	(0.16)	(0.08)	(0.05)	(0.04)	(0.04)	(0.01)
Income 2	2.469***	1.234***	0.625***	0.491***	0.504***	0.965***
	(0.16)	(0.08)	(0.05)	(0.04)	(0.04)	(0.02)
Income 3	1.775***	1.178***	0.879***	0.854***	0.861***	1.047***
	(0.12)	(0.06)	(0.04)	(0.03)	(0.03)	(0.04)
Age	0.483***	0.146***	0.005	−0.061***	−0.052**	0.110***
	(0.06)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Age^2	−0.010***	−0.003***	0.000	0.001***	0.001**	−0.002***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Age^3	0.000***	0.000*	−0.000*	−0.000***	−0.000***	0.000***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Education (High School)	0.373***	0.134***	0.029	−0.013	0.005	0.108***
	(0.06)	(0.03)	(0.02)	(0.01)	(0.01)	(0.01)
Education (University)	0.043	0.129***	0.150***	0.150***	0.152***	0.137***
	(0.04)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Business owner	0.564***	0.181***	0.079***	0.072***	0.131***	0.223***
	(0.07)	(0.03)	(0.02)	(0.01)	(0.02)	(0.01)
Adults	0.164***	0.023	−0.004	0.006	0.030***	0.040***
	(0.03)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Labor productivity	0.252	0.266**	0.196***	0.188***	0.212***	0.221***
	(0.19)	(0.10)	(0.06)	(0.05)	(0.05)	(0.07)
Unemployment	−0.003	−0.014**	−0.021***	−0.015***	−0.014***	−0.015***
	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	−5.826***	0.223	3.297***	4.784***	5.266***	2.688***
	(1.41)	(0.71)	(0.45)	(0.35)	(0.38)	(0.38)
Obs.	110,253	110,253	110,253	110,253	110,253	110,253
Uncensored Obs.	77,315	77,315	77,315	77,315	77,315	77,315

Note: Each specification includes quarterly time dummies, month dummies, and age cohort dummies. Both the quantile and mean regressions account for selection (only those with positive debt are included in the outcome regressions) and the reported point estimates are unadjusted, meaning they apply only to those with positive debt. *** Significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.

crease in house prices is associated with a 0.125 percent increase of the 10th percentile of the debt distribution, and a 0.461 percent increase at the 90th percentile. This implies that house price increases are not only associated with increases in debt along all the debt distribution, but also with its dispersion.

The fact that house prices have a larger effect on the top end of the debt distribution is likely a reflection of higher household borrowing to purchase a residence, since recent homeowners make up the top end of the debt distribution. Additionally, our reported results are interesting in that house prices are positively associated with the lower end of the total debt distribution. This suggests that the relationship between house prices and debt does not arise solely due to home-purchase mortgage debt, and a connection between house prices and non-mortgage debt could exist all along the total debt distribution.

Nevertheless, given the lack of an exclusion restriction and the fact that the direction of causality is not clear between house prices and total household debt (we do not have a valid instrument), we consider these findings to be exploratory in nature.

Appendix C. Possible effects of debt on house prices

Although it is possible that the rise in non-mortgage debt, in particular through HELOCs, could have contributed to increases in house prices, the size of this effect is likely small. To show that this is, indeed, the case, we use the information in our data set about lines of credit. The CFM has always classified lines of credit as secured and unsecured, with additional classification of secured credit lines into home-secured introduced in 2005. As pointed out in Crawford and Faruqui (2012), it is likely that the lines of credit classified as secured prior to 2005 were predominantly backed by housing assets. Combining this information with the purposes of debt in the CFM, we know that in 2007, only 1.3 percent of households report using a HELOC to purchase a residence or business (or alternatively, 1.9 percent of homeowners). Table C1 presents the uses of HELOCs, as well as the average outstanding amount for those with positive balances (note that it is possible that some of the households with zero balances on their HELOCs also actively use them, but repay their balances regularly).

We see that the average household with positive balances on a HELOC has $39,502 outstanding, with $5,622 (or 14.2 percent) used for the purchase of a residence or business (for the 1.3 percent of households that report using a HELOC to purchase a residence or business, the average amount borrowed was $69,361). This is less than the shares of debt used for consumption (16.7 percent), debt repayment (24.6 percent) and other investment (19.5 percent). Given these numbers, it is possible that households' ability to take on debt through instruments like HELOCs influenced house prices, but this effect is probably small.

Table C1
Uses of home equity lines of credit (HELOCs), 2007.

	Amount	% of Total HELOCs
Consumption	6604	16.7
Home renovation	3494	8.9
Debtrepayment	9685	24.6
Investment	13,333	33.7
Purchase of residence/business	(5,622)	(14.2)
Other	6386	16.2
Total outstanding HELOCs	39,502	100.0

Note: Purchase of residence/business is a joint category in the CFM and cannot be separated between the two purposes.

Table D1
Regressions with house price growth.

	Heckman model	
	I	II
Interest rate	−0.031	−0.030
	(0.02)	(0.02)
Income 1	0.043	0.045
	(0.03)	(0.03)
Income 2	0.338***	0.339***
	(0.04)	(0.04)
Income 3	0.772***	0.770***
	(0.06)	(0.06)
Age	−0.042	−0.066*
	(0.03)	(0.03)
Age^2	0.001	0.001*
	(0.00)	(0.00)
Age^3	−0.000	−0.000
	(0.00)	(0.00)
Education (High School)	−0.050	−0.052
	(0.03)	(0.03)
Education (University)	0.115***	0.115***
	(0.02)	(0.02)
Business Owner	0.080**	0.081**
	(0.03)	(0.03)
Adults	−0.011	−0.012
	(0.01)	(0.01)
Labor productivity	0.408***	0.408***
	(0.11)	(0.11)
Unemployment	−0.037***	−0.037***
	(0.01)	(0.01)
House price growth	−0.061	−0.099
	(0.17)	(0.25)
Homeowner	0.068*	0.008
	(0.03)	(0.04)
House price growth*Homeowner	0.050	
	(0.17)	
Constant	9.324***	9.695***
	(0.58)	(0.61)
Combined effects of house prices on homeowners of different age groups		
Age 18–35		0.288*
Age 36–55		−0.092
Age 56+		−0.170
Obs.	105,544	105,544
Uncensored Obs.	52,585	52,585

Note: The dependent variable is house price growth (year-over-year quarterly growth). All other details are the same as columns V and VI in Table 3. *** Significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.

Appendix D. Alternative specification: house price growth

A number of related studies examine the relationship between the growth rate of house prices and either consumption level, consumption growth or debt growth. Campbell and Cocco (2007) focus on the relationship between house price growth and consumption growth, and Disney and Gathergood (2011) and Mian and Sufi (2011) look at the association between house price growth and debt growth. Attanasio et al. (2009) present the results from regressing the level of consumption on house price growth (but their main specification is in log levels).

In line with this literature, Table D1 presents the results of our regression analysis using house price growth (the year-over-year quarterly growth rate of regional house prices), instead of the level of house prices. The combined coefficient on house price growth and its interaction term with the homeownership dummy in column I of Table D1 is not statistically significant, with no relationship found between the growth rate of house prices and non-mortgage debt (note that we do this only for the Heckman model estimates, but the interpretation for the two-part and double-hurdle models are very similar). We present these results for comparison purposes, but urge caution in their interpretation. Our data consist of repeated cross-sections and therefore, we cannot track

Table E1
Mortgage refinancing.

	Amount	% of Equity Extraction
Consumption	5046	10.7
Home renovation	5815	12.4
Debt repayment	15,246	32.4
Investment	17,062	36.3
Other	3865	8.2
Equity extraction	47,035	100.0

changes in individual household homeownership status over the period spanned by the growth in house prices, which may affect our parameter estimates.

Appendix E. Mortgage refinancing

In 2007, households are asked whether they refinanced their mortgage to increase the amount borrowed in the last twelve months. From their responses, we know that approximately 3.3 percent of households refinanced their mortgage (this represents 9.5 percent of all households that have outstanding mortgage debt). The respondents also report the additional amount borrowed with refinancing and the primary reason for increasing the size of their mortgage. Table E1 reports the mean additional amount borrowed through refinancing, as well as the percentage used for consumption, home improvement, debt repayment, investment and other uses.

Conditional on having refinanced their mortgage, the average household borrowed an additional $47,035 through refinancing, 10.7 percent of which went to consumption ($5,046). The vast majority of net debt refinancing was used for debt repayment and investment—combined, they accounted for 68.7 percent of mortgage refinancing. Because we do not have data on mortgage refinancing for all the years in the sample, we are unable to explore the long-term relationship between house prices and consumption supported by mortgage refinancing.

However, we can provide some back-of-the-envelope calculations to give us an idea of what role house prices played in driving consumption growth through mortgage refinancing. To do this, we take the extreme case where we assume that there was zero mortgage refinancing in 1999 and then refinancing resulting directly from house prices increased in a linear fashion each year until it reached the 2007 average number of $47,035. Using a similar methodology as insection 5.2, and holding the share of households refinancing constant at 3.3 percent each year and assuming that households use 10.7 percent of their equity withdrawal on consumption, we calculate that the cumulative change in consumption would have been $22,647 for those households that did refinance. The average across all households would have then been $747 (22,647$\times$ 0.033). This number is larger than the $577 we report as coming from house price increases through non-mortgage debt; however, it is highly dependent on the assumptions made (which may be considered extreme).

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