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Abstract – We analyse the effect of housing wealth on household indebtedness for the period 2002 to 2014 in Australia. Overall we find that approximately one quarter of the growth in household debt during this period can be explained by rising house prices. This rise is mostly driven by the wealth effect associated with rising house prices, and a collateral effect which is present for households that are collateral and liquidity constrained. We uncover a weaker wealth effect for households that have faced negative shocks to income or employment which indicates precautionary behaviour.

JEL classifications: D91, I38, J26.
Keywords: Housing Wealth, Household Debt, Credit Constraint.

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HILDA SURVEY The Household, Income and Labour Dynamics in Australia (HILDA) Survey was initiated and is funded by the Australian Government Department of Social Services (DSS) and is managed by the Melbourne Institute of Applied Economic and Social Research (Melbourne Institute). The findings and views reported in this report, however, are those of the authors and should not be attributed to either DSS or the Melbourne Institute.
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1 Introduction

The international economic turmoil wrought by the Global Financial Crisis (GFC) placed in sharp relief the importance of links between housing and financial markets for macroeconomic stability, and ultimately national wellbeing. Following these events, there have been concerted attempts within the research and policy community to better understand the linkages across these critical markets. We exploit the unique Australian experience of significant housing price growth accompanied by high levels of home ownership and substantial levels of household debt to examine the nature of the relationship between housing wealth and household indebtedness. We identify a significant wealth effect flowing from housing price growth.

It is well recognised that the key to understanding the interconnection of housing and financial markets is to examine how individuals' and households' economic decisions are tied across the two markets. The effects of house prices on household indebtedness can be studied using the life-cycle or permanent income (LC/PIH) model of consumer behaviour. In the simplest version of the LC/PIH model, household spending and borrowing over time depend on expected lifetime income based on the flow of income, and the stock held of financial and non-financial wealth (including housing). Households smooth fluctuations in current income by accumulating wealth - saving when income is relatively high and drawing down wealth through dissaving and debt when income is relatively low. Anticipated changes in wealth are built into consumption plans and unanticipated changes lead to a revision of those plans. Numerous papers have applied this framework to better understand the consequences of house price changes for the borrowing, spending and housing decisions of households (see for example, Miles, 1992; Iacoviello, 2004; Campbell and Cocco, 2007; Attanasio et al., 2011; Windsor et al., 2015). According to the model a real increase in house prices may lead homeowners to increase their consumption over time and enjoy a higher standard of living. Homeowning households raise their consumption level through either dissaving or debt accumulation due to the gain in wealth. This direct effect is referred to as the 'wealth effect'.

The inclusion of uncertainty or capital market imperfections in the form of borrowing constraints in the basic model expands the set of optimal saving and borrowing decisions (see Deaton, 1991; Carroll, 1997). In particular, the LC/PIH model reveals an indirect effect of changes in housing prices on behaviour via borrowing capacity. The borrowing constraint may manifest in two forms - a borrowing limit on non-mortgage debt (a credit or liquidity constraint) and a collateral constraint on mortgage debt.

Hurst and Stafford (2004) show that two predictions concerning households' financial behaviour emerge from this augmented model. First, households will tap into their hous-

ing equity if they receive an unexpected and substantial negative income shock and have low liquid wealth (as distinct from illiquid housing wealth). Households may effectively use their housing equity as a buffer against the income shock. Second, the mortgage debt of households who are credit and collateral constrained will respond positively to an unexpected housing price increase. This response is the housing collateral effect, whereby increasing housing prices help relax the binding collateral constraint experienced by some households.

Disney et al. (2010) note a third prediction of the model when households have access to unsecured debt through the non-mortgage credit market. Unsecured credit attracts a higher interest rate than secured credit due to greater default risk. Given this higher cost, households will favour the cheaper mortgage debt and, whenever possible, are expected to readjust the composition of their debt and consolidate unsecured borrowing into secured borrowing. Here, the increase in housing prices again relaxes the collateral constraint and we expect total debt to increase given that the price of debt has fallen. However, in comparison to the model with no unsecured borrowing, the increase in total debt holdings is expected to be smaller. In summary, the LC/PIH model predicts that changes in house prices may lead households to adjust both their level of indebtedness and the composition of the debt held.

Over the past decade researchers have tried to test these predictions against observational data. Debelle (2004) and Dylan and Kohn (2007) use macroeconomic data from the US and find a strong correlation between increases in the house prices and household debt during the early 2000s. Another strand of literature has directly focused on the effect of house prices on home equity-based borrowing (Greenspan and Kennedy, 2005; Greenspan and Kennedy, 2008; Yamashita, 2007; Cooper, 2010; Cooper, 2013; Mian and Sufi, 2011). These studies find that households do access their home equity in response to house price appreciation. Their results show that homeowners who are credit constrained have the strongest response to house price changes. Recent studies also highlight the importance of the 'collateral effect'. Disney et al. (2010) show that house price movements appear to have an effect on unsecured debt in the UK. They find that rising house prices allow borrowing-constrained households to refinance and increase their overall level of debt. Using US data, Disney and Gathergood (2011) also show that borrowing-constrained homeowners react to higher house prices by accessing their housing equity to finance higher levels of spending.

The purpose of this paper is to provide new and unique Australian evidence on this important link between housing wealth and household indebtedness. To date no paper has examined Australian micro-level household data to examine these questions directly.

Our study is of value for two reasons. First, debt behaviour can differ substantially across countries. Australia experienced a prolonged increase in both housing prices and household debt during the last quarter century. Since the GFC, the rate of growth in house prices has slowed, especially compared to the increase from the mid-1990s. Total household debt and specifically housing debt, on the other hand, have continued to rise. In the mid-1990s, household debt was approximately 50 per cent of household disposable income. This ratio rose to over 150 per cent of income by 2007, with housing debt alone accounting for almost 90 per cent of this, and has since remained constant. We have not observed Australian households reducing their debt burden as witnessed in other countries more severely affected by the GFC, such as the United States and in Europe. Second, compared to many other developed countries, Australia has a high level of home ownership (67.3% in 2015 - comparable to Canada, and marginally higher than that in the US and UK) and high levels of mortgage debt (Badarinza et al., 2016). This makes the impact of house price changes particularly salient to households. Thus, while the Australian experience differs from that of other major economies, our evidence provides valuable new insights into household behaviour and contributes to the international literature.

Our results indicate that during the period 2002 to 2014 in Australia, one quarter of growth in household debt can be attributed to rising house prices. This rise is mostly driven by the wealth effect associated with rising house prices. We also find that collateral constraints have a strong effect on the behaviour of households who have high levels of property debt relative to the value of their property. These constraints limit their ability to extract additional housing wealth following housing price increases. Liquidity constraints also appear to impact upon households with little access to short term credit or who are up against their short term credit limits. We also uncover a significant wealth effect for households that faced negative income or employment shocks. However, the magnitude of the wealth effect for households that experience such shocks is more modest than for those who did not suffer a shock. This suggests that households that experienced shocks may be more cautious about extracting additional housing equity. In addition, we find evidence for a wealth effect in the response of non-mortgage debt. We find that households that are not liquidity or collateral constrained leverage their additional housing wealth to take out investment loans.

In the next section, we describe our empirical strategy. In Section 3, we introduce our data and present summary statistics. Section 4 presents the main results and robustness checks, and the final section concludes the paper.

2 Methods

To test the predictions of the LC/PIH model we estimate the impact of housing price changes on household indebtedness. The econometric methodology employed in this paper is most similar to that of Disney et al. (2010). Here we detail our baseline specification and discuss two important econometric issues. Our baseline specification is

$$\Delta Debt_{it} = \beta_0 + \beta_1 \Delta HP_{it} + x'_{it}\alpha + u_{it} \tag{1}$$

where Δ is the first difference operator, $Debt_{it}$ is household debt, HP_{it} is the measure of house prices and x_{it} is a vector of covariates included to control for household demographics and the level of and changes in household income and non-housing wealth.

The first concern is that our main variable of interest, house prices, are self-reported in our survey data. Self-reported house prices may be endogenous to household debt because households may choose to consume additional housing services via home renovation and finance the renovation through housing equity. The housing renovation would then raise the price of the house and the observed positive relationship between the house price and household debt would reflect a household decision rather than capturing the true effect described above (Disney and Gathergood, 2011). Further, self-reported house prices may suffer from measurement error. Consequently, we use the median house price at the local government area (LGA) level as a proxy for self-reported house prices. Because an individual household should not have an influence on the local housing market, the variation in LGA house prices is plausibly exogenous to an individual household's indebtedness.

The second econometric issue is due to household mobility. Households make a decision to move taking into account the local housing market conditions, and they may finance their purchase of the new residence through mortgage debt. Through this channel observed local housing prices may be endogenous to household indebtedness for the households who move. To eliminate this source of endogeneity we focus on the sample of households that do not move during the observation period. However, the non-moving households may not be a random sample of home-owners and we therefore control for this selection through a Heckman selection model (Disney et al., 2010). The specification of the selection equation is:

$$NotMove_{it} = \alpha_0 + \alpha_1 IntToMove_{i,t-1} + \alpha_2 NS_{i,t-1} + \alpha_3 LCS_{i,t-1} + \alpha_4 CWN_{i,t-1} + v_{it} \tag{2}$$

where $NotMove_{it}$ is an indicator for not moving. We model the selection as a function of four lagged variables chosen to capture the likelihood of moving. These are

the households' self-reported intentions to move, $IntToMove_{i,t-1}$, their satisfaction with their neighbourhood, $NS_{i,t-1}$, their satisfaction with their local community, $LCS_{i,t-1}$, and the frequency with which they chat with neighbours, $CWN_{i,t-1}$. See the Online Data Appendix for more details on these variables.

As noted previously, the LC/PIH model predicts that house price changes may affect both the level and composition of household debt. Accordingly, we estimate (1) for households' total debt, mortgage debt and non-mortgage debt, and sub-components of non-mortgage debt. Our coefficient estimates from specification (1) directly measure the net effect of house price changes on household indebtedness and its composition. To examine the wealth and collateral effects discussed above we extend our model specification.

2.1 Collateral Constraint

The collateral effect channel implies that we should observe a different response to house price changes depending on whether a household is collateral constrained. One measure for the collateral constraint is the loan-to-value (LTV) ratio, that is, the value of the mortgage over the value of property offered as collateral. Households with a high LTV ratio have a higher probability of being collateral constrained while those with a low LTV are more likely to be unconstrained. An increase in housing prices should relax previously binding collateral constraints. Based on the LC/PIH model we expect that households that are collateral constrained will respond to an increase in house prices by increasing their mortgage debt and reducing their unsecured debt, with an overall increase in total debt.

To test these predictions we augment our baseline specification (1) as follows:

$$\begin{aligned}\Delta Debt_{it} = \beta_0 &+ \beta_1 \Delta HP_{it} \times \mathbf{I}(LTV_{i,t-1} = 0) \\ &+ \beta_2 \Delta HP_{it} \times \mathbf{I}(0 < LTV_{i,t-1} \leq 0.5) \\ &+ \beta_3 \Delta HP_{it} \times \mathbf{I}(0.5 < LTV_{i,t-1} \leq 0.8) \\ &+ \beta_4 \Delta HP_{it} \times \mathbf{I}(LTV_{i,t-1} > 0.8) \\ &+ x'_{it}\alpha + u_{it}\end{aligned} \tag{3}$$

where $\mathbf{I}(.)$ is the indicator function, $LTV_{i,t-1}$ is the lagged LTV and we use threshold conditions to separately identify outright owners ($LTV_{i,t-1} = 0$), households with a low ($0 < LTV_{i,t-1} \leq 0.5$), moderate ($0.5 < LTV_{i,t-1} \leq 0.8$) or high ($LTV_{i,t-1} > 0.8$) LTV ratio. We use the lagged LTV value to capture the initial collateral position of households and estimate the impact of house price changes on households conditional on whether or

not they were initially constrained. It is important to note that a high LTV ratio does not necessarily imply that household is borrowing constrained - as by definition a high LTV indicates that household had access to credit market.

We specify the threshold for a high LTV ratio as 0.8, appealing to the Australian institutional context. During our sample period, households could borrow up to the full value of the house in 2002 and 2006 (that is, potentially LTV = 1) while following the GFC this limit was reduced to 95 per cent of the value of the house (LTV = 0.95). However, in most cases households that borrow above a LTV ratio of 0.8 need to pay additional lenders mortgage insurance (ranging from 0.5% to 5% of the mortgage value). This insurance is a significant transaction cost that would likely deter most households from borrowing above the LTV threshold of 0.8. Indeed, we observe that fewer than 5 per cent of households in our sample have an LTV of greater than 0.8.

2.2 Liquidity Constraints and Income Shocks

In addition to estimating the collateral effect, we examine the differential impact of house price changes on households that are either liquidity constrained or experience a negative shock in the form of an unexpected fall in income or unemployment. As discussed above, we expect that these households will be more sensitive to changes in their wealth due to house price changes. Where the data allows we also examine whether households that are both collateral and liquidity constrained, or are collateral constrained and experience a negative shock, are more sensitive to changes in house prices.

More specifically, we employ three measures to identify liquidity constrained households. Our first measure comes from households' self-reported ability to raise emergency funds. We define a household as liquidity constrained if they were unable to raise emergency funds (either $2,000 through to 2008, or $3,000 from 2009) at any time in the past four years.[1] This self-reported measure captures two dimensions of the liquidity constraint – households that could not borrow from financial institutions and households that could not borrow from their network (extended family or friends). Our second measure defines the liquidity constrained as households that are hand-to-mouth (HtM), where the definition of HtM is as proposed by Kaplan et al. (2014). More specifically, a HtM household is one that either carries no liquid wealth or has borrowed up to their credit limit at the end of the pay period.[2] Our third measure classifies households as

[1]This corresponds to the time since the household previously answered questions on their wealth (four years prior) and the current year when they again provide detailed contemporaneous information on wealth.

[2]Kaplan et al. (2014) differentiate between wealthy and poor HtM households defining those who hold positive illiquid wealth as wealthy HtM. In Australia, because of mandatory superannuation retirement

liquidity constrained by their credit card debt balance. If this balance is greater than \$3,000 we consider the household to be liquidity constrained. Because our second and third measures require data only asked in the wealth modules we use these measures as at the previous wealth module, which is 4 years prior.

We also obtain two measures of a negative shock from the data. The first is the negative income shock. For this we decompose the household income process into permanent and transitory components following Blundell et al. (2008) and extract the residual of the income process as a measure of the annual income shock. We classify households with an income shock at or below the 10th percentile of the distribution of shocks in any year in the past 4 years as households suffering a negative income shock. Our second measure is an indicator for whether either the head of the household or their spouse (or both) were unemployed for more than one month at any time in the last 4 years. The Online Data Appendix explains the construction of our liquidity and negative shock measures in greater detail.

The theoretical model predicts that in response to a change in housing prices, households who are liquidity constrained are likely to adjust their debt composition because of their inability to borrow more secured debt and the higher cost of borrowing unsecured debt. For example, if the change in their house price is positive, we expect that they will adjust their debt portfolio towards mortgage debt and away from non-mortgage unsecured debt.

To investigate, we estimate the following equation:

$$\Delta Debt_{it} = \beta_0 + \beta_1 \Delta HP_{it} \times \mathbf{I}(D_{i,t-1} = 0) + \beta_2 \Delta HP_{it} \times \mathbf{I}(D_{i,t-1} = 1) + x'_{it}\alpha + u_{it} \quad (4)$$

where $D_{i,t-1}$ is an indicator variable for households that are liquidity constrained. We use the lagged indicator to capture the initial positions of households and examine whether these households respond to changes in the price of their house in the intervening period. The theory also predicts that households that have experienced negative shocks will also adjust their debt holdings, accessing their housing equity if they are not collateral constrained and increasing their debt to smooth out shocks. We again use equation (4) but define $D_{i,t-1}$ as an indicator variable for whether the household experienced a negative income or unemployment shock in the previous period.

A further theoretical prediction suggests that households are even more likely to tap into their housing equity if they are both liquidity constrained and have experienced a

saving, almost every household that is HtM is wealthy HtM (unless households' net debt in properties is too large) and so we elect to ignore the distinction between the wealthy and poor HtM.

substantial negative shock (Hurst and Stafford, 2004). We examine this prediction with the specification:

$$\begin{aligned}\Delta Debt_{it} = \beta_0 &+ \beta_1 \Delta HP_{it} \times \mathbf{I}(D^{LC}_{i,t-1} = 0) \times \mathbf{I}(D^{NS}_{i,t-1} = 0) \\ &+ \beta_2 \Delta HP_{it} \times \mathbf{I}(D^{LC}_{i,t-1} = 0) \times \mathbf{I}(D^{NS}_{i,t-1} = 1) \\ &+ \beta_3 \Delta HP_{it} \times \mathbf{I}(D^{LC}_{i,t-1} = 1) \times \mathbf{I}(D^{NS}_{i,t-1} = 0) \\ &+ \beta_4 \Delta HP_{it} \times \mathbf{I}(D^{LC}_{i,t-1} = 1) \times \mathbf{I}(D^{NS}_{i,t-1} = 1) + x'_{it}\alpha + u_{it}\end{aligned} \tag{5}$$

where $D^{LC}_{i,t-1}$is an indicator for our measures of liquidity constraint and $D^{NS}_{i,t-1}$ is the indicator for having experienced a substantial negative shock.

Finally, we investigate whether there is a stronger impact of house price changes on those households that are: (a) both collateral constrained and liquidity constrained or; (b) collateral constrained and have experienced a negative shock. Our specification is:

$$\begin{aligned}\Delta Debt_{it} = \beta_0 &+ \beta_1 \Delta HP_{it} \times \mathbf{I}(D_{i,t-1} = 0) \times \mathbf{I}(LTV_{i,t-1} > 0.X) \\ &+ \beta_2 \Delta HP_{it} \times \mathbf{I}(D_{i,t-1} = 0) \times \mathbf{I}(LTV_{i,t-1} \leq 0.X) \\ &+ \beta_3 \Delta HP_{it} \times \mathbf{I}(D_{i,t-1} = 1) \times \mathbf{I}(LTV_{i,t-1} > 0.X) \\ &+ \beta_4 \Delta HP_{it} \times \mathbf{I}(D_{i,t-1} = 1) \times \mathbf{I}(LTV_{i,t-1} \leq 0.X) + x'_{it}\alpha + u_{it}.\end{aligned} \tag{6}$$

In case (a), $D_{i,t-1}$ is an indicator variable for households that are liquidity constrained, and we expect that house price changes will have a strong impact on households that are both liquidity and collateral constrained because of their inability to borrow in the previous period. In case (b), $D_{i,t-1}$, is an indicator variable for whether the household experienced a negative income or unemployment shock in the previous period. We expect that if a household suffers a negative shock (and is not collateral constrained), they will increase their total debt and given the lower cost of mortgage debt we expect that (conditional on transaction costs) they will increase their mortgage debt leaving their non-mortgage, unsecured debt unchanged. In contrast, if a household is collateral constrained (but not liquidity constrained) and suffers a negative shock, then we instead expect to see an increase in total debt and a one-for-one increase in their non-mortgage debt.

3 Data and Summary Statistics

3.1 Data

The dataset employed in this study is the un-confidentialised Household Income and Labour Dynamics in Australia (HILDA) Survey Release 14.0. HILDA is a longitudinal survey of approximately 7000 households that has been in the field annually since 2001. The survey covers a broad range of Australian households' economic and social behaviours and the sample is designed to be representative of the Australian population.

Detailed questions relating to household finance have been asked in the wealth modules included in the 2002, 2006, 2010 and 2014 wave of the HILDA Survey. As these data include a consistent set of questions on household wealth, including the values of household mortgage debt and non-mortgage debt, we restrict our sample to these four waves. We use the un-confidentialised data (which included detailed location information) in order to match households with LGA house price information. We construct an unbalanced panel of households where the household head is aged between 20 to 75 years. The sample is limited to home-owning households who responded in two consecutive waves, providing us with an unbalanced panel of 4101 unique households and 10726 observations. We discuss the characteristics of our sample below, and full details of the sample selection procedure are provided in the Online Data Appendix.

Household finance variables are reported at the household level and are constructed as follows: the value of the household's properties is defined as the reported value of the principal or owner-occupied residence plus the reported value of other properties; household income is household gross annual labour income plus public transfers plus non-labour income; financial wealth is the total of equity investment, cash investment, trust and bank accounts; mortgage debt is the total value of debt collateralised on property - both the owner-occupied home and other properties; non-mortgage debt includes vehicle loans, investment loans, personal loans, student loans and credit card debt; and the loan-to-value ratio (LTV) is defined accordingly as the total mortgage debt over the total property value.

As noted above, an important concern is measurement error in self-reported property values. We correct for this by using LGA-level median house prices in place of the self-reported value for the owner-occupied home. For other property assets, we do not know the property's location so we use the metropolitan statistical region (MSR)-level median house price instead.[3] Our area median house price series are constructed from the *RP*

[3]Approximately 20% of home-owning households in our main sample own 'other properties'. Our results are robust to using the state level aggregate or the national level aggregate house price as our proxy for other properties.

Data historical house price dataset. This dataset contains monthly median house and unit sale prices at the LGA (council) level across Australia from January 2000. We convert these monthly price series into quarterly or annual series as needed and match this data to HILDA by the LGA or MSR code using the 2011 ASGS geographic codes, house type (unit or house) and the interview month. Our sample includes approximately 340 LGAs from the 568 LGAs across Australia in 2011.

3.2 Summary Statistics

Table 1 displays demographics and household finance summary statistics for the four survey years. For our panel, household demographics are relatively stable over these four waves due to our selection criteria. The mean age of heads is 48.2 years in 2002 and 53.4 years in 2014. Approximately 60% of household heads are male, more than 70% of household heads reside with a partner and on average households have one child.

Despite the stability in demographics, household financial positions exhibit substantial variation over the observation period. While household income grew at between 2 and 3 per cent per annum from 2002-2014, financial wealth increased by 6.5 per cent per annum between 2002 and 2006 before shrinking at a rate of 1 per cent per annum across the GFC years (between 2006 and 2010) and then recovering to a modest annual pace of growth of 1 per cent per year between 2010 and 2014. The value of owner occupied housing was growing at a rapid 8.6 per cent per annum at the beginning of our observation period, before slowing to an annual growth rate of 2 per cent between 2006 and 2010 and then shrinking very slightly in the post GFC years between 2010 and 2014. A similar pattern of growth is observed in LGA median housing prices. We present further evidence of the house price slowdown in Figure 1 which plots the annual house price growth aggregated at the state level and the national level (calculated from *RP Data*). Although there is a substantial variation across states, house price growth was generally trending upward in every state prior to 2008 before reversing in the years since 2008.

Turning to our sample of households' debt holdings, we observe that average total household debt has grown over the sample period although the pace of growth has slowed over the period. This pattern is also seen in average household mortgage debt, thus mirroring, though not matching in scale, the slowdown in housing price growth. Consequently, average LTVs fell between 2002 and 2006, before increasing since then. Average non-mortgage debt grew strongly between 2002 and 2006 at 13.6 per cent per annum before slowing to a grow at 2.3 per cent per annum between 2006 and 2010. On average, between 2010 and 2014 households reduced their non-mortgage debt at a rate of 3 per cent per annum.

One way to look at the cross-sectional variation in the characteristics of our sample is to consider the variation by household LTV. It is evident that households with high LTVs tend to be younger, which reflects that earlier in the life cycle households are more likely to have recently purchased housing and as yet have not built up much housing equity. The households with the highest LTVs also tend to have the smallest financial wealth, smallest value of owner occupier housing and the lowest net worth relative to households with a lower LTV. Through to 2010, this group also appears to accumulate more debt - both mortgage and non-mortgage - than the other two groups with lower LTVs. However between 2010 and 2014, the high LTV households show a larger reduction in their level of debt, and in both mortgage and non-mortgage components.

In Table 2 we examine the characteristics of our sample of households by whether or not they are liquidity constrained and whether or not they have experienced an income or unemployment shock. In general we observe that those that are liquidity constrained or that have suffered a negative shock share common characteristics. However, in some dimensions the groups that have suffered a negative income shock or have a high credit card debit appear to differ from other constrained or shocked households.[4] First, we note that for each measure of liquidity constraints, those that are constrained by one measure are also more likely to be constrained according to our other two measures and they are also more likely to have experienced an unemployment shock. However, they are slightly less likely to have experienced a negative income shock. Similarly, those that are liquidity constrained or that have experienced an unemployment shock also have higher LTV ratios, lower financial wealth, lower property wealth, and lower net worth on average, while those who have experienced a negative income shock have lower LTVs and higher wealth on average. Households that experience shocks or that are liquidity constrained have lower household income, although this is not the case for households with a high credit card debt. Overall, our measures of liquidity constrained households appear to identify a broadly similar group of households while our two negative shock measures, while positively correlated, appear to capture somewhat more disparate groups of households.

3.3 The relationship between debt and housing prices

For a more complete understanding of the distribution of the collateral position and financial wealth of our sample of households, we plot the empirical distribution function

[4]The hand-to-mouth households are those who either maintain a small amount of liquidity or have used all their liquidity, while those who self-report to be constrained could be households with no access to liquidity (and credit) or who have exhausted their liquidity.

of mortgage debt, total debt, non-mortgage debt, LTV and net worth of Australian households across 2002-14 in Figures 2-6. From the cumulative distribution function one can read off the percentage of the sample that has more or less debt or wealth in a particular year, illustrating both the cross-sectional and time-series variation.

From Figure 2 we see that just over 40% of Australian households have no mortgage in 2002 while by 2014 this proportion has dropped slightly and the distribution of mortgage debt has generally shifted outwards and to the right, indicating an increasing concentration of households with larger mortgage debt. The scale of shift between successive waves has lessened over time.[5] Figure 3 for total debt exhibits a similar pattern to that shown in Figure 2 for mortgage debt, reflecting the fact that mortgages are a substantial component of households' total debt holdings. Figure 4 also shows a outwards shift in the distribution of non-mortgage debt between 2002 and 2006 at least for debt levels of $15000 and above. The distributions for 2006 and 2010 are difficult to distinguish, while we observe that between 2010 and 2014 the distribution of non-mortgage debt has twisted, shifting outwards at lower levels of non-mortgage debt and shifting inwards at higher levels of non-mortgage debt.

Figure 5 displays the empirical distribution function for the LTV ratios. Between 2002 and 2006 we clearly observe that the share of households with LTV ratios of between around 0.1 and 0.8 fell. Between 2006 and 2010, the LTV ratio distribution shifts outwards – this may be a reflection of the effects of the GFC if households have taken out additional mortgage debt to smooth financial stress. Finally, between 2010 and 2014, the LTV distribution shifts outwards again across the distribution.

Figure 6 illustrates the distribution of household net worth. In each wave there are approximately 12 households possessing negative net worth. For the majority of households with positive net worth, we observe that the distribution has consistently shifted outwards over the sample period reflecting a general increase in net worth across households. The largest gain is between 2002 and 2006, while between 2006 and 2010 the gain in net worth is much smaller and households at both the upper and lower ends of the wealth distribution experience no real gain in net worth. Between 2010 and 2014, the net worth of households across the distribution again increases.

Pursuing our preliminary examination of the distribution of debt and wealth one step further, we examine the association between housing values and household indebtedness using quantile regression. This analysis serves to examine whether the relationship be-

[5]To statistically test these differences, we use the test for stochastic dominance developed by Barrett and Donald (2003). The results are summarised in Table A1 of the Online Data Appendix. The test results confirm the visual examination. For example, the 2006 mortgage debt distribution first order stochastically dominates (FOSD) 2002, 2010 FOSD 2006, 2014 FOSD 2010 and 2014 FOSD 2002.

tween the value of a households' gross housing wealth and their debt varies across the distribution of debt. Here we focus on the wealth distributions independently, treating them as separate cross-sections. For each year, our specification regresses total household debt on the self-reported value of property for all home-owning households. We present the results graphically, plotting the estimated coefficients from quantile regressions at an 0.05 increment starting from the 0.05 quantile through to the 0.95 quantile for total debt across four waves in Figure 7.

The OLS coefficient plots suggest that the association between the value of housing and household debt has strengthened over the period, particularly between 2002 and 2006 when the mean association between the value of housing and household total debt almost doubled during the housing boom. The OLS coefficient estimate on housing value indicates that a $10000 increase in the value of property is associated with an approximate $2000 increase in total debt since 2006, ceteris paribus. Turning to the quantiles of household total debt, we observe substantial heterogeneity in the association between the value of property held and household total debt. The higher is the conditional quantile of household debt, the stronger the association between that value and the household's gross housing wealth; and this relationship strengthens over the period.

In summary, our preliminary investigation of the data shows: (i) there is strong positive association between house prices and overall household indebtedness; and (ii) there are important differences in the relationship between house price and household indebtedness across high- and low-debt households. Given the heterogeneous association across household debt positions, we now turn to our detailed analysis of households' behavioural responses to housing price changes.

4 Results and Discussion

As discussed in Section 2, our main analysis utilises household panel data over the period from 2002 to 2014 to investigate the impact of rising house values on household debt and to uncover the underlying transmission mechanism that links house prices and household debt. Table 3 presents estimates for the baseline specification (1). For brevity, we only present coefficient estimates for the main variable of interest, the change in the value of housing, which is the sum of the value of owner-occupied housing and other property if any. We address the potential endogeneity and measurement error in self-reported housing value by proxying with the contemporaneous LGA median sales price and we correct for the selection of non-moving households.[6] Full results are reported in the

[6]Robust standard errors are presented in all tables. We also check the results with standard errors clustered at LGA level - our results are qualitatively unchanged and in most cases the p-values are

Online Data Appendix.

Each column of each panel in Table 3 presents the estimates for a different dependent variable. In Panel A, the first column shows that a real dollar increase in the price of housing increases a household's total debt by 27 cents, holding other factors constant. This estimate suggests that approximately one quarter of the growth in household debt during this period may be attributed to rising house prices. The LC/PIH model predicts that house price increases should increase the level of secured debt held while decreasing (or leaving unchanged) unsecured debt. Decomposing total debt we find that a one dollar increase in the value of housing and property assets is responsible for a 23 cent increase in mortgage debt and a 3 cent increase in non-mortgage debt. Thus, while we do find that secured mortgage debt increases with an increase in housing prices, we also find a small increase in non-mortgage debt.

We then further decompose non-mortgage debt in order to explore what may be driving the unexpected positive association between housing prices and non-mortgage debt. In columns (4) and (5) of Panel A, we separate non-mortgage debt into two components, other debts and credit card debt. The largest part of the unsecured component is credit card debt, and we find that the response of credit card debt to house price changes is economically small and statistically insignificant. This accords with the predictions of the model: unsecured debt should decrease or remain unchanged in the face of an increase in wealth from a house prices increase. Instead, the positive response of non-mortgage debt to house price changes mostly comes through the 'other debt' component. Due to data limitations, we cannot further decompose this category using the full sample period. However, we can explore this decomposition using the data from 2006-2014. In Panel B, using a sample restricted to the subperiod 2006-2014, we examine the effect of house prices on the components of other debt. It is clear that the increase in the non-mortgage debt is mainly driven by changes in a secured component of this debt: investment loans.

One plausible explanation for this finding is that households are increasing their investments in shares when house prices increase and the value of their property portfolio increases. We classify this as a wealth effect. A similar wealth effect channel has been identified in the US: Mian et al. (2013) find an increase in vehicle spending out of an increase in housing wealth. We also note that investment loans are most likely margin loans. Consequently, there is some risk that the increase in investment loan debt is a

extremely similar. For our selection equation, the likelihood of the household being a non-mover decreases with the household's intention to move (coefficieint -0.88, se 0.07), increases with satisfaction with their local community (coefficient 0.09, se 0.03), increases with the frequency with which they chat with neighbours (coefficient 0.16, se 0.03) and is insignificantly affected by their satisfaction with their neighbourhood (coefficient -0.03, se 0.03). The coefficients on the exclusion restrictions are jointly significant at the 5% level.

mechanical increase in value of the loan following a margin call rather than a behavioural response to increasing housing wealth, yet we judge this to be unlikely. The aggregate data shows that, over the two four year periods from 2006-2010 and from 2010-2014, the total margin lending outstanding and the value of the underlying securities has fallen. Furthermore, the average number of margin calls per 1000 clients is just 1.2 over the period from 2006-2014, despite hitting a peak of 8.6 in Dec 2008.[7]

Next, we examine whether households are more sensitive to changes in housing prices if they face borrowing constraints in the form of collateral constraints before turning our attention to households that are liquidity constrained or that have experienced negative shocks.

Table 4 presents our main estimates distinguishing households by their initial LTV positions, that is, their LTV in the previous wealth module. This model specification (3) uses the initial LTV as a measure of the collateral constraint faced by the household, interacting the change in the value of housing assets with a series of indicator variables that distinguish households by their initial LTV positions. We distinguish between the behaviour of those households that were outright owners at the previous wealth survey from those with a modest amount of property debt relative to the vale of the property (i.e. LTV), those with a moderate LTV and those with a high LTV ratio. Here, in column (1), we observe a positive wealth effect for households without pre-existing mortgage debt. These households appear to access the additional wealth gained from the increase in housing prices by taking out additional debt.[8] In column (2) we observe that these households do not appear to adjust their non-mortgage debt when housing prices increase. These findings accord with our expectations: households that own their home outright are presumably not collateral constrained and so if necessary they can access cheaper secured debt rather than unsecured non-mortgage debt.

Turning to households who previously had low or moderate LTVs, we observe that they respond strongly and significantly to an increase in housing prices by increasing their total and non-mortgage debt. Moreover, the higher the LTV (while still being less than or equal to 0.8) the more sensitive their debt holdings are to the change in housing prices. This suggests that households with intermediate LTV ratios do not face collateral constraints. We interpret these findings as strong evidence for a wealth

[7]Author calculations based on Table D10 from http://www.rba.gov.au/statistics/tables/, Reserve Bank of Australia.

[8]Some 18% of households who were outright owners at the previous wave have some property debt at the next wave. Of these, 80% take out some debt on their own home and for 52% the additional home mortgage debt is associated with moving house. Those that take on new property debt tend to be younger, have higher average incomes but have similar net wealth to those that do not take on new property debt.

effect: these households extract their new housing wealth by increasing their total debt (and indeed do increase their mortgage debt (not shown)). In addition, these households also significantly increase their non-mortgage debt. In light of the results discussed above from Table 3, the increase in non-mortgage debt can also be interpreted as a wealth effect as households leverage their additional housing wealth to take out loans for investment purposes. It is also notable that, not surprisingly, the magnitude of the effect for indebted households is greater than that for outright owners.

In contrast, the total debt and non-mortgage debt of households with initial LTV ratios above 0.8 does not appear to respond to changes in house prices. Approximately 100 households, or 4% of the sample, have these high LTV ratios in each year of the survey.[9] We interpret this finding as an indication that these households, who are the most likely to be collateral constrained, are indeed borrowing constrained and do not significantly adjust their total debt or their non-mortgage debt when house prices change.

In Table 5 we examine the differential impact of house price changes on households that are liquidity constrained. Across our three measures of liquidity constraint, we observe that households who are liquidity constrained, as well as those who are not, respond to house price changes by increasing their total debt. That is, there is significant evidence for the wealth effect for households regardless of whether they are liquidity constrained. It appears that all home owning households increase their total debt in response to a change in housing prices. In contrast, in columns (4)-(6) we observe that the estimated effect of a change in housing prices on non-mortgage debt for liquidity constrained households is generally insignificant, while the unconstrained do increase their non-mortgage debt significantly. This finding is in line with the theory - those households that are liquidity constrained, though not collateral constrained, are expected to access their increased housing equity by taking out more mortgage debt but we do not expect to observe an increase in their non-mortgage debt as this incurs a higher cost. In summary, we find a wealth effect for both liquidity constrained and unconstrained households. However, the wealth effect is weaker for liquidity constrained households as they do not take on further non-mortgage debt - they appear to be unable or unwilling to leverage their additional housing wealth to take out loans for investment purposes.

Turning to Table 6 we assess whether the response to a change in housing prices varies according to whether the household experienced a negative shock in the previous four

[9]The number of households whose LTV is greater than 0.8 is 80 in 2002; 62 in 2006, 85 in 2010 and 124 in 2013. While Dungey et al. (2015) find that some 16 per cent of newly originated owner-occupier mortgages in Australia from the period 2003-2008 have an LTV greater than 0.8 (author calculations from Table 1), our sample comprises both new and existing loans. As such, we are not surprised that the share of high LTVs in our sample is lower.

years. Using either of our measures for a negative shock - to income or employment - we find that households who did not experience a negative shock increased their total debt by significantly more than those who did experienced an income shock. Nevertheless, for households who have faced a shock we still find significant evidence for the wealth effect. These households do increase their total debt but do not increase their non-mortgage debt. This finding is in line with the predictions of the theoretical model - households that are not collateral constrained (which is most of our sample given the small share of households with high LTVs) are expected to access their increased housing equity by taking out additional debt and we expect to find larger changes in their total debt (and implicitly in their mortgage debt) than in their more costly non-mortgage debt component. Indeed, it is worth noting that the estimates for households that have not experienced a shock are quite similar to those for the whole sample in Table 3, while those that experience a negative shock increase their total debt by less. Those households that have suffered a negative shock extract less of the additional housing wealth - corresponding to a weaker wealth effect or perhaps evidence of precautionary behaviour.

4.1 Are some households more sensitive than others to changes in housing prices?

Given these findings, we further explore the predictions of the theoretical model and examine whether households that are both collateral and liquidity constrained, or that are either collateral or liquidity constrained and have experienced a negative income shock, are more sensitive to changes in housing wealth.

In Table 7 we examine the differential impact of changing housing prices across households that are liquidity constrained and have experienced a negative shock to household income or employment. Among households that did not experience a negative shock, there is evidence that those that are liquidity constrained (at least those that are hand-to-mouth) increase their total debt by significantly more than those that are not liquidity constrained. These findings accord with our results in Table 5. We also find that, whether liquidity constrained or not, households that experience a negative shock adjust their total debt by less than households that did not experience a negative income shock. Indeed, in contrast to the theoretical prediction that households experiencing a combination of liquidity constraint and negative shocks should be more likely to extract additional housing equity when housing prices rise, we find that these households increase their indebtedness by less than those that are not liquidity constrained and did not experience a negative economic shock. This accords with our earlier finding that

households experiencing shocks seem to be less likely to extract the new housing wealth through increases in debt.

Turning to non-mortgage debt, we find that households that experience a negative shock, irrespective of liquidity constraints, leave their non-mortgage debt unchanged in response to a change in housing prices. Looking across our three measures of liquidity constraints, the evidence consistently indicates that only households that are not liquidity constrained and have not experienced a shock appear to increase their non-mortgage debt in response to a change in the value of their property. One interpretation is that liquidity constrained households indeed cannot access additional non-mortgage debt even if they should need to in the face of a negative economic shock. Those that are not liquidity constrained and who experience a negative shock appear to prefer to smooth the effects of the shock through mortgage rather than more expensive non-mortgage debt.

In Table 8 we examine the differential impact of changing housing prices according to the degree of collateral constraint the household faces, and whether they are also liquidity constrained. Households that are both collateral and liquidity constrained will have limited access to additional debt. Indeed, in the final two rows of the Table 8 we find some evidence that households with LTV ≥ 0.8 appear to be borrowing constrained: in response to an increase in housing prices they do not significantly increase either their total or non-mortgage debt.[10] The collateral constraint appears to dominate, with even those households that are not liquidity constrained not responding to the change in housing prices. For households that are not collateral constrained (with an LTV between 0 and 0.8), liquidity constraints do appear to bind. These households respond to the increase in housing prices by increasing their total debt (and implicitly their mortgage debt) but they do not, or possibly can not, increase their non-mortgage debt. In contrast, with the exception of outright owners, those households that are not collateral constrained and are not liquidity constrained do increase their non-mortgage debt. In light of our findings in Panel B of Table 3 discussed above, these households appear to be experiencing a wealth effect and leveraging their additional housing wealth to diversify their investment portfolio by investing in stocks.

Finally, we consider those households that are both collateral constrained and have experienced a negative shock to income or employment in Table 9. For households that are outright owners or have low or moderate LTVs, we observe similar findings to those reported in Table 6. Households who experienced a negative shock increase their total debt by significantly less than those who did not experience an income shock

[10]Note that a relatively small number of observations (22-60 per wave) identify the coefficient for those households that are collateral and liquidity constrained (in the final row of the table).

and they do not increase their non-mortgage debt. Our results for households that are collateral constrained and experience an employment shock indicate that these households are borrowing constrained and unable to smooth the shock through either mortgage or non-mortgage debt. In contrast, the results for collateral constrained households that experienced a negative income shock do not accord with our theoretical predictions - while these households are expected to increase their non-mortgage debt to smooth the shock, we would not expect them to be able to access additional mortgage debt (which they appear to have done given the increase in total debt exceeds the increase in non-mortgage debt). It may be that despite LTV ≥ 0.8, these households are not collateral constrained. Indeed, in Table 2 we see that these households have higher financial wealth and net worth than the households who did not experience a negative income shock, and this may obviate any collateral constraints faced.

4.2 Robustness checks

Here we address three potential concerns. First, we examine whether the responsiveness of household debt to housing price changes, that is, the wealth effect, varies across households at different stages of the life-cycle. We have two goals. One, to show that our findings thus far are not simply a product of ageing through the life-cycle, and two, to examine whether our findings on total and non-mortgage debt vary with the life-cycle. Second, we check whether rising house prices affect the probability of refinancing the mortgage on the owner-occupied home. This serves as a robustness check on our finding that households respond to rising house prices by taking out additional debt, as in order to do so, at least some households must refinance their mortgage. Finally, to address the potential concern that the changes in housing prices are a proxy for local economic conditions we include the LGA unemployment rate as an additional control for these economic conditions.

To address the first concern relating to age effects, we re-estimate our baseline specification separately on three sub-samples defined by age of the household head: 20-39 years of age; 40-54 years of age; and 55 years of age and older. Our estimates are presented in Table 10. We find that a one dollar increase in the value of housing and property assets is responsible for a 16 - 36 cent increase in total debt. That is, there is a significant wealth effect across all ages. Nevertheless, the effect is decreasing in age: those households close to or post retirement age (the 55 plus age group) appear to be the least sensitive to changes in housing prices. This may reflect two key factors important in this stage of the life-cycle. First, these households may choose not to access these housing wealth gains through down-sizing either due to a preference to hold onto the

family home, or due to incentives driven by the institutional context in which the own home is excluded from the public pension means tests based on assets. Second, given these households have a limited capacity to repay any additional mortgage debt through labour earnings, financial institutions may be less willing to extend additional mortgage credit to these households. Further, we find that only households in their middle-age significantly increase their non-mortgage debt in response to a change in housing prices. Recall that from our main results for this baseline specification we found that the result for non-mortgage debt was driven by other loans (specifically investment loans). Here, for the middle age group we find the same again. Meanwhile, the young and the older households appear to act more closely in accordance with the predictions of the basic LC/PIH model.

As our results demonstrate that households respond to rising house prices by taking out additional debt, we conduct a robustness check on this result by examining whether rising house prices affect the probability of refinancing the mortgage on the owner-occupied home.[11] We present our findings for our baseline specification in Panel A of Table 11 where the dependent variable is now an indicator variable for whether households refinanced in the past four years. In Panel B we assess whether there is a collateral effect, allowing for an interaction with the lagged LTV ratio. For ease of interpretation we rescale the house price changes variable - a one unit change in house price is equivalent to a one million dollar change. We present the average marginal effects of the change in housing prices and we allow for an interaction effect with whether or not the household owns only an owner occupied home or also additional property. We find that a $1m increase in the housing price increases the average probability of refinancing by a small but statistically significant 4.7 percentage points. This effect is only present for those households who do not own additional property.

When we interact house price changes with LTV thresholds, we observe that for outright owners who own only their own home, the probability of refinancing is significantly and negatively affected by a change in house prices, with the average probability falling by 0.18. In contrast, those that own only their own home but have outstanding mortgage debt and small or moderate LTV ratio are roughly 10 percentage points more likely to refinance. Thus, we find evidence supporting our earlier findings of a wealth effect from housing price gains - the additional wealth is associated with a higher probability

[11]Note that we may expect a weaker result here as house price growth may have a more modest effect on the probability of refinancing than on the level of debt because households may choose to tap into housing equity through lines of credit or redraw facilities rather than formally refinancing their mortgage debt on their own home. Other households with additional property may refinance their mortgages on these additional properties which we cannot observe directly.

of refinancing and thus households indeed appear to extract this additional wealth from their owner occupied home. We find no effect on the probability of refinancing for those with a high LTV, reinforcing our earlier findings that these households are collaterally constrained. For households that also own additional property, we only find a significant effect on refinancing for those who own their own home outright. These households are 15 percentage points more likely to refinance their mortgage on their own home in response to an increase in housing prices. This is consistent with our previous findings on the wealth effect from housing price rises flowing through to households' investment portfolios.

One remaining concern may be that the changes in housing prices we exploit to assess the effects of housing wealth on household indebtedness are highly correlated with and act as a proxy variable for local economic conditions. If this were the case, our results would imply that an improvement in economic conditions increases household indebtedness perhaps through some kind of household confidence mechanism. However, we confirm that our findings do not reflect the effect of local economic conditions by including the unemployment rate for the LGA in each of our main specifications. Our findings are qualitatively unchanged and in many cases extremely similar.

5 Conclusion

While many commentators recognise the role that the housing market had in fuelling consumption and economic growth over the previous decade (Case et al., 2005), the GFC exposed the potential for significant negative spillovers between the housing market and the broader economy. Although Australia was not hit particularly hard by the GFC compared to the US and the UK, patterns in household saving ratios, LTV ratios and bank lending rates substantially changed after the GFC. The increases in housing debt prior to the GFC and the dramatic decline in house prices in many countries following the GFC highlight a self-reinforcing link between housing and the broader economy. Subsequent increases in both house prices and housing debt have raised concerns regarding future economic and financial instability (OECD, 2012).

The objective of this paper is to identify the nature and magnitude of the relationship between house prices and household debt. It is well known that there is a positive relationship between house prices and household debt. However, empirical estimates of the magnitudes of this relationship are scarce and limited to the UK and the US. The Australian case has been less well studied, yet with a high level of home and mortgage ownership and significant spatial and time variation in housing prices, it provides

additional novel evidence for the international literature.

Our descriptive analyses show a strong relationship between house prices and household debt and its mortgage and non-mortgage components. There is a clear heterogeneity in the relationship between house price and overall household indebtedness between high- and low-debt households. Households with a greater debt burden are the most sensitive to house price changes. That is, in response to an increase in house prices these high-debt households increase their debt more than low-debt households.

The GFC highlighted important links between housing markets, financial markets and the broader economy that in part reflected house price-related wealth effects. Our formal analysis confirms this and underlines the importance of house prices for monetary policy. Our results indicate that during the period 2002 to 2014 in Australia, one quarter of growth in household debt can be attributed to rising house prices. This rise is mostly driven by the wealth effect associated with higher house prices. Our findings complement recent research undertaken by the Federal Reserve Boards in the US that show a strong connection between household indebtedness and house prices (Mian and Sufi, 2011; Glick and Lansing, 2010; Jordà et al., 2014). We identify a wealth effect of house prices on households that own their homes outright (with no outstanding mortgage) and also on the debt holdings of all but the most highly leveraged households. Moreover, we also find evidence for a wealth effect in the response of non-mortgage debt. More specifically, we find that households leverage the additional housing wealth to take out investment loans. Households appear to diversify their investment portfolio in response to the rise in housing wealth. For the most leveraged households we find that collateral constraints limit their ability to extract additional housing wealth following housing price increases. Liquidity constraints also appear to impact upon households with little access to short term credit or who are up against their credit limit. These households experience a wealth effect from housing price increases, but unlike their unconstrained counterparts, they do not leverage this wealth to diversify their investment portfolios. We also uncover a wealth effect for households that have faced negative shocks to income or employment. However, the magnitude of the wealth effect for households that have experienced a negative is more modest than for those that did not suffer a shock. This suggests that households that have experienced negative economic shocks may be more cautious about extracting additional housing wealth.

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Figure 1: Housing Price Growth in Australia

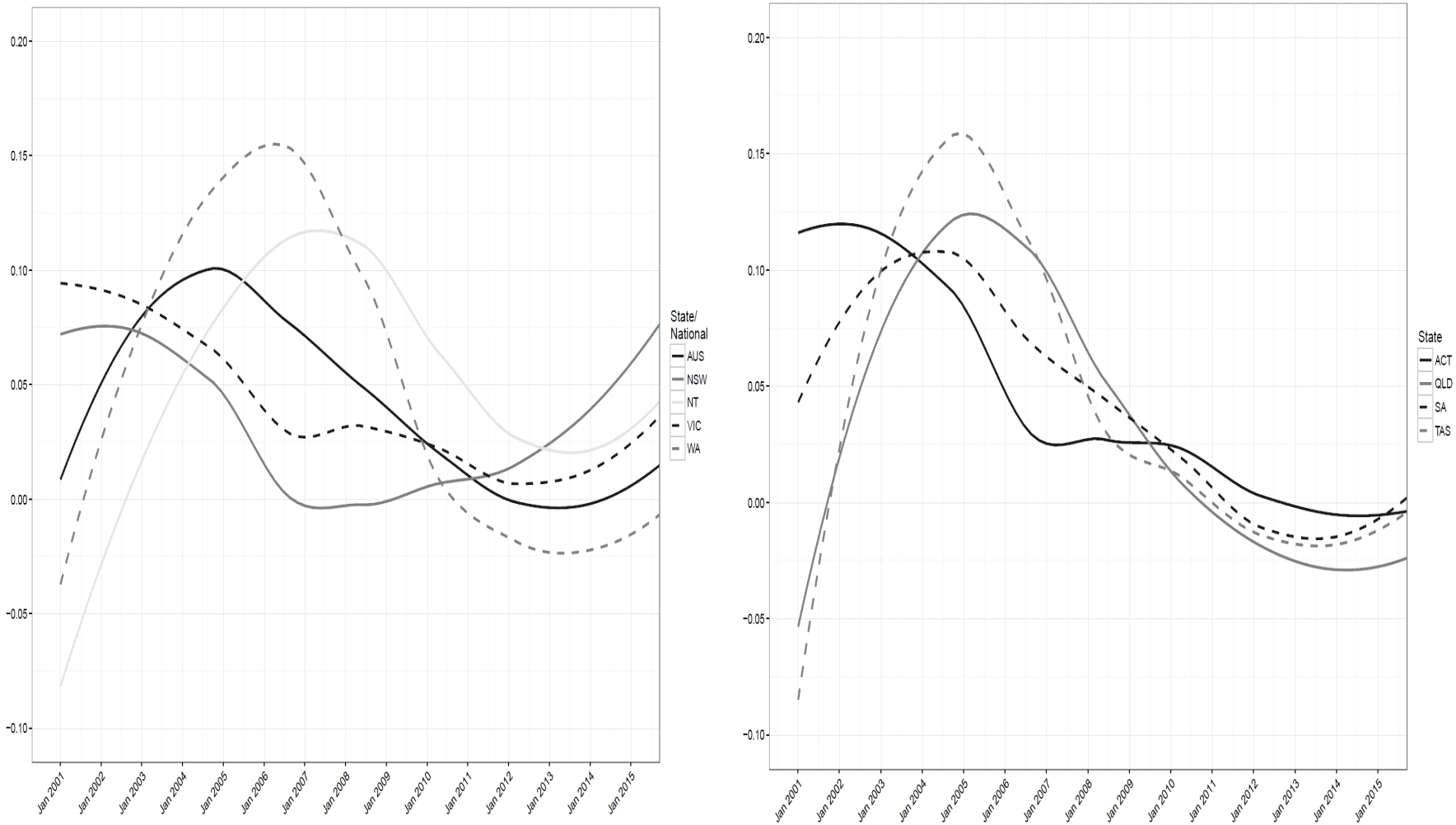


Figure 2: Empirical Distribution of Total Mortgage Debt

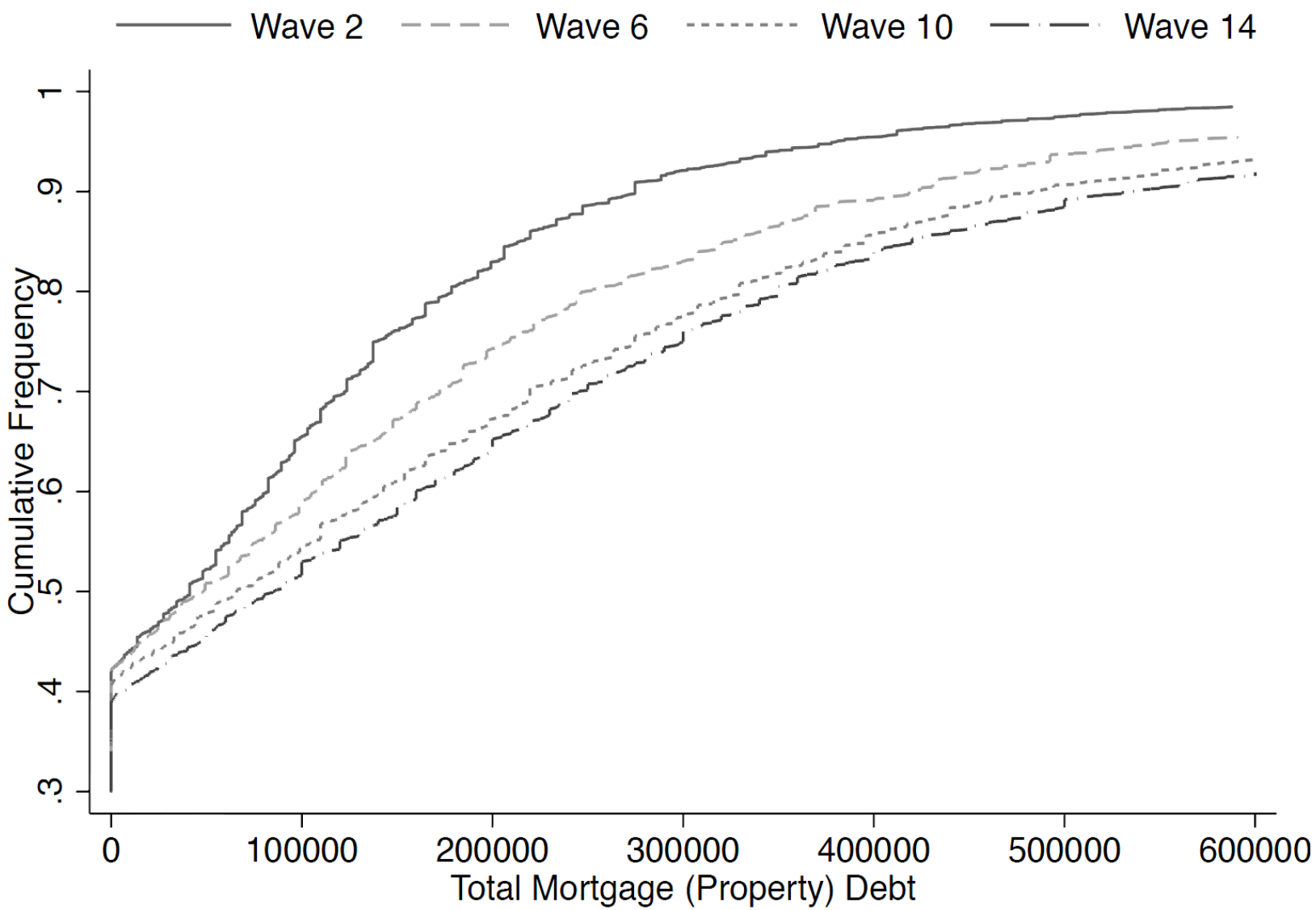


Figure 3: Empirical Distribution of Total Debt

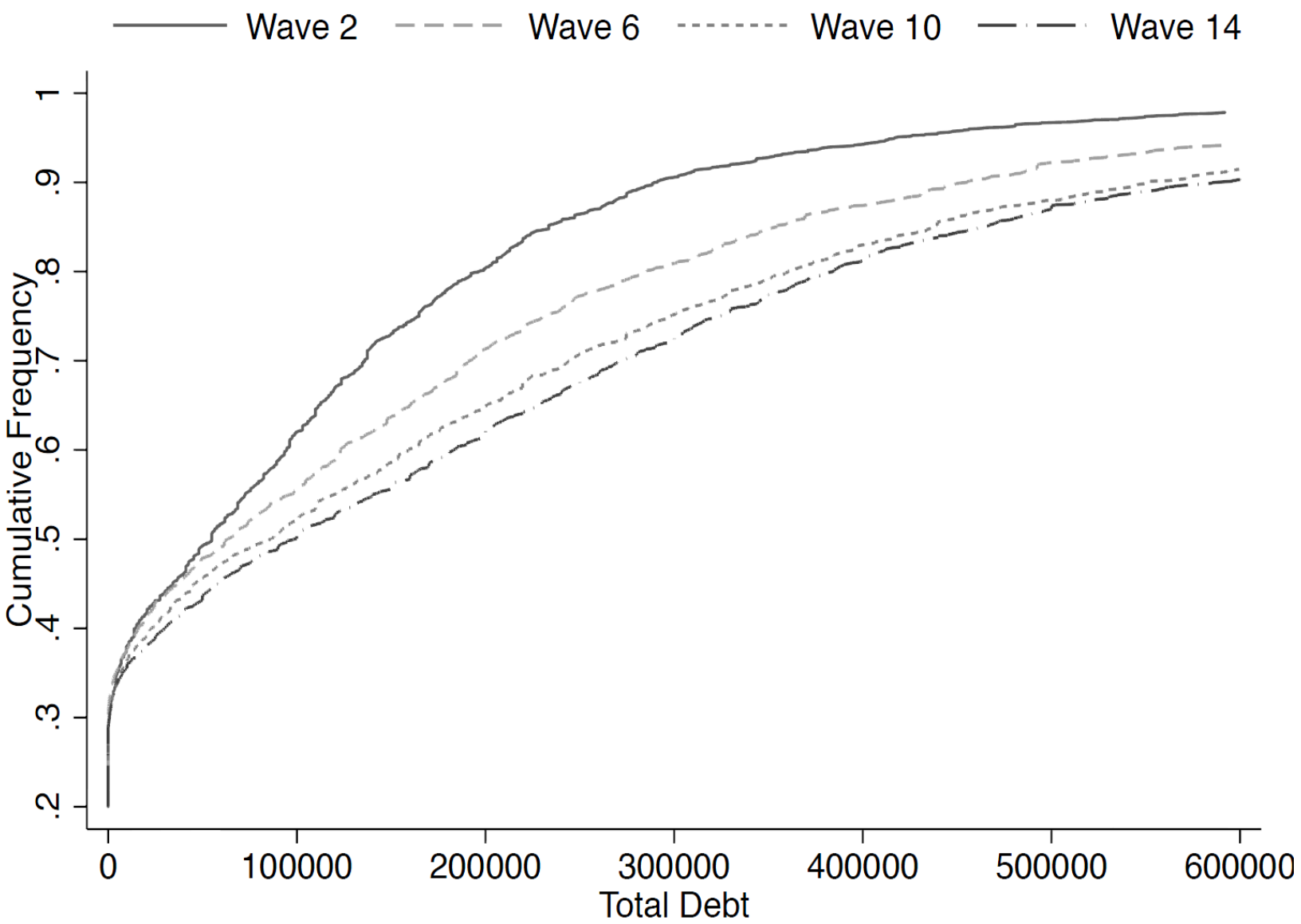


Figure 4: Empirical Distribution of Non-mortgage Debt

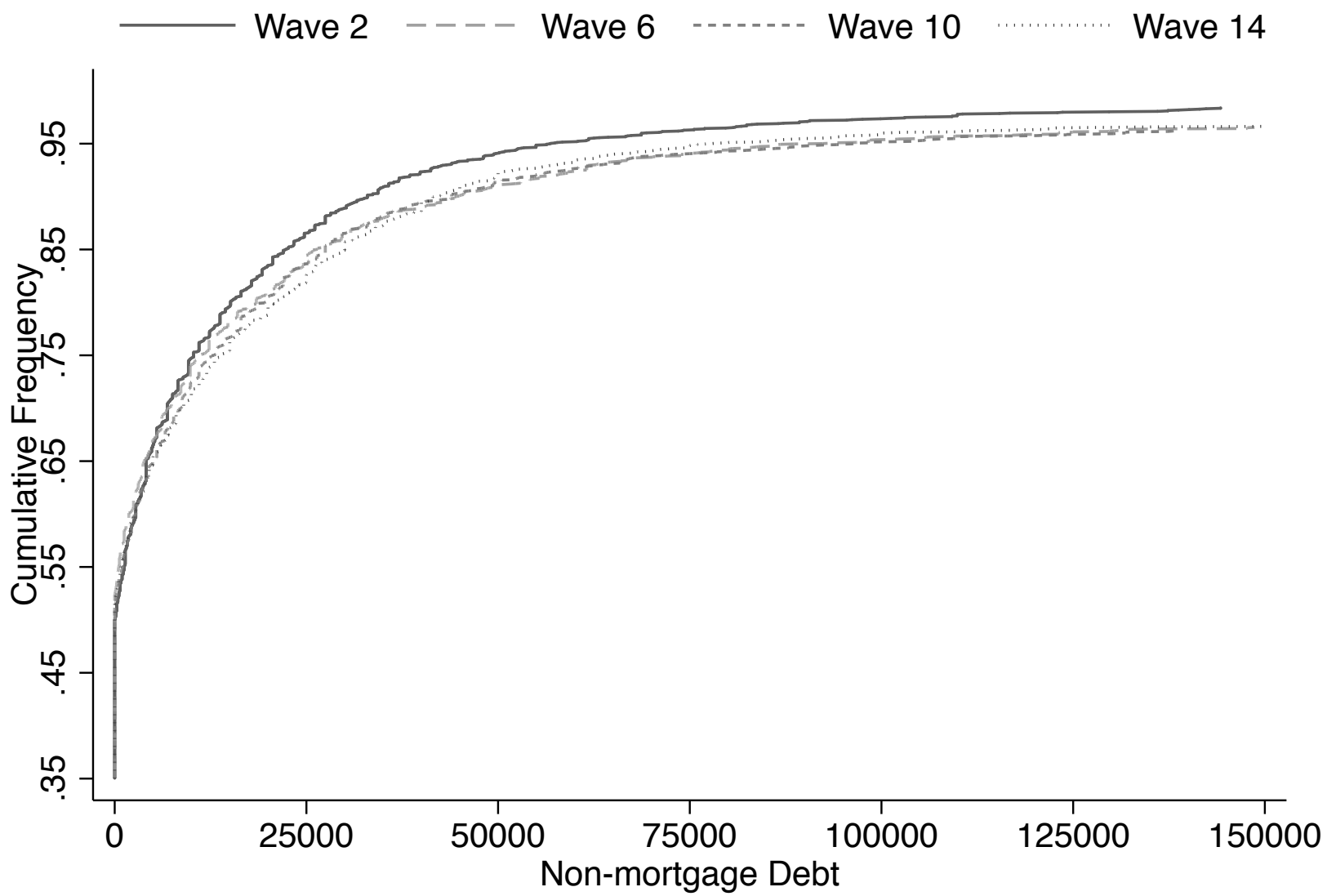


Figure 5: Empirical Distribution of LTV

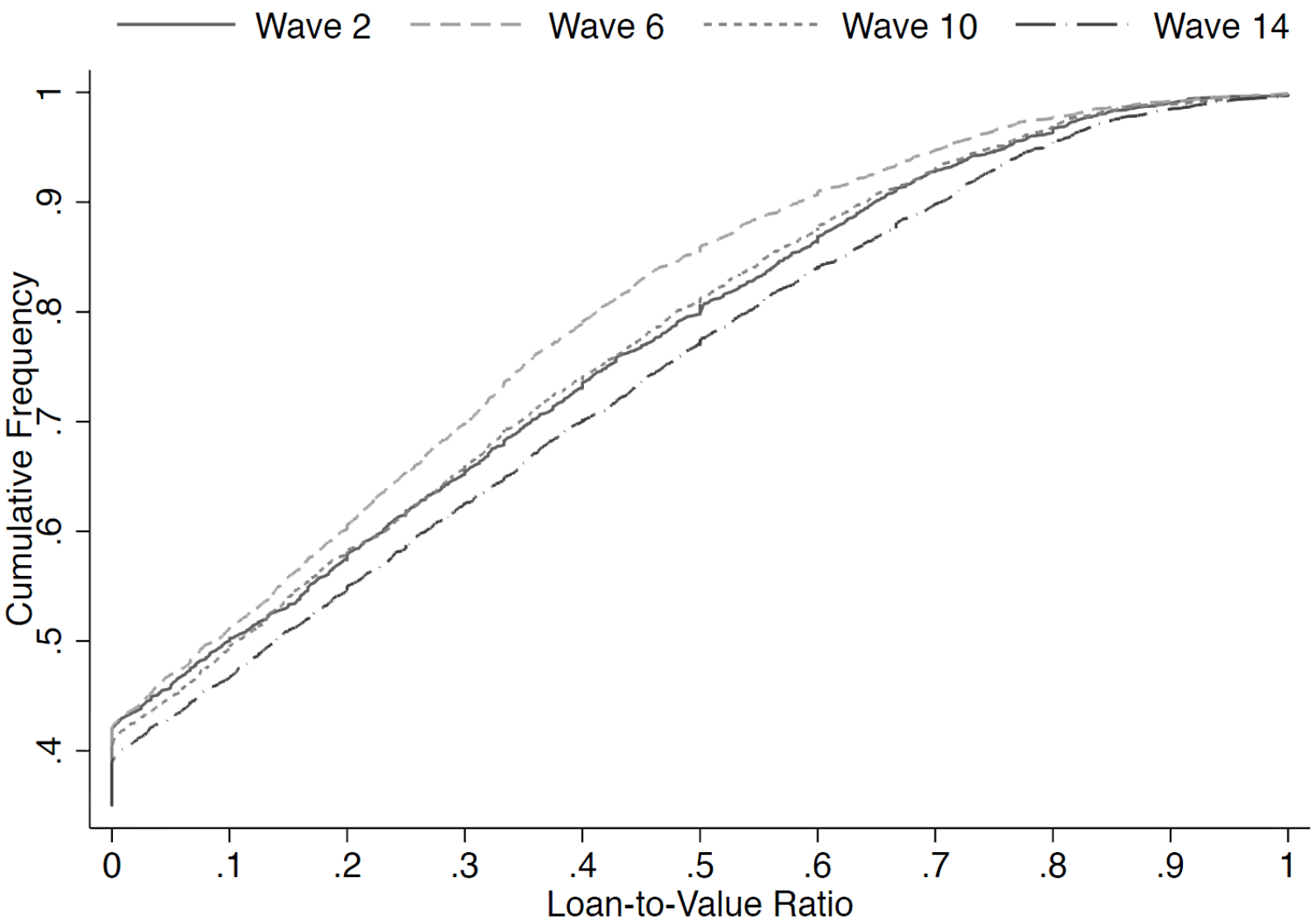


Figure 6: Empirical Distribution of Household Net Worth

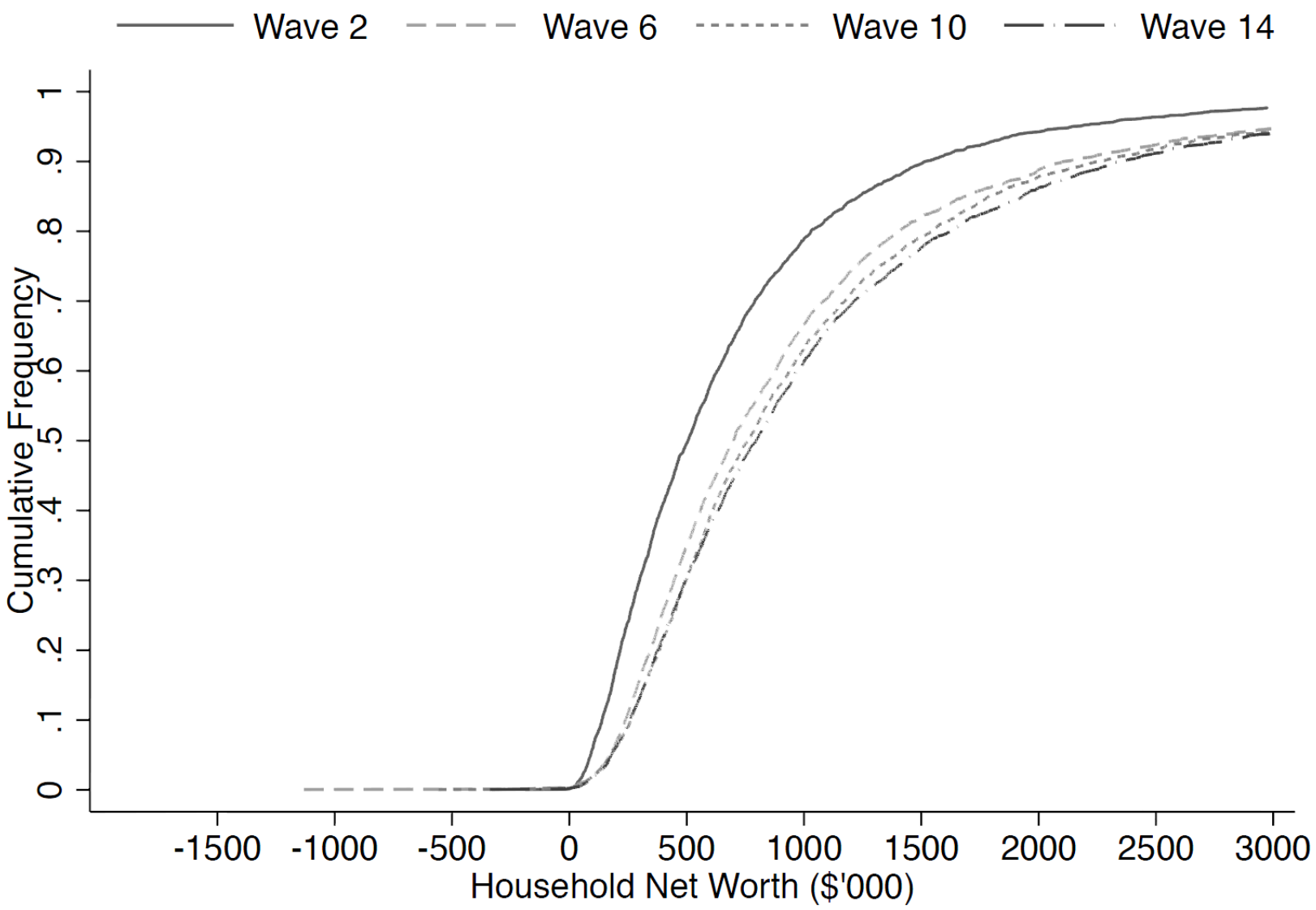
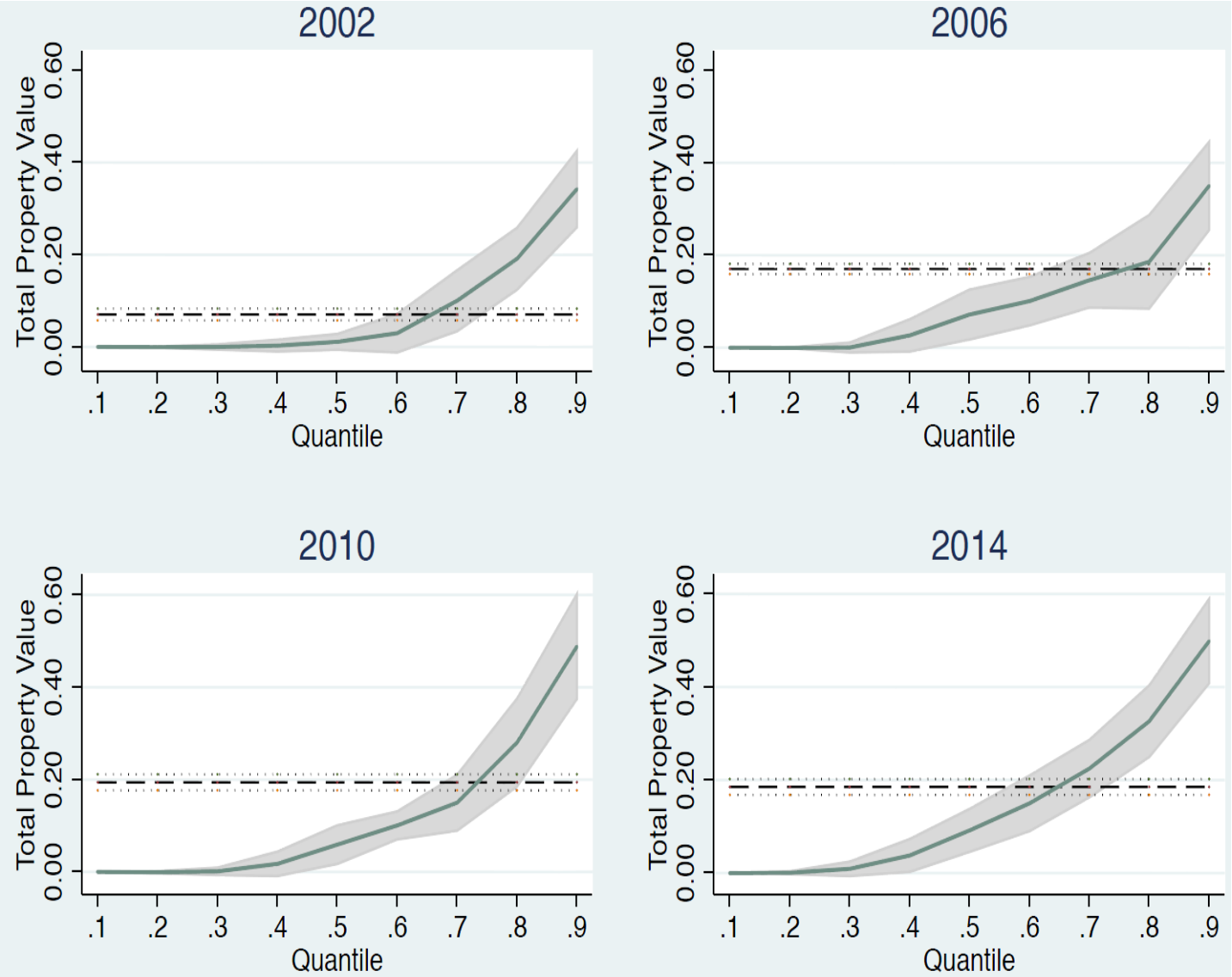


Figure 7: Quantile Regression of Total Debt on Total Property Value



Note: The green solid line is the plot of the coefficient on property (owner-occupied housing and other property) at different quantiles of total household debt. The shaded area is the 95% confidence interval calculated using robust standard errors. The black dashed line is the result of the OLS regression and the light dotted lines are the 95% confidence interval for the OLS estimate. Covariates in this quantile regression are age and age squared, female, indicator variables for household head's education level, the number of kids, an indicator variable for owning more than one property, years left to pay the mortgage, indicator variables for major statistical regions, household gross income and household gross income squared.

	2002				2006			
	Estimation Sample	LTV ≤ 0.5	0.5<LTV≤0.8	LTV > 0.8	Estimation Sample	LTV ≤ 0.5	0.5<LTV≤0.8	LTV > 0.8
Age	48.2	50.7	37.9	36.0	51.0	53.0	39.9	36.1
Female	0.38	0.39	0.31	0.36	0.39	0.40	0.31	0.39
Kids	0.90	0.87	1.02	1.19	0.91	0.85	1.28	1.26
Partner	0.73	0.72	0.76	0.80	0.75	0.74	0.86	0.84
Household Gross Income ($'000)	96.2	93.5	111.0	88.8	108.2	106.1	121.2	117.6
Financial Wealth ($'000)	109.3	127.9	34.1	22.2	140.3	156.0	49.9	12.3
Owner-occupied Property Value ($'000)	418.9	447.3	314.9	254.4	582.3	599.7	489.4	422.7
LGA Median Property Value ($'000)	323.9	333.8	287.4	260.2	438.1	441.9	414.2	419.5
Total Property Value ($'000)	495.7	528.6	377.0	272.6	771.3	795.2	645.3	515.1
Total Debt ($'000)	114.0	78.6	261.3	260.0	174.3	127.1	456.9	497.3
Total Mortgage ($'000)	99.4	65.9	238.1	240.2	149.7	105.9	412.5	451.2
Non-mortgage Debt ($'000)	14.7	12.7	23.2	19.8	24.4	21.2	44.2	45.5
Net worth ($'000)	766.2	879.0	325.3	164.3	1091.3	1205.3	434.7	164.7
Loan-to-Value Ratio	0.23	0.12	0.64	0.88	0.20	0.12	0.63	0.89
N	2412	1944	388	80	2804	2411	331	62

	2010				2014			
	Estimation Sample	LTV ≤ 0.5	0.5<LTV≤0.8	LTV > 0.8	Estimation Sample	LTV ≤ 0.5	0.5<LTV≤0.8	LTV > 0.8
Age	52.3	54.9	41.6	36.5	53.4	56.7	42.8	38.4
Female	0.39	0.40	0.33	0.44	0.40	0.42	0.34	0.35
Kids	0.87	0.80	1.26	0.89	0.90	0.78	1.30	1.29
Partner	0.77	0.75	0.86	0.89	0.78	0.75	0.89	0.86
Household Gross Income ($'000)	118.3	112.3	144.2	143.3	127.8	121.4	151.1	143.7
Financial Wealth ($'000)	137.1	156.2	58.0	34.6	140.5	164.0	66.1	32.2
Owner-occupied Property Value ($'000)	638.6	659.7	558.3	488.3	634.3	661.9	567.6	430.7
LGA Median Property Value ($'000)	514.4	520.8	483.2	504.1	523.4	534.4	503.0	415.1
Total Property Value ($'000)	829.1	843.7	794.6	615.4	828.4	848.1	803.8	588.9
Total Debt ($'000)	211.8	136.0	532.7	586.4	227.7	132.6	560.2	539.4
Total Mortgage ($'000)	185.0	111.5	497.6	538.5	203.8	112.9	518.3	516.0
Non-mortgage Debt ($'000)	26.8	24.4	35.0	47.8	23.8	19.7	41.8	23.3
Net worth ($'000)	1129.5	1260.8	608.0	302.4	1163.8	1331.6	632.1	398.5
Loan-to-Value Ratio	0.22	0.12	0.64	0.89	0.25	0.12	0.65	0.88
N	2808	2283	440	85	2702	2095	484	123

Table 1: **Summary Statistics - Means of Key Variables by year**

Note: Household finance variables are reported at the household level and are constructed as follows: household income is household gross annual labour income plus public transfers plus non-labour income; financial wealth is the total of equity investment, cash investment, trust and bank account; household total properties value is defined as the reported value of the principal residence plus the reported value of other properties; non-mortgage debt includes vehicle loans, investment loans, personal loans, student loans and credit card debt; and loan-to-value (LTV) ratio is defined as mortgage value over property value. All monetary values are rescaled to 2014 Australian dollar values.

		by measure of liquidity constraint						by measure of negative shock			
		Hand to Mouth		High credit card debt		Emergency funds		Negative income shock		Unemployment shock	
	Estimation Sample	Not constrained	Constrained	Not constrained	Constrained	Not constrained	Constrained	No shock	Shock	No shock	Shock
Household Gross Income ($'000)	117.9	120.0	108.1	115.5	130.8	125.2	77.3	124.7	103.9	119.6	107.6
Financial Wealth ($'000)	139.3	162.2	31.4	154.0	60.8	160.0	23.2	121.4	176.2	150.2	72.1
Owner-occupied Property Value ($'000)	618.3	641.9	506.9	620.9	604.4	651.8	428.6	599.7	657.0	627.7	560.3
LGA Median Property Value ($'000)	491.6	501.9	443.2	491.4	492.6	505.5	413.7	488.1	498.8	492.9	483.7
Total Property Value ($'000)	809.4	853.0	604.3	817.1	768.3	869.1	474.6	772.5	885.7	829.3	687.2
Total Debt ($'000)	204.3	199.3	227.9	187.6	293.3	213.1	154.7	208.9	194.7	203.6	208.5
Total Mortgage ($'000)	179.2	173.7	205.2	163.6	262.4	186.1	140.8	183.7	169.9	178.8	182.0
Non-mortgage Debt ($'000)	25.0	25.5	22.5	23.9	30.8	27.0	13.8	25.2	24.7	24.8	26.4
Net worth ($'000)	1127.8	1235.8	619.7	1180.9	845.6	1245.2	469.8	1045.5	1297.9	1181.9	795.3
Loan-to-Value Ratio	0.23	0.20	0.34	0.20	0.36	0.21	0.30	0.24	0.19	0.22	0.28
Share of sample that is liquidity constrained by measure:											
- Hand to Mouth	0.18	0	1	0.13	0.41	0.13	0.41	0.19	0.15	0.16	0.25
- Has high credit card debt	0.16	0.11	0.37	0	1	0.14	0.25	0.17	0.14	0.15	0.20
- Unable to raise emergency funds	0.15	0.11	0.36	0.13	0.24	0	1	0.16	0.14	0.13	0.28
Share of sample that has experienced a:											
Negative income shock	0.33	0.34	0.28	0.33	0.29	0.33	0.31	0	1	0.31	0.40
Unemployment shock	0.14	0.13	0.20	0.13	0.18	0.12	0.26	0.13	0.17	0	1
N	8314	6856	1458	6998	1316	7055	1259	5604	2710	7150	1164

Table 2: **Summary Statistics - Household characteristics across liquidity constraints and income shocks**

Note: Household finance variables are reported at the household level and are constructed as follows: household income is household gross annual labour income plus public transfers plus non-labour income; financial wealth is the total of equity investment, cash investment, trust and bank account; household total properties value is defined as the reported value of the principal residence plus the reported value of other properties; non-mortgage debt includes vehicle loans, investment loans, personal loans, student loans and credit card debt; and loan-to-value (LTV) ratio is defined as mortgage value over property value. All monetary values are rescaled to 2014 Australian dollar values.

	Panel A - Full Sample 2002-2014				
	Total Debt	Mortgage Debt	Non-mortgage debt		
	(1)	(2)	(3)	(4)	(5)
			Total non-mortgage	Credit card	Other
	Coef./ S.E.	Coef./ S.E.	Coef./ S.E.	Coef./ S.E.	Coef./ S.E.
Δ HP$_t$	0.270***	0.229***	0.0302***	0.0002	0.0303***
	[0.0214]	[0.0163]	[0.0093]	[0.0004]	[0.0093]
Observations	8314	8314	8314	8314	8314
No. of Households who moved	4101	4101	4101	4101	4101
p-value	0.958	0.875	0.000	0.974	0.000

	Panel B - from 2006-2014					
	Total non-mortgage	Credit card	Hire Purchase	Car Loan	Investment Loan	Personal Loan
	(6)	(7)	(8)	(9)	(10)	(11)
	Coef./ S.E.	Coef./ S.E.	Coef./ S.E.	Coef./ S.E.	Coef./ S.E.	Coef./ S.E.
Δ HP$_t$	0.0378***	0.0004	-0.0007	0.0002	0.0463***	-0.0016
	[0.0115]	[0.0005]	[0.0008]	[0.0014]	[0.0110]	[0.0037]
Observations	5510	5510	5510	5510	5510	5510
No. of Households who moved	2894	2894	2894	2894	2894	2894
p-value	0.0134	0.483	0.011	0.001	0.225	0.000

Table 3: **Household Indebtedness on House Price Changes**

Note: Robust standard errors are in brackets. *** p<0.001 , ** p<0.05, * p<0.1. The estimated equation is (1). ΔHP is the instrumented change in the value of property - both the owner occupied home and other property. Covariates are: household head age and age squared, gender, indicator variables for household head's lagged education level, the change in the number of children present, lagged employment status and labour force status, the change in employment status, the change in household gross income, lagged household gross income, the change in household financial assets, lagged household financial assets, a lagged indicator variable for owning more than one property and indicator variables for the major statistical region of residence. Full results are reported in the Online Data Appendix. p-value is for the test of the Heckman selection correction term.

	Total Debt	Non-mortgage Debt
	(1)	(2)
	Coef./ S.E.	Coef./ S.E.
$\Delta HP_t \times (LTV_{t-1} = 0)$	0.175***	0.0040
	[0.0245]	[0.0105]
$\Delta HP_t \times (0 < LTV_{t-1} \leq 0.5)$	0.312***	0.0344***
	[0.0312]	[0.0132]
$\Delta HP_t \times (0.5 < LTV_{t-1} \leq 0.8)$	0.406***	0.0778**
	[0.0701]	[0.0321]
$\Delta HP_t \times (LTV_{t-1} > 0.8)$	0.223	0.0917
	[0.151]	[0.0827]
Observations	8314	8314
No. of Households who moved	4101	4101
p-value	1.000	0.000

Table 4: **Household Indebtedness on House Price Changes by LTV**

Note: Robust standard errors are in brackets. *** $p<0.001$, ** $p<0.05$, * $p<0.1$. The estimated equation is (3). Δ HP is the instrumented change in the value of property - both the owner occupied home and other property. All regressions are corrected for sample selection and include the covariates listed in the note to Table 3. Full results are available from the authors on request. p-value is for the test of the Heckman selection correction term.

	Total Debt			Non-mortgage Debt		
	(1)	(2)	(3)	(4)	(5)	(6)
	Coef./ S.E.	Coef./ S.E.	Coef./ S.E.	Coef./ S.E.	Coef./ S.E.	Coef./ S.E.
Δ HP$_t$ × Can raise emergency funds$_{[(t-1)-(t-4)]}$	0.275***			0.0323***		
	[0.0228]			[0.0100]		
Δ HP$_t$ × Can NOT raise emergency funds$_{[(t-1)-(t-4)]}$	0.212***			0.0094		
	[0.0422]			[0.0082]		
Δ HP$_t$ × Not HtM$_{t-4}$		0.259***			0.0310***	
		[0.0229]			[0.0102]	
Δ HP$_t$ × HtM$_{t-4}$		0.340***			0.0253*	
		[0.0455]			[0.0137]	
Δ HP$_t$ × Low Credit Card debt$_{t-4}$			0.264***			0.0336***
			[0.0230]			[0.0104]
Δ HP$_t$ × High Credit Card debt$_{t-4}$			0.304***			0.0103
			[0.0475]			[0.0111]
Observations	8314	8314	8314	8314	8314	8314
No. of Households who moved	4101	4101	4101	4101	4101	4101
p-value	0.980	0.966	0.964	0.000	0.000	0.000

Table 5: **Household Indebtedness on House Price Changes by Liquidity Constraint Measures**

Note: Robust standard errors are in brackets. *** p<0.001 , ** p<0.05, * p<0.1. The estimated equation is (4). ΔHP is the instrumented change in the value of property - both the owner occupied home and other property. "Can/Can NOT raise emergency funds$_{(t-1)-(t-4)}$" is an indicator variable equal to one if the household self-reported that they would have trouble raising \$2000 (or \$3000) in an emergency in any of the 4 previous years. "HtM$_{t-4}$" represents households that are classified as hand-to-mouth as at the previous wealth module. "High/Low Credit Card Debt$_{t-4}$" is an indicator for whether the household had credit card debt of more/less than \$2000 (or \$3000) at the previous wealth module. All regressions are corrected for sample selection and include the covariates listed in the note to Table 3. Full results are available from the authors on request. p-value is for the test of the Heckman selection correction term.

	Total Debt		Non-mortgage Debt	
	(1)	(2)	(3)	(4)
	Coef./ S.E.	Coef./ S.E.	Coef./ S.E.	Coef./ S.E.
$\Delta HP_t \times$ No negative shock to $Income_{[(t-1)-(t-4)]}$	0.280***		0.0476***	
	[0.0255]		[0.0119]	
$\Delta HP_t \times$ Negative Shock to $income_{[(t-1)-(t-4)]}$	0.161***		-0.0002	
	[0.0256]		[0.0126]	
$\Delta HP_t \times$ No unemployment $shock_{[(t-1)-(t-4)]}$		0.252***		0.0357***
		[0.0212]		[0.0104]
$\Delta HP_t \times$ Unemployment $shock_{[(t-1)-(t-4)]}$		0.132***		-0.0068
		[0.0371]		[0.0097]
Observations	8314	8314	8314	8314
No. of Households who moved	4101	4101	4101	4101
p-value	0.000	0.000	0.000	0.000

Table 6: **Household Indebtedness on House Price Changes by Income Shock**

Note: Robust standard errors are in brackets. *** p<0.001 , ** p<0.05, * p<0.1. The estimated equation is (4). ΔHP is the instrumented change in the value of property - both the owner occupied home and other property. "(No) Negative shock to $Income_{(t-1)-(t-4)}$" is an indicator variable equal to one if the household experienced a negative shock to their income in any of the 4 previous years - the Online Data Appendix details the construction of the income shock measure. The smaller sample size in columns (1) and (3) is because the missing 21 households are missing the income shock variable in all of the 4 previous years. Results are robust to including these 21 households and assuming that they did not suffer any income shocks. "(No) Unemployment $shock_{(t-1)-(t-4)}$" is an indicator variable equal to one if either spouse or both experiences 1 month or more of unemployment in any of the previous 4 years. The results are robust to using either a 1 or 3 month period of unemployment. All regressions are corrected for sample selection and include the covariates listed in the note to Table 3. Full results are available from the authors on request. p-value is for the test of the Heckman selection correction term.

	Total Debt			Non-mortgage Debt		
	(1) Emergency funds Coef./ S.E.	(2) HtM Coef./ S.E.	(3) Credit card debt Coef./ S.E.	(4) Emergency funds Coef./ S.E.	(5) HtM Coef./ S.E.	(6) Credit card debt Coef./ S.E.
Income Shock						
Δ HP_t × Not Liq. Constrained x No Shock	0.285***	0.265***	0.272***	0.0517***	0.0508***	0.0550***
	[0.0274]	[0.0269]	[0.0277]	[0.0130]	[0.0133]	[0.0137]
Δ HP_t × Not Liq. Constrained x Shock	0.164***	0.155***	0.167***	-0.0007	-0.0019	-0.0016
	[0.0273]	[0.0269]	[0.0267]	[0.0135]	[0.0139]	[0.0138]
Δ HP_t × Liqudity Constrained x No Shock	0.235***	0.367***	0.322***	0.0120	0.0309*	0.0108
	[0.0503]	[0.0561]	[0.0515]	[0.00844]	[0.0180]	[0.0129]
Δ HP_t × Liqudity Constrained x Shock	0.130**	0.213***	0.114	0.0046	0.0131	0.0115
	[0.0513]	[0.0712]	[0.0783]	[0.0158]	[0.0119]	[0.0190]
Observations	8314	8314	8314	8314	8314	8314
No. of Households who moved	4101	4101	4101	4101	4101	4101
p-value	0.000	0.000	0.000	0.000	0.000	0.000
Unemployment Shock						
Δ HP_t × Not Liq. Constrained x No Shock	0.290***	0.236***	0.245***	0.0374***	0.0362***	0.0392***
	[0.0247]	[0.0219]	[0.0227]	[0.0110]	[0.0113]	[0.0115]
Δ HP_t × Not Liq. Constrained x Shock	0.159***	0.130***	0.140***	-0.0072	-0.0078	-0.0069
	[0.0438]	[0.0415]	[0.0324]	[0.0113]	[0.0117]	[0.0111]
Δ HP_t × Liqudity Constrained x No Shock	0.230***	0.368***	0.300***	0.0152*	0.0326**	0.0140
	[0.0520]	[0.0520]	[0.0445]	[0.00868]	[0.0165]	[0.0125]
Δ HP_t × Liqudity Constrained x Shock	0.165**	0.143*	0.104	-0.0061	-0.0034	-0.0068
	[0.0676]	[0.0781]	[0.124]	[0.0147]	[0.0131]	[0.0162]
Observations	8314	8314	8314	8314	8314	8314
No. of Households who moved	4101	4101	4101	4101	4101	4101
p-value	0.963	0.000	0.000	0.000	0.000	0.000

Table 7: **Household Indebtedness on House Price Changes by Liquidity Constraint Measures and Income Shock**

Note: Robust standard errors are in brackets. *** p<0.001 , ** p<0.05, * p<0.1. The estimated equation is (5). ΔHP is the instrumented change in the value of property - both the owner occupied home and other property. "Can/Can NOT raise emergency funds$_{(t-1)-(t-4)}$" is an indicator variable equal to one if the household self-reported that they would have trouble raising $2000 (or $3000) in an emergency in any of the 4 previous years. "HtM$_{t-4}$" represents households that are classified as hand-to-mouth as at the previous wealth module. "High/Low Credit Card Debt$_{t-4}$" is an indicator for whether the household had credit card debt of more/less than $2000 (or $3000) at the previous wealth module. The Income Shock is our indicator variable equal to one if the household experienced a negative shock to their income in any of the 4 previous years - the Online Data Appendix details the construction of the income shock measure. The unemployment shock is our indicator variable equal to one if either spouse or both experiences 1 month or more of unemployment in any of the previous 4 years. All regressions are corrected for sample selection and include the covariates listed in the note to Table 3. Full results are available from the authors on request. p-value is for the test of the Heckman selection correction term.

	Total Debt			Non-mortgage Debt		
	(1) Emergency funds Coef./ S.E.	(2) HtM Coef./ S.E.	(3) Credit card debt Coef./ S.E.	(4) Emergency funds Coef./ S.E.	(5) HtM Coef./ S.E.	(6) Credit card debt Coef./ S.E.
Δ HP_t × Not Liq. Constrained × (LTV = 0)	0.180***	0.170***	0.170***	0.0042	0.0042	0.004
	[0.0257]	[0.0255]	[0.0258]	[0.0110]	[0.0110]	[0.0110]
Δ HP_t × Liqudity Constrained × (LTV = 0)	0.0880**	0.251***	0.236***	-0.000840	0.000600	0.00208
	[0.0377]	[0.0784]	[0.0729]	[0.0097]	[0.0211]	[0.0233]
Δ HP_t × Not Liq. Constrained × (0 < LTV ≤ 0.5)	0.323***	0.327***	0.316***	0.0369**	0.0389**	0.0373**
	[0.0337]	[0.0354]	[0.0342]	[0.0144]	[0.0157]	[0.0154]
Δ HP_t × Liqudity Constrained × (0 < LTV ≤ 0.5)	0.201***	0.244***	0.294***	0.0127	0.0125	0.0203
	[0.0434]	[0.0524]	[0.0669]	[0.0128]	[0.0098]	[0.0163]
Δ HP_t × Not Liq. Constrained × (0.5 < LTV ≤ 0.8)	0.418***	0.364***	0.396***	0.0920**	0.0882**	0.0980**
	[0.0817]	[0.0864]	[0.0837]	[0.0387]	[0.0396]	[0.0395]
Δ HP_t × Liqudity Constrained × (0.5 < LTV ≤ 0.8)	0.349***	0.544***	0.444***	0.0122	0.0409	-0.0016
	[0.110]	[0.0818]	[0.0968]	[0.0107]	[0.0292]	[0.0128]
Δ HP_t × Not Liq. Constrained × (LTV > 0.8)	0.239	0.0425	0.259	0.0925	0.0429	0.127
	[0.155]	[0.119]	[0.177]	[0.0850]	[0.0795]	[0.108]
Δ HP_t × Liqudity Constrained × (LTV > 0.8)	-0.305	1.084***	0.119	0.0594	0.336	-0.0149
	[0.346]	[0.410]	[0.276]	[0.0496]	[0.252]	[0.0155]
Observations	8314	8314	8314	8314	8314	8314
No. of Households who moved	4101	4101	4101	4101	4101	4101
p-value	0.896	0.975	0.969	0.000	0.000	0.000

Table 8: **Household Indebtedness on House Price Changes by Liquidity Constraint Measures and LTV**

Note: Robust standard errors are in brackets. *** p<0.001 , ** p<0.05, * p<0.1. The estimated equation is (6). ΔHP is the instrumented change in the value of property - both the owner occupied home and other property. "Can/Can NOT raise emergency funds$_{(t-1)-(t-4)}$" is an indicator variable equal to one if the household self-reported that they would have trouble raising $2000 (or $3000) in an emergency in any of the 4 previous years. "HtM$_{t-4}$" represents households that are classified as hand-to-mouth as at the previous wealth module. "High/Low Credit Card Debt$_{t-4}$" is an indicator for whether the household had credit card debt of more/less than $2000 (or $3000) at the previous wealth module. All regressions are corrected for sample selection and include the covariates listed in the note to Table 3. Full results are available from the authors on request. p-value is for the test of the Heckman selection correction term.

	Total Debt		Non-mortgage Debt	
	(1) Negative Income Shock Coef./ S.E.	(2) Unemployment Shock Coef./ S.E.	(3) Negative Income Shock Coef./ S.E.	(4) Unemployment Shock Coef./ S.E.
$\Delta HP_t \times$ No shock × (LTV = 0)	0.190***	0.150***	0.0182*	0.0044
	[0.0282]	[0.0222]	[0.0094]	[0.0114]
$\Delta HP_t \times$ Shock × (LTV = 0)	0.103***	0.177***	-0.0141	0.0015
	[0.0291]	[0.0599]	[0.0191]	[0.0096]
$\Delta HP_t \times$ No shock × (0 < LTV ≤ 0.5)	0.308***	0.307***	0.0510***	0.0429***
	[0.0356]	[0.0320]	[0.0171]	[0.0152]
$\Delta HP_t \times$ Shock × (0 < LTV ≤ 0.5)	0.210***	0.0978**	0.0048	-0.0098
	[0.0456]	[0.0477]	[0.0188]	[0.0155]
$\Delta HP_t \times$ No shock × (0.5 < LTV ≤ 0.8)	0.384***	0.358***	0.0884**	0.0884**
	[0.0674]	[0.0607]	[0.0389]	[0.0355]
$\Delta HP_t \times$ Shock × (0.5 < LTV ≤ 0.8)	0.186**	0.196**	0.0353	-0.0127
	[0.0760]	[0.0918]	[0.0291]	[0.0230]
$\Delta HP_t \times$ No shock × (LTV > 0.8)	0.249	0.306	0.0955	0.127
	[0.216]	[0.198]	[0.115]	[0.111]
$\Delta HP_t \times$ Shock × (LTV > 0.8)	0.272***	0.145	0.0831**	-0.00225
	[0.0511]	[0.227]	[0.0390]	[0.0297]
Observations	8314	8314	8314	8314
No. of Households who moved	4101	4101	4101	4101
p-value	0.000	0.000	0.000	0.000

Table 9: **Household Indebtedness on House Price Changes by Income Shock Measures and LTV**

Note: Robust standard errors are in brackets. *** p<0.001 , ** p<0.05, * p<0.1. The estimated equation is (6). ΔHP is the instrumented change in the value of property - both the owner occupied home and other property. The Income Shock is our indicator variable equal to one if the household experienced a negative shock to their income in any of the 4 previous years - the Online Data Appendix details the construction of the income shock measure. The unemployment shock is our indicator variable equal to one if either spouse or both experiences 1 month or more of unemployment in any of the previous 4 years. All regressions are corrected for sample selection and include the covariates listed in the note to Table 3. Full results are available from the authors on request. p-value is for the test of the Heckman selection correction term.

	Total Debt Coef./ S.E.	Non-mortgage Debt Coef./ S.E.
	Panel A: 20-39 yr olds	
Δ HP$_t$	0.355***	0.0442
	[0.0802]	[0.0496]
Observations	1465	1465
No. of Households who moved	1129	1129
p-value	0.449	0.222
	Panel B: 40-54 yr olds	
Δ HP$_t$	0.301***	0.0408**
	[0.0347]	[0.0166]
Observations	3177	3177
No. of Households who moved	1563	1563
p-value	0.000	0.000
	Panel C: 55+ yr olds	
Δ HP$_t$	0.159***	0.00532
	[0.0219]	[0.00722]
Observations	3672	3672
No. of Households who moved	1409	1409
p-value	0.883	0.650

Table 10: **Household Indebtedness on House Price Changes by age of the household head**

Note: Robust standard errors are in brackets. *** p<0.001 , ** p<0.05, * p<0.1. The estimated equation is (1) separately estimated for each age group and for each debt variable. ΔHP is the instrumented change in the value of property - both the owner occupied home and other property. Covariates are: household head age and age squared, gender, indicator variables for household head's lagged education level, the change in the number of children present, lagged employment status and labour force status, the change in employment status, the change in household gross income, lagged household gross income, the change in household financial assets, lagged household financial assets, a lagged indicator variable for owning more than one property and indicator variables for the major statistical region of residence. Full results are available from the authors on request. p-value is for the test of the Heckman selection correction term.

		Probablility of refinancing	
		Coeff/SE	Marginal effect
Panel A: Change in housing prices			
	Owns, in (t-1):		
ΔHP_t	- only the owner occupied home	0.240*	0.0465*
		[0.141]	(0.0277)
ΔHP_t	- additional property	0.123	0.0239
		[0.219]	(0.0423)
Observations		7795	
No. of Households who moved		4101	
p-value		0.811	
Panel B: Change in housing prices interacted with LTV			
	Owns, in (t-1):		
$\Delta HP_t \times (LTV_{t-1} = 0)$	- only the owner occupied home	-0.922**	-0.179**
		[0.447]	(0.0879)
$\Delta HP_t \times (0 < LTV_{t-1} \leq 0.5)$	- only the owner occupied home	0.559***	0.109***
		[0.188]	(0.0380)
$\Delta HP_t \times (0.5 < LTV_{t-1} \leq 0.8)$	- only the owner occupied home	0.496*	0.0963*
		[0.260]	(0.0514)
$\Delta HP_t \times (LTV_{t-1} > 0.8)$	- only the owner occupied home	1.043	0.202
		[0.937]	(0.182)
$\Delta HP_t \times (LTV_{t-1} = 0)$	- additional property	0.773***	0.150***
		[0.213]	(0.0443)
$\Delta HP_t \times (0 < LTV_{t-1} \leq 0.5)$	- additional property	-0.163	-0.0316
		[0.292]	(0.0571)
$\Delta HP_t \times (0.5 < LTV_{t-1} \leq 0.8)$	- additional property	0.517	0.100
		[0.461]	(0.0895)
$\Delta HP_t \times (LTV_{t-1} > 0.8)$	- additional property	0.248	0.0481
		[1.326]	(0.257)
Observations		7795	
No. of Households who moved		4101	
p-value		0.746	

Table 11: **Probability of Refinancing on House Price Changes**

Note: Robust standard errors are in brackets. *** p<0.001 , ** p<0.05, * p<0.1. The estimated equation is a selection corrected probit for the probability of refinancing. The dependent variable for Panel A and Panel B is an indicator variable for whether the household has refinanced their mortgage on their owner occupied property in the last four years, *Delta*HP is the instrumented change in the value of property - both the owner occupied home and other property, and it is interacted with an indicator variable for whether or not the household owned only the owner occupied home four years ago (at the previous wealth module survey) or also owned additional property. Covariates are: household head age and age squared, gender, indicator variables for household head's lagged education level, the change in the number of children present, lagged employment status and labour force status, the change in employment status, the change in household gross income, lagged household gross income, the change in household financial assets, lagged household financial assets, the lagged number of years left to pay remaining on the owner occupied mortgage and indicator variables for the major statistical region of residence. Full results are available from the authors on request. p-value is for the test of the Heckman selection correction term.

Data Appendix

Sample Selection

We exclude the top-up sample, households with multiple families and self-employers and observations with missing key demographic variables (education and state of residence) are dropped as well. We select household heads, drop households where heads are not responding and restrict the sample to household heads aged between 20 to 75. Because of the difficulty in tracing household heads in dissoluted households between waves, we restrict our attention to heads whose marital status has not changed between waves. We further restrict our sample to home-owning households who have consecutively responded in two waves and exclude households whose calculated LTV is greater than 1.1. Finally we exclude households that are missing information on key variables. The table here details the selection procedure:

Table: Sample Selection

	Number of Observations	
	Dropped	Remaining
Full Sample		270942
Keep Wealth Module Waves	194232	76710
Exclude Non-Responding Households	19726	56984
Exclude Age <20 or Age >75	8823	48161
Exclude Self Employees	3698	44463
Exclude Multi-Family	1806	42657
Exclude Missing Demographics	24	42633
Exclude Non-Heads	17280	25357
Exclude Non-homeowners	9946	15411
Exclude LTV >1.1 and missing	135	15276
Exclude households not responding in at least two consecutive wealth modules	2240	13036
Exclude households who split up or divorce	640	12396
Exclude Missing data in key variables	1670	10726

Identifying Liquidity Constraints and Negative Income and Employment Shocks

Our first measure of liquidity constraint is constructed from answers to the following survey question: 'suppose you had only one week to raise $2,000 (asked in 2001-2008, while from 2009 the nominal dollar amount was $3,000) for an emergency, which of the following best describes how hard it would be for you to get that money'.[12] We

[12]La Cava and Simon (2003) constructed a proxy for the constraint using similar self-reported measures.

identify liquidity constrained households as those answered with either 'could not raise emergency funds' or 'have to undertake drastic measures to raise funds' in any of the four most recent waves. To address the issue of respondent households failing to submit a response to this question, we estimate a probit regression with liquidity constraint as the dependent variable and observable household characteristics as independent variables. We define households with a predicted probability greater than or equal to 0.5 as liquidity constrained households.[13]

Our second measure of liquidity constraint is inspired by Kaplan et al. (2014) who propose using a classification of households as wealthy hand-to-mouth (wHtM), or not, as a proxy for liquidity constraint. Following Kaplan et al. (2014) we designate a household as hand-to-mouth (HtM) if it satisfies one of the following two conditions as at the previous wealth module survey (i.e. four years prior):

1. has positive liquid wealth equal to less than a fortnight's income ($A_t > 0$ and $A_t \leq \frac{Y_t}{12}$)

2. have negative or zero liquid wealth that is larger (in absolute terms) than approximately one fortnight's income but less than their credit limit which is assumed to be equal to one month's income ($A_t \leq \frac{Y_t}{26} - \frac{Y_t}{12} < 0$)

where A_t is household net liquid wealth and Y_t is annual household gross regular income. Note that unlike Kaplan et al. (2014) we do not place a condition on their illiquid wealth holdings. In Australia, because of mandatory superannuation retirement saving, almost every household that is hand-to-mouth is wealthy hand-to-mouth (unless households' net debt in properties is too large) and so we elect to ignore the distinction between the wealthy and poor hand-to-mouth. This measure proxies for the (financial) liquidity constraint, but is a conservative measure in that it likely overestimates the proportion of households that are liquidity constrained. Households who have little or no liquid wealth either have no access to credit or are not borrowing, and the latter households are not liquidity constrained.[14]

Our third measure of liquidity constraint is derived from the household's level of credit card debt as at the wealth module survey (i.e. four years prior). We designate a household as liquidity constrained if their credit card debt in real terms (2014$) is greater than $3000.

To obtain our indicator for a negative income shock, we follow the permanent income literature and extract the change in the residual of household income (Blundell et al., 2008). Specifically, we assume household log disposable income y_{it} follows:

$$y_{it} = P_{it} + z'_{it}\Theta + v_{it} \text{ and } P_{it} = P_{it-1} + \zeta_{it}$$

[13]This is a common practice in the literature. For example, see the works by Zeldes (1989) and Jappelli et al. (1998). Our findings are robust to using only actual responses.

[14]An alternative measure that proxies for the constraint is directly constructed from net worth and income. This measure would miss those households that have no access to credit. See Kaplan et al. (2014) for a detailed discussion.

where P_{it} is the permanent income component and is a random walk process, z_{it} is a set of observable income characteristics, v_{it} is a mean-reverting transitory income shock component and ζ_{it} is a serially uncorrelated process and uncorrelated with v_{it}.[15] To partial out the predictable effects of observable characteristics on income and obtain the residual as a measure of income shock, we regress log real household disposable income on age, year indicator variables, a set of family characteristics (indicator variables for education, number of adults, number of children, residence states, employment status, benefit recipient, job types and industry types, working hours and partner's working hours), and interactions of family characteristics with year indicator variables. We then obtain the income shock by

$$\Delta(y_{it} - z'_{it}\Theta) = \zeta_{it} + \Delta v_{it}$$

We define those who have experienced a negative income shock as households for whom $\Delta(y_{it} - z'_{it}\Theta) < -0.41$, roughly corresponding to the 10th percentile of the distribution of the income shock variable, in any of the previous four years.

Last, we obtain an indicator for a negative employment shock. This indicator is derived from the variable "Per cent time spent unemployed in last financial year". We define those who have experienced the unemployment shock as households in which the household head or spouse (if any) has experienced a period of one month or longer of unemployment in any of the previous four years.

Summary statistics on key variables for households that are liquidity constrained or that have experienced a negative income or employment shock are presented in Table 2 and are discussed in Section 3.2.

Moving Intentions

As discussed in Section 2, in or to deal with endogeneity issues due to moving households we focus on non-moving households and use a Heckman selection model (Equation (2)). Below we described the variables used in estimation:

- *IntToMove* , measures the intention to move - the exact question is "How likely to move in next 12 months" (Very likely, Likely, Not sure, Unlikely, Very Unlikely) - we group likely and very likely together and create an indicator variable
- *NS* , measures individuals' satisfaction with their neighbourhood - the exact question is "I want you to pick a number between 0 and 10 that indicates your level of satisfaction with the neighbourhood in which you live" (0= Totally Dissatisfied; 5= Neither Satisfied nor Dissatisfied; 10 = Totally Satisfied)
- *LCS* , measures individuals' satisfaction with their local community - the exact question is "I want you to pick a number between 0 and 10 that indicates your level of satisfaction with feeling part of your local community" (0= Totally Dissatisfied; 5= Neither Satisfied nor Dissatisfied; 10 = Totally Satisfied)

[15] This is a standard model in the literature. For example, see the works by MaCurdy (1982), Abowd et al. (1989) and Blundell et al. (2008).

- *CWN* , measures the frequency with which individuals chat with their neighbours - the exact question is "How often do you chat with your neighbours?" (1 = Never; 2= Rarely; 3=Occasionally; 4= Sometimes; 5= Often; 6 = Very Often)

Appendix References

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Table A1 - Tests of first-order stochastic dominance: p-values					
		2002 v 2006	**2006 v 2010**	**2010 v 2014**	**2002 v 2014**
Total debt	Direct	0.283	0.967	0.851	0.957
	Reverse	0.000	0.000	0.024	0.000
	Equality	0.000	0.000	0.045	0.000
	Conclusion	2006 FOSD 2002	2010 FOSD 2006	2014 FOSD 2010	2014 FOSD 2002
Property debt	Direct	0.863	0.979	0.973	0.996
	Reverse	0.000	0.000	0.011	0.000
	Equality	0.000	0.000	0.023	0.000
	Conclusion	2006 FOSD 2002	2010 FOSD 2006	2014 FOSD 2010	2014 FOSD 2002
Non-mortgage debt	Direct	0.012	0.755	0.520	0.252
	Reverse	0.020	0.092	0.203	0.003
	Equality	0.025	0.178	0.419	0.006
	Conclusion	--	2010 FOSD 2006	--	2014 FOSD 2002
LTV	Direct	0.000	0.990	0.988	0.986
	Reverse	0.936	0.000	0.004	0.012
	Equality	0.000	0.000	0.007	0.023
	Conclusion	2002 FOSD 2006	2010 FOSD 2006	2014 FOSD 2010	2014 FOSD 2002
Net worth	Direct	0.977	0.956	0.796	0.993
	Reverse	0.000	0.000	0.118	0.000
	Equality	0.000	0.001	0.248	0
	Conclusion	2006 FOSD 2002	2010 FOSD 2006	--	2014 FOSD 2002

Table A2 -Panel A: Full Sample 2002-2014					
Dependent variable:	Total debt Coef./S.E.	Mortgage debt Coef./S.E.	Non-mortgage debt Coef./S.E.	Credit Card debt Coef./S.E.	Other debt Coef./S.E.
Δ HP_t	0.268***	0.228***	0.0298***	0.000178	0.0297***
	[0.0214]	[0.0163]	[0.00935]	[0.000396]	[0.00932]
Δ Household $income_t$	0.335**	0.284*	0.0262	-0.00212	0.0221
	[0.165]	[0.155]	[0.0442]	[0.00146]	[0.0440]
Household $income_{(t-1)}$	0.385**	0.318*	0.0398	-0.00305**	0.0429
	[0.194]	[0.188]	[0.0391]	[0.00136]	[0.0392]
Household financial $assets_{(t-1)}$	-0.0256**	-0.0138	-0.0168**	0.000141	-0.0168**
	[0.0129]	[0.0104]	[0.00811]	[0.000310]	[0.00819]
Δ Household financial $assets_t$	-0.0173	-0.0177	-0.00470	0.000248	-0.00566
	[0.0194]	[0.0142]	[0.0111]	[0.000245]	[0.0113]
Ownd 2nd+ $property_{(t-1)}$	24,937**	22,625**	-9,414*	-92.94	-9,453*
	[12,372]	[9,847]	[5,447]	[237.7]	[5,472]
Age of household head	-4,407*	-4,931**	259.7	0.103	-375.2
	[2,584]	[2,027]	[1,318]	[61.24]	[1,300]
Age of household head squared	30.31	36.51*	-0.166	-0.173	5.582
	[24.25]	[19.02]	[12.03]	[0.551]	[11.90]
Employment $status_{(t-1)}$	-15,461	-15,465	3,439	244.6	2,524
	[23,038]	[21,139]	[16,718]	[614.9]	[16,820]
Labour force $status_{(t-1)}$	-18,505	-14,626	-3,188	-191.8	-2,639
	[21,710]	[19,575]	[15,732]	[600.6]	[15,821]
Became $employed_{(t-(t-1))}$	-5,499	-7,031	1,974	558.9**	-103.8
	[11,192]	[10,540]	[4,494]	[246.9]	[4,417]
Became $unemployed_{(t-(t-1))}$	-19,452	-22,803	9,525	660.5	5,477
	[28,943]	[27,761]	[8,492]	[575.8]	[8,474]
Δ Number of $kids_t$	-7,235	-6,832	1,022	161.6	-1,325
	[10,256]	[6,221]	[4,389]	[166.5]	[4,372]
Gender (female=1)	-3,118	1,042	-1,315	-259.1	-531.2
	[6,851]	[5,609]	[2,949]	[163.8]	[2,917]
Education $level_{(t-1)}$: university	-19,382*	-20,582**	651.9	112.3	309.6
	[10,596]	[8,897]	[4,851]	[265.9]	[4,872]
Education $level_{(t-1)}$: diploma	-8,267	-4,680	-2,001	-236.0	-2,009
	[7,440]	[5,650]	[3,570]	[202.3]	[3,579]
Education $level_{(t-1)}$: high school	-19,574*	-14,281	-4,288	-257.2	-3,912
	[11,128]	[9,879]	[4,654]	[250.9]	[4,645]
Observations	8271	8271	8271	8271	8271
No. of Households who moved	4072	4072	4072	4072	4072
p-value	0.973	0.812	1.33e-09	0.971	2.00e-09

Robust standard errors in brackets, *** p<0.01, ** p<0.05, * p<0.1. Controls also include LGA level fixed effects. p-value is for the test of the Heckman selection correction term.

Table A2 -Panel B: from 2006-2014

Dependent variable:	Non-mortgage debt Coef./S.E.	Credit Card debt Coef./S.E.	Hire Purchase Coef./S.E.	Car loan Coef./S.E.	Investment Loan Coef./S.E.	Personal Loan Coef./S.E.
Δ HP_t	0.0374***	0.000367	-0.000714	0.000212	0.0459***	-0.00154
	[0.0115]	[0.000502]	[0.000771]	[0.00138]	[0.0110]	[0.00367]
Δ Household $income_t$	-0.0163	-0.00257	-0.000767	0.00353	-0.00498	0.00745
	[0.0454]	[0.00189]	[0.00190]	[0.00339]	[0.0531]	[0.00877]
Household $income_{(t-1)}$	0.0243	-0.00393**	-0.00192	-0.00687*	0.0242	-0.000474
	[0.0403]	[0.00182]	[0.00170]	[0.00363]	[0.0409]	[0.00708]
Household financial $assets_{(t-1)}$	-0.0179**	0.000155	4.74e-05	0.000515	-0.0191**	0.000523
	[0.00841]	[0.000416]	[0.000163]	[0.000408]	[0.00844]	[0.000621]
Δ Household financial $assets_t$	-0.00387	0.000296	0.000167	0.000135	-0.00749	0.00338
	[0.0129]	[0.000347]	[0.000204]	[0.000513]	[0.0126]	[0.00206]
Ownd 2nd+ $property_{(t-1)}$	-3.046	40.45	-31.13	167.9	4,840	-3,645**
	[6,323]	[327.8]	[388.3]	[537.6]	[6,050]	[1,544]
Age of household head	744.9	20.10	30.71	19.20	-163.1	-433.6
	[2,119]	[87.69]	[46.98]	[197.1]	[1,607]	[1,401]
Age of household head squarec	-2.608	-0.342	-0.227	-0.298	5.359	3.101
	[18.86]	[0.782]	[0.436]	[1.715]	[14.87]	[12.12]
Employment $status_{(t-1)}$	3,911	-108.9	-242.0	-349.2	1,189	-607.7
	[20,272]	[826.2]	[581.7]	[1,228]	[21,292]	[1,489]
Labour force $status_{(t-1)}$	2,165	93.09	10.53	435.7	5,283	710.2
	[19,164]	[819.6]	[573.8]	[1,266]	[20,199]	[1,641]
Became $employed_{(t-(t-1))}$	33.58	526.2*	-196.6	-253.1	5,611	1,411
	[5,593]	[311.1]	[160.1]	[703.3]	[7,861]	[1,092]
Became $unemployed_{(t-(t-1))}$	16,575	186.4	-233.3	508.2	16,269	-28.37
	[11,423]	[838.3]	[383.4]	[1,723]	[11,892]	[2,645]
Δ Number of $kids_t$	6,880	119.9	-151.2	333.7	6,556	-71.79
	[4,837]	[220.1]	[99.15]	[402.2]	[4,933]	[1,209]
Gender (female=1)	51.78	-234.9	202.6	-205.7	-204.8	1,467
	[4,023]	[219.8]	[291.4]	[405.3]	[3,735]	[1,391]
Education $level_{(t-1)}$: university	3,177	145.1	284.4	-294.1	342.9	2,619
	[5,897]	[372.1]	[267.3]	[550.8]	[5,678]	[1,699]
Education $level_{(t-1)}$: diploma	301.5	-293.9	29.54	52.05	-1,208	429.4
	[4,559]	[284.9]	[224.1]	[463.7]	[4,571]	[905.5]
Education $level_{(t-1)}$: high school	-1,527	-442.2	-1,068	-1,552*	1,769	1,221
	[6,123]	[336.6]	[904.0]	[858.4]	[6,351]	[977.2]
Observations	5482	5482	5482	5482	5482	5482
No. of Households who moved	2876	2876	2876	2876	2876	2876
p-value	0.0140	0.487	0.00973	0.00113	0.228	0.000121

Robust standard errors in brackets, *** p<0.01, ** p<0.05, * p<0.1. Controls also include LGA level fixed effects. p-value is for the test of the Heckman selection correction term.