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House prices, household debt and labour supply in Australia

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ACRONYMS

AHURI	Australian Housing and Urban Research Institute Limited
ABS	Australian Bureau of Statistics
CDF	Cumulative Distribution Function
DSS	Australian Government Department of Social Services
FSR	Financial Stability Review
GFC	Global Financial Crisis
HILDA	Household, Income and Labour Dynamics in Australia
LC	Life-cycle
LC/PIH	Life-cycle or Permanent Income Model
LCM	Life-cycle model
LFP	Labour force participation
LGA	Local Government Area
LTV	Loan to value
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
PI	Permanent income
PIH	Permanent income hypothesis
RBA	Reserve Bank of Australia
RP	Residential Property data
RQ	Research Question
UK	United Kingdom
US	United States

EXECUTIVE SUMMARY

The international economic turmoil wrought by the Global Financial Crisis (GFC) placed in sharp focus the importance of links between housing, finance and labour 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. There is a growing understanding of the role played by the housing market on financial markets in transmitting the effects of the crisis, through a direct impact on mortgages and household debt. In turn, the links between housing and financial markets had repercussions for labour market outcomes such as employment and unemployment levels, and the performance of the economy. Importantly, although there were many common features to the GFC, each individual country's experience of the economic crisis was unique due to differences in domestic housing, financial and labour market institutions.

It is well recognised that the key to understanding the linkages between the housing, financial and labour markets is to examine how individuals' and households' economic decisions are tied across these markets. Economic models predict that household borrowing decisions will be based on income, financial and housing wealth. Changes in house prices lead households to adjust their level of indebtedness and the composition of the debt held. Labour market studies show that labour force participation and hours of work decisions are sensitive to households' housing tenure and their stage in the life-cycle. For these relationships to guide policy development, empirical evidence is required to confirm the importance of these relationships and, moreover, to gauge the magnitude of the specific channels of influence.

The objective of the research presented in this report is to identify the nature and magnitude of the relationship between house prices, household debt and the labour market decisions of Australian households. It is well known that there is a positive relationship among house prices, household debt and labour supply, however empirical estimates of the magnitudes of this relationship in Australia are scarce. Therefore, this project analyses the link between house prices, mortgage debt, and labour supply using rich and contemporary data drawn from the Household, Income and Labour Dynamics in Australia (HILDA) survey for the period of 2001 to 2012 (waves 1–12).

The project builds on existing AHURI research in related areas, specifically: *Housing wealth and consumer spending* (Yates and Whelan 2009); *Housing, location and employment* (Bradbury and Chalmers 2003); *Downsizing amongst older Australians* (Judd, Liu et al. 2014); and *Housing equity withdrawal* (Ong, Jefferson et al. 2013).

The project addresses three distinct, though interrelated, questions:

- What is the nature and magnitude of
  1. the relationship between house prices and household debt
  2. between house prices and the mortgage and non-mortgage (e.g., consumer debt or HECS debt) components of household debt?
- Does labour supply respond to changes in house prices and mortgage debt? Is there a causal link?
- How large are these effects? Are some types of households more responsive to house price changes than others?

Our key findings can be summarised as follows:

There is a strong relationship between house prices changes and household indebtedness.

- *Total household debt*: our results show that a $1,000 AUD (2013 AUD) increase in house value is associated with a $240 increase in total household debt among home owners.
- *Non-mortgage debt*: within total household debt, we find that an increase in house prices leads to a reduction in the non-mortgage debt of home owners.
    1. More specifically, a 1 per cent increase in local house price growth is associated with a 0.321 per cent decrease in the non-mortgage debt of home owners. When their housing wealth increases, home owners adjust their debt portfolios, and hence reduce their debt servicing.
- Together, these findings reveal that house price increases are associated with a reallocation of household debt from non-mortgage debt to mortgage debt.

There are important differences in the relationship between house prices and household indebtedness across demographic groups, and by level of debt holdings.

- The responsiveness of household debt to house prices is greater among households with higher levels of indebtedness.
- House price changes are associated with larger increases in total debt for home owners who initially borrow a larger fraction of the property price (or have a higher 'Loan to Value' (LTV) ratio).
- Home owners with greater non-mortgage debt and higher LTV ratios are the most responsive to house price movements.
- Middle-aged home owners exhibit a stronger response to house price movements than both older and younger home owners.
- Overall the findings show that house price changes influence household debt through two channels: a direct wealth effect and an indirect collateral effect via the household's borrowing capacity. That is, some households face borrowing constraints and, for these households, rising house prices increase the value of their property that may be used as security for a loan and thereby loosen the borrowing constraints.

House price movements have clear and consistent impacts on labour market activities. The magnitude of the effect varies by gender, family type and life-cycle stage.

- There are important differences in the patterns of labour supply and housing wealth over the life-cycle, by gender and between partnered and single Australians. These differences prompted our decision to conduct our empirical analysis of labour supply responses to housing wealth and debt separately for these sub-groups.
- The most important responses to house price changes are in the labour force participation and hours of work by women (both partnered and single). The effect is strongest among the older cohort and is associated with early retirement by those experiencing above average housing wealth gains.
- Younger partnered men and women exhibit a reduction in hours of work in response to the gain in housing wealth. That is, these gains in wealth effectively fund time away from work to undertake non-market activities. These activities

potentially include providing household care for children, ageing parents, undertaking volunteer work or enjoying more leisure.

- → The results indicate that it is important to consider the links among labour supply, housing debt and house prices separately for these demographic groups.

The findings presented in this report have important implications for public policy and national wellbeing. Specifically, our findings relate to labour force productivity growth, the performance of the retirement income system and the stability of the macroeconomy. Our results also highlight the importance of considering the links between, and the impact of policy on, labour supply, debt and house prices separately for different demographic groups.

Our examination of differences in the patterns of labour supply, housing debt and wealth over the life-cycle has important implications for employment policies and labour force productivity. More specifically, higher debt-to-income levels are associated with longer working hours for middle aged and older men and for younger and older women. In addition, the positive wealth effect of house price growth leads to a reduction in labour supply for older women (via early retirement) and for young partnered men and women (substituting from market work to non-market carer activities). Hence, we find that housing markets have the potential to either promote or dampen labour supply and hence labour force productivity.

Our findings also have direct relevance to the Australian retirement income system. As just noted, house price growth can lead to earlier retirement. Importantly, we also find that house price increases lead to an increase in the dispersion of debt levels across the population. Our results show that the house price effect is largest at the upper part of the debt distribution and for middle-aged households. These households are then more vulnerable to future housing and labour market shocks. This, in turn, has implications for the adequacy of our retirement income system.

Last, the results of our research are also relevant to macroeconomic stability. In particular, our finding that the responsiveness of household debt to house prices is greatest among households with higher levels of indebtedness highlights a potential systemic risk. The take-up of further mortgage debt among highly leveraged households (through the 'collateralisation effect') exposes those households to the risk of significant loss if house prices fall or if interest rates rise. This is in contrast to a general belief in Australia that debt is held by those most able to service it, namely, higher-income and higher-wealth households. Macroeconomic policy-makers should interpret high levels of household debt and rising household income-to-debt ratios in Australia with concern. In a number of countries with similar situations, regulations have been implemented to limit the growth of household indebtedness.

1 INTRODUCTION

1.1 Motivations and aims of the project

The effect of house prices on households' financial decisions has long been an important question facing researchers and policy-makers. Basic economic models predict that a households borrowing decisions will be based on their income and financial wealth, and particularly their housing wealth. Increases in house prices may lead households to take on additional debt, refinance an existing mortgage, or change the composition of the debt held. Studies of labour supply have also found significant changes in work patterns due to house price movements. Labour force participation and hours of work decisions have been found to be sensitive to households' housing tenure and their stage in the life-cycle. For these relationships to aid in the development of policy in Australia, empirical evidence is needed to confirm the importance of these relationships, and to gauge the magnitudes of the effects.

Australia experienced a prolonged increase in house prices and household debt during the last 25 years. 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. In Australia we have not seen households reducing their debt burden as witnessed in other countries more severely affected by the GFC, such as the United States and in Europe.

Concerns have been raised internationally regarding rising household indebtedness and the potential threat this poses for macroeconomic stability. High household debt levels are seen as creating vulnerabilities that can amplify and transmit macroeconomic shocks, and undermine prospects for economic growth (Cecchetti 2012). Households are more likely to reduce consumption when house prices fall and debt remains unchanged (Jannson 2013). High debt is seen as undermining economic stability (Drehmann and Jueselius 2012) while the likelihood of recession is greater when household debt is above the long term average (Sutherland et al. 2012).

The concerns about economic and financial stability lead to questions about the effect of housing wealth on household indebtedness and other important economic decisions, particularly labour supply. In countries that have seen households reducing their debt since the GFC, attention has also turned to the relationship between debt and household consumption. When debt is high relative to asset values (or debt servicing is high relative to income) households may be forced to reduce consumption which can contribute to a downturn in economic activity (Mian and Sufi 2011; Mian, Rao and Sufi 2013; Dynan and Kohn 2007; Johnson and Li 2007; McCarthy and McQuinn 2015).

Similar questions have been raised in Australia, with greater focus on the rise in housing debt among households who invest in properties additional to their principal residence. This is demonstrated by the Reserve Bank of Australia (RBA) in their *Submission to the inquiry into affordable housing* (2014a). Concerns with the growth in lending to housing investors and the potential impact on financial stability led to the introduction of measures from late 2014 to curb this growth (RBA 2014b). Even before the current investor finance boom, concerns were raised about the vulnerability of investors to interest rate changes (Debelle 2004). Concerns were also raised about vulnerability to declines in house price as both of these outcomes could result in

negative equity, where the value of debt exceeds the housing asset value (RBA 2014a: 7).

The consequences of these developments for Australian housing affordability, and labour markets, are largely unknown and lead to a number of key questions:

- How do these changes impact housing choices and labour supply in Australia?
- How do unemployment experiences affect a household's ability to service mortgage debt or maintain their housing services?
- Do mortgage commitments lead unemployed workers to accept any available job, which may offer poor prospects for progression, a mismatch of skills, and lost workforce productivity?

The answer to these questions requires a better understanding of the relationship between house prices, household debt and labour supply.

Thus, this project has several aims. The first aim is to establish the relationship between house prices and household debt in Australia, and between the mortgage and non-mortgage components of that debt. In our analysis we consider both the direct wealth effect and the indirect collateral effect of changes in house prices. It is important to include a role for the collateral effect as it captures the impact of changes in house prices on household borrowing (collateral) constraints and illuminates why responses to changes in prices vary across households depending on their LTV ratios (the ratio of the mortgage loan to the house value or price) and the extent to which they are borrowing constrained. Moreover, the collateral effect also reveals links between mortgage and non-mortgage debt. Households that face collateral constraints cannot, by definition, increase their mortgage debt and so are more likely to have non-mortgage debt than other households. When these constrained households experience increases in the value of their housing wealth, they are more likely to refinance their mortgage to reallocate this relatively more expensive unsecured non-mortgage debt into cheaper, secured (collateralised) mortgage debt. Understanding the links between house prices, household debt and between the mortgage and non-mortgage components of that debt is important for gauging the health of the Australian economy and to guide Australian policy-making.

The second aim is to investigate the links between labour supply, house prices and mortgage debt. There is a clear positive correlation among these three in Australia, which is commonly reported throughout the international literature. However, there is little agreement on the direction of causality underlying the correlation, or the strength of the relationships. This study therefore examines the nature and magnitude of the relationship between labour supply and mortgage commitments as well as between labour supply and housing prices. Further, we explore whether the relationships vary by age, gender and marital status.

In summary, our research project aims to investigate the interrelationships among house prices, household debt and labour supply decisions in Australia and the consequences of these links for long-term national wellbeing. The findings of the project will assist macroeconomic policy-makers by elucidating the role of household labour supply and debt decisions in response to developments in the housing market.

This research builds on existing research, specifically, reports by Yates and Whelan (2009), '*Housing wealth and consumer spending*'; Bradbury and Chalmers (2003), '*Housing, location and employment*'; Judd, Liu et al. (2014), 'Downsizing amongst older Australians'; and Ong, Jefferson et al. (2013), 'Housing equity withdrawal'. This study also aims to contribute to the international research literature by utilising the

uniquely detailed longitudinal household debt and wealth data information available in the HILDA survey.

1.2 Research questions

The project is structured around three distinct though interrelated research questions:

Research Question 1 (RQ-1): House prices and household indebtedness in Australia

> What is the nature and magnitude of: (a) the relationship between house prices and household debt and (b) between house prices and the mortgage and non-mortgage components of household debt?

Research Question 2 (RQ-2): House prices, housing debt and labour supply decisions

> Does labour supply respond to changes in house prices and mortgage debt? Is there a causal link?

Research Question 3 (RQ-3): Differences in the effects by household type

> How large are these effects? Are some types of households more responsive to house price changes than others?

The salience of these questions lies in their immediate policy relevance: the links between housing markets, household debt and labour supply have important macroeconomic implications, particularly in the context of upswings or declines in the economy and house prices.

1.3 Structure of the report

This Final Report consists of two main chapters: Chapter 2 examines the links between house prices and household debt in Australia and Chapter 3 investigates the relationship between labour supply, house prices and household debt in Australia.

Each chapter begins with a brief description of the underlying economic rationale for a significant relationship among these factors. Following this there will be a brief review of the international and Australian evidence on the linkages among house prices, household indebtedness and labour supply. Then, an outline of the methods used in the empirical analysis and then present and discuss the main findings.

Chapter 4 concludes with a discussion of the policy implications of the combined findings.

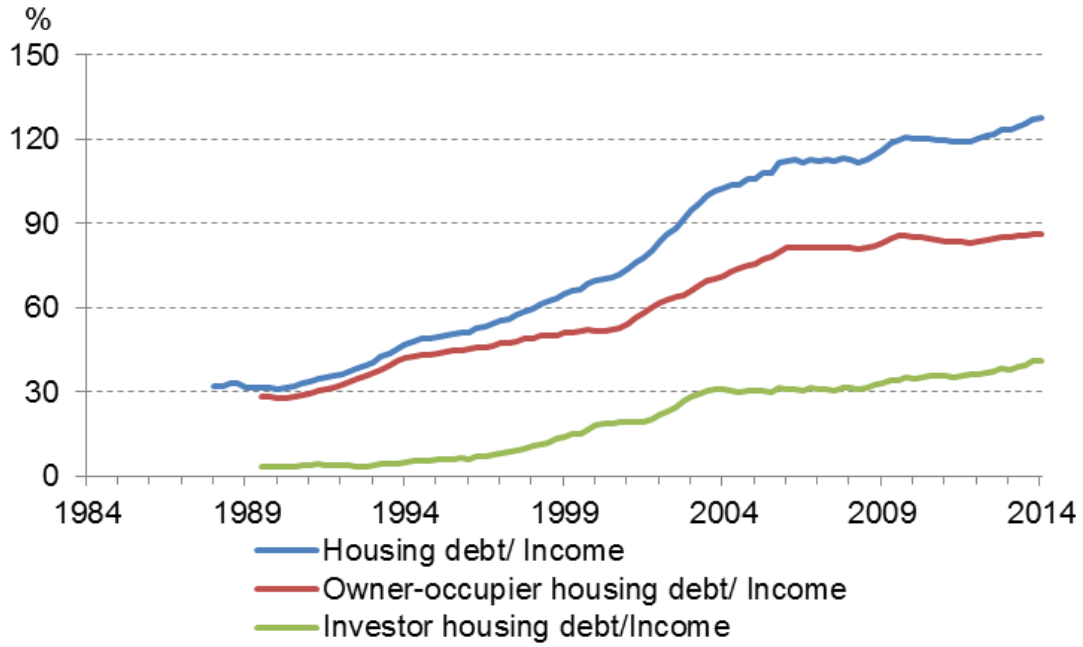
2 HOUSE PRICES AND HOUSEHOLD INDEBTEDNESS

2.1 Introduction

If house prices increase, how should we expect a household's debt to respond? How large are the effects? What are the channels through which household debt is associated with house prices? Are some types of households more responsive than others?

These are important questions, which will become increasingly salient as house prices and household debt continue to rise in Australia. This chapter of the Final Report examines the link between house prices and house-price-induced changes in debt in Australia. This research seeks to shed light on the mechanisms through which house prices and household debt are linked.

Figure 1: Household debt ratios in Australia (% Household disposable income)



Source: RBA statistics, Table E1; ABS 5206 Table 20

Australia experienced a sustained increase in house prices over the past two decades (ABS 2014). Figure 1 shows that the growth in real house prices was accompanied by growth in household debt as a proportion of income. The increase in household debt is largely due to an increase in mortgage debt. The Organisation for Economic Co-operation and Development (OECD) report from 2012 shows that Australia's household debt ratios (debt divided by disposable income) are high by international standards. The growth in debt may indicate that households are not in a strong position to endure negative economic 'shocks' or events such as periods of unemployment.

From a macroeconomic perspective, the link between house prices and mortgage debt has implications for financial stability. For example, in terms of monetary policy, a key issue is whether greater indebtedness may affect the sensitivity to economic shocks of household spending. House prices may have a larger effect on consumer spending the stronger the link between house prices and debt. Yates and Whelan

(2009) showed that rising house prices have substantial effects on 'credit-constrained' households—those with debt up to their borrowing limit—since house price increases help to relax borrowing constraints. Higher house prices may also have stretched some households to take on larger mortgages, adding to housing stress and resulting in less money being available for discretionary spending. Regulations have recently been enacted in a number of developed countries to limit the growth of household indebtedness (RBA 2014b) reflecting a concern for household and, ultimately, national wellbeing.

In this section we address the following research questions, and thereby provide evidence-based insights into the policy discussions:

- (RQ-1): What is the nature and magnitude of the relationship between house prices and household debt, and between the mortgage and non-mortgage components of household debt?
- (RQ-3): How large are these effects, and are some types of households more affected than others?

Our analysis reveals a strong relationship between house price changes and household indebtedness in Australia. We also find important differences in the relationship between house price and indebtedness across households. In particular, home owners with greater unsecured debt, and with higher LTV ratios, have a stronger positive association between house price movements and indebtedness compared to other households.[1]

The next section begins with a brief description of the underlying economic reasons for a relationship between household debt and house prices. We outline the life-cycle model (LCM), which is the common economic framework for considering these relationships. With this as a guide, we discuss the implications of house price changes for borrowing behaviour and household decisions regarding debt. We then review key international and Australian studies on the relationship between house prices and household debt. Section 2.3 presents our descriptive analysis of the links between household debt and house prices in Australia using macro and micro-level data. In Section 2.4 we outline the methods employed in our in-depth empirical analysis, and we then present our key findings on the links between Australian house prices and household debt.

2.2 Background framework and literature

This section provides a general overview of conceptual ideas and background literature. These provide the context for the empirical analysis in this chapter. The reader is also directed to the Positioning Paper that accompanies this report (Atalay, Barrett et al. 2015) for a more detailed discussion of the economic framework and a comprehensive literature review of the topic.

The effects of house prices on household indebtedness can be studied by using the model of consumer behaviour known as the 'life-cycle' or 'permanent income' (LC/PIH) model. In the simplest version of LC/PIH, household spending over time is assumed to depend on expected lifetime income. Households smooth any fluctuations in current income by accumulating wealth. They achieve this by saving when income is relatively high and by drawing on that wealth through dissaving (and holding debt) when income is relatively low. Anticipated changes in wealth are built into consumption plans; unanticipated changes lead to a revision of those plans.

[1] The LTV ratio is defined as the value of the loan or mortgage debt divided by the value of property.

Several papers in the literature use this framework to understand the consequences of house price changes on the borrowing, spending and housing decisions of households (see, e.g., Miles 1992; Iacoviello 2004; Campbell and Cocco 2007; Attanasio, Leicester et al. 2011). According to LC/PIH, an increase in house prices may lead home owners to increase their consumption over time and enjoy a higher standard of living. Unexpected increases in house prices make home owners richer; and this direct effect is referred to as the '*wealth effect*'. In addition, the LC/PIH model reveals an indirect effect on borrowing capacity. For some households, rising prices increase home owners' equity and thereby loosen constraints for those at their borrowing limit. This avenue is known as the '*collateral effect*' of increasing house prices, whereby the value of property that may be used as security for a loan has increased. These two effects have different implications for potential 'upsizers' and 'downsizers' among households at different ages (or stages of the life-cycle).

Consider a rise in house prices. The expected response to this 'shock' according to this framework include:

1. An owner-occupier household who is not credit constrained (i.e., a home owner who is able to borrow more money) and is not planning to move, experiences both an increase in housing wealth and in the cost of living (due to the increase in the cost of housing services). This household is insured against the house price fluctuation (by virtue of being a home owner), and if she does not adjust her housing consumption (by moving or changing tenure status), her consumption and borrowing should not change. The life-cycle model predicts that housing wealth will be spent later in life. Therefore, this household may engage in debt financing of consumption by drawing on equity in the home (e.g. through a mortgage redraw facility). Other related types of borrowing include refinancing of existing mortgages or adjusting the composition of existing debt.
2. An owner-occupier household who is not credit constrained but is planning to move by downsizing or upgrading will be affected by house prices when she is both selling and buying houses, and hence, she will necessarily adjust her debt level.
3. An owner-occupier household that is credit constrained may use the positive house price change to relax the constraint and access the additional wealth through a home equity loan, loan refinancing or using a mortgage redraw facility.
4. The behaviour of a home owner with a mortgage is affected by her initial collateral. A home owner with a low initial LTV ratio, and hence high collateral, would not be expected to respond to rising house values by increasing their debt. By contrast, a home owner with a high LTV ratio may be significantly affected by the house price increase, and she may lower her debt service costs by consolidating any unsecured debts into their mortgage.

Starting in the early 2000s, researchers have tried to test these predictions in light of data on observed behaviour. Debelle (2004) and Dynan and Kohn (2007) used macro data from the US and found a strong correlation between increases in the house prices and household debt during the 2000s. One strand of literature has directly focused on the effect of house prices on home equity-based borrowing (Greenspan and Kennedy 2005; 2008; Yamashita 2007; Cooper 2010; 2013; Mian and Sufi 2011). These studies find that households do use their home equity in response to house price appreciation. Their results show that home owners who are credit constrained have the strongest response to house price changes. Recent studies also highlight the importance of the 'collateral effect'. Disney, Bridges et al. (2010) show that house price movements appear to have an effect on unsecured debt in the UK. They show 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 home owners react to higher house prices by accessing their housing equity to finance higher levels of spending.

Australian evidence on the relationship between house prices and debt is scarce. Recent reports by Ong, Haffner et al. (2013) and Judd, Liu et al. (2014) present evidence of the rising share of older households with mortgages, and the increasing prevalence of home equity withdrawals in Australian. In Yates and Whelan (2009), they examine the effects of house prices on general spending during the late 1990s and mid-2000s. Their analysis highlights important collateral effects of house price rises.

Our research directly studies the impact of house prices on household indebtedness. Using longitudinal data, we investigate wealth and collateral channels that link house price changes and household debt. We also examine the impact of house prices on the composition of household debt. Specifically, we investigate the effect of house prices on the mortgage and non-mortgage components of household debt.

2.3 Empirical findings

Here we will first briefly describe our data. Following this, the broad trends in household indebtedness since 2001 will be discussed and a description of the relationship between debt and LTV ratios and its distribution in the Australian population will be provided. We then present results from our cross sectional and panel regression analysis. These analyses allow us to isolate the link between house prices and household debt, and the mortgage and non-mortgage components of debt.

2.3.1 Descriptive statistics

We utilise the HILDA survey, which is a population-based longitudinal or 'panel' study of household labour market activity and family dynamics. The HILDA survey has been funded by the Australian Government since 2001. Our main analysis is conducted at the household level, in which we consider housing and debt values for the respondent and his or her partner. In addition to standard questions concerning household demographics, health and economic status, the HILDA survey asks detailed questions regarding wealth and debt in three of the thirteen waves available at the time of writing: 2002, 2006 and 2010. Respondents in those waves are asked about their assets and liabilities. This information from the three 'wealth modules' enables us to consider the dynamics of household debt and the borrowing behaviour of Australian households. In addition to the self-reported house values in the HILDA dataset, our analysis utilises the historical record of house prices collected by Residential Property data (RP data). The details of the data sources and descriptive statistics are presented in the Positioning Paper.

Summary statistics for household indebtedness are provided in Table 1. In the Positioning Paper we present results for all households. In this final report we focus on home-owning households who respond to at least two of the three wealth modules (see Atalay, Barrett et al. 2015 for comprehensive descriptive statistics). This is the main sample considered throughout Chapter 2 of this Final Report. Our sample is restricted to households where the 'household head' (the most senior person in household) is not older than 75 years nor younger than 20 years. All monetary values are rescaled to 2013 dollar values (AUD).

Financial variables are reported at the household level, defined as the household head plus spouse/live-in partner. The financial variables are constructed as follows: household income is defined as household gross annual labour income plus annual pension income plus annual benefit income plus 'non-labour income'; financial wealth

is the sum of financial (savings accounts, stock holdings, etc.) and non-financial (housing and other property) wealth. For financial variables, we use self-reported values where possible. Household 'total properties' value is defined as the value of the principal residence (for home owners) plus the reported value of other properties. An important concern is measurement error in self-reported property values. We correct for this by using Local Government Area (LGA) level median house prices in place of the self-reported values. Second, LTV ratios are a key variable of interest. For our current analysis, we exclude from the analysis the small number of households that have LTV ratios for 'all properties' greater than 1.1. We also consider unsecured debt, which is debt that is not 'collateralised' or 'secured' against property. For our purposes unsecured debt is calculated as the sum of credit card debt, HECS/HELP debt and overdue household bills, vehicle loans and personal loans.

Table 1 shows that real household income grew at 3 per cent per annum over the four-year period 2002–06, and financial wealth increased by 30 per cent over the same period. However, the growth in household wealth was exceeded by the growth in the value of housing. From 2006 to 2010, household income increased by 9 per cent, financial wealth declined by 10 per cent and mean house value continued to increase though at a slower rate. These changes indicate that, following the GFC, housing values, unlike other financial variables, continued to rise in Australia. Changes in house values are matched by the increase in mortgage debt.

The lower panel of Table 1 also reveals that disaggregating households by their LTV ratios reveals substantial differences in the level of unsecured debt. Households with LTV ratios higher than 0.80 have, on average, unsecured debt that is more than two times greater than do households with LTV ratios less than 0.5. The groups with higher LTV ratios are typically younger, more likely to have children, have higher income growth, and have lower levels of financial wealth and housing equity. Therefore, higher LTV ratios are associated with higher levels of unsecured debt. These findings suggest that these types of households are more vulnerable to risks in both the housing and financial markets.

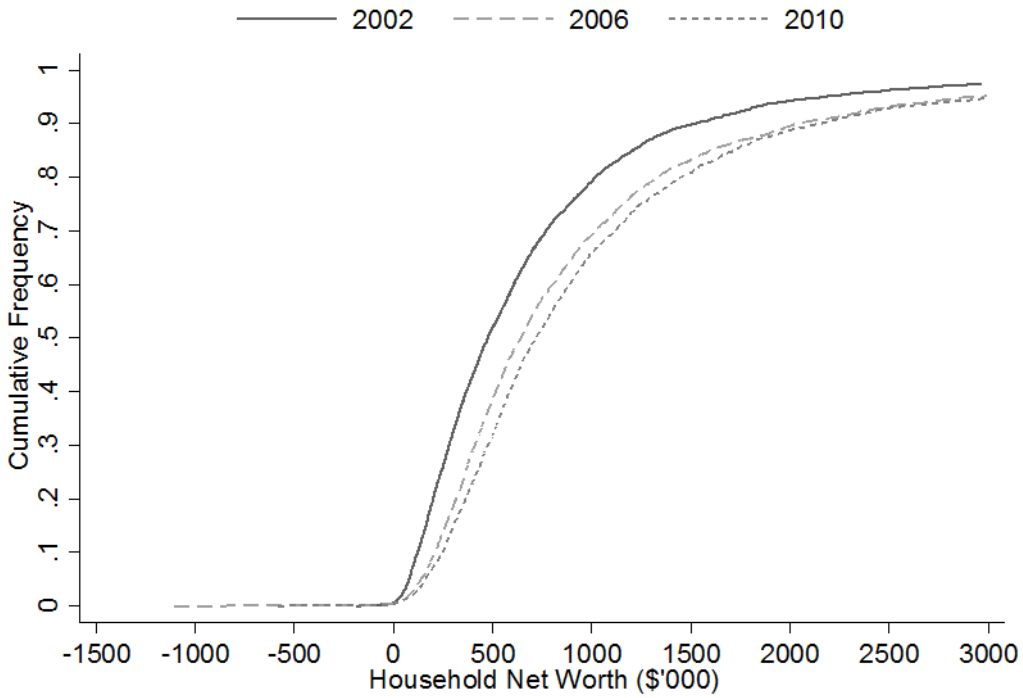
Table 1: Summary statistics from HILDA wealth modules: 2002, 2006 and 2010

Sample average, HILDA wealth modules, 2002, 2006 and 2010												
	2002				2006				2010			
	All sample	LTV <0.5	0.5< LTV <0.8	LTV >0.8	All sample	LTV <0.5	0.5< LTV <0.8	LTV >0.8	All sample	LTV <0.5	0.5< LTV <0.8	LTV >0.8
Financial variables												
Income	94,628	92,207	104,730	93,322	105,661	102,848	119,527	116,876	115,615	110,998	138,221	126,854
Financial assets	106,841	128,469	33,920	17,214	142,659	164,142	45,228	38,988	128,102	145,343	63,623	19,353
House value	409,875	440,257	317,182	240,930	552,181	573,770	462,873	398,226	618,702	643,916	528,133	436,924
Non-mortgage debt	16,099	13,704	23,722	21,370	22,349	18,998	35,710	36,530	24,816	22,523	33,535	45,302
Mortgage debt	101,641	62,997	238,632	230,826	148,721	100,366	377,886	39,764	175,767	108,348	453,691	482,534
LTV ratio	0.24	0.12	0.63	0.87	0.22	0.12	0.63	0.88	0.23	0.12	0.64	0.89
Age	47.1	49.9	37.8	35.6	50.5	52.8	40.1	37.9	52.3	55.03	43.2	39.8
Male	0.59	0.57	0.62	0.62	0.58	0.57	0.6	0.58	0.58	0.58	0.61	0.47
Children	0.93	0.88	1.04	1.1	0.91	0.84	1.25	1.2	0.91	0.81	1.36	1.05
Married	0.63	0.63	0.6	0.6	0.64	0.63	0.69	0.6	0.65	0.64	0.7	0.57
Number of households	4,815	2,588	507	1,720	4,612	2,704	371	1,537	4,010	2,327	463	1,220

Source: Author calculations from HILDA survey data (2002, 2006 and 2010). All Financial variables are measured in 2013$.

To illustrate the distribution of household wealth and debt levels, Figures 2 to 6 below plot the cumulative distribution of debt and household 'net worth' in the three waves of HILDA survey wealth data (2002, 2006, 2010). It is important to note that our sample here is limited to home-owning households who appear in at least two of the three wealth modules. In the Positioning Paper that accompanies this report (Atalay, Barrett et al. 2015), results are presented for a larger sample that includes all types of households.

Figure 2: Distribution of net worth of home owners: 2002, 2006 and 2010

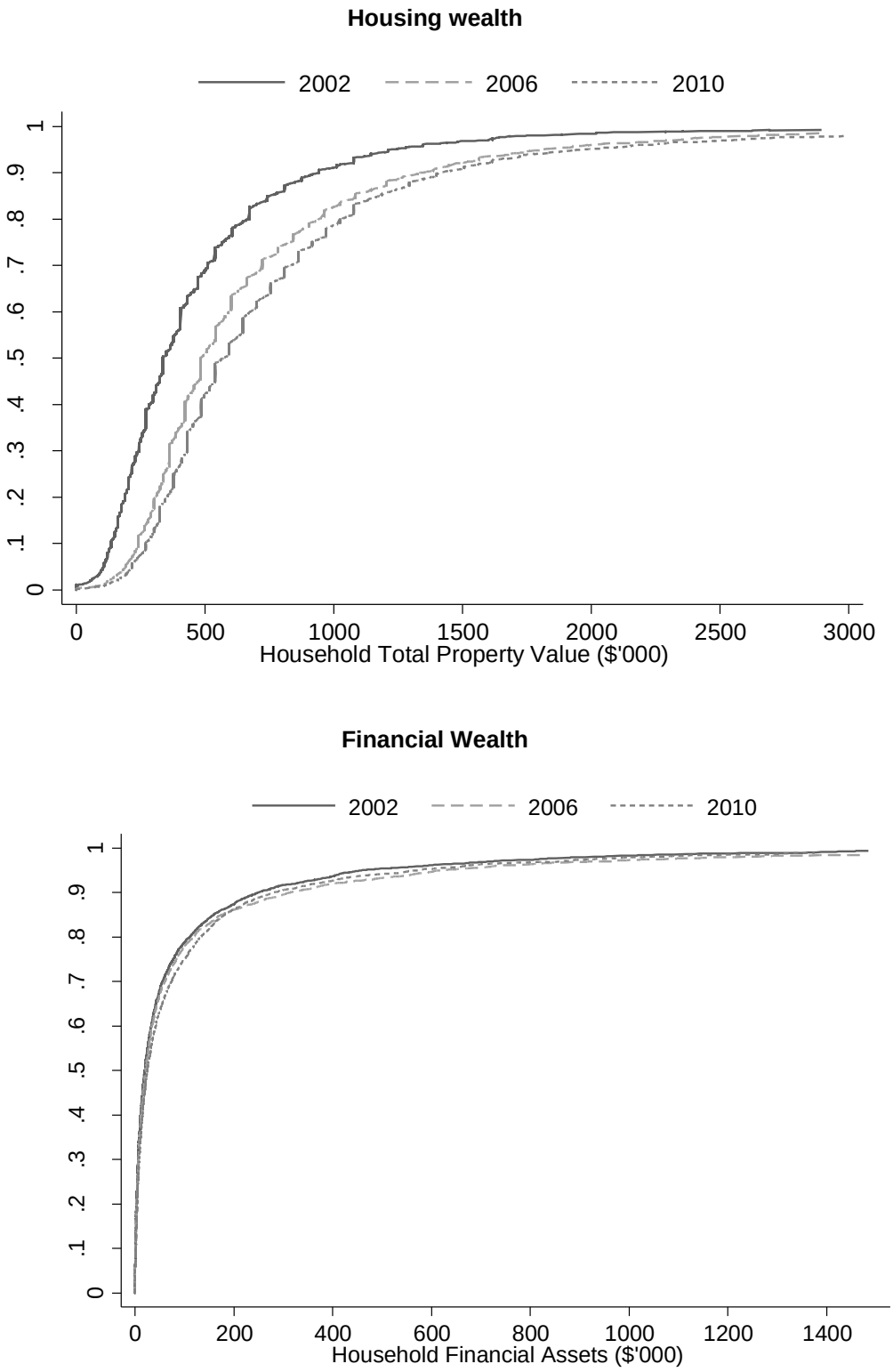


Source: Author calculations from HILDA panel data (2002, 2006 and 2010)

With the cumulative distribution of net worth, one can read off the percentage of the sample that has more or less wealth in a particular year. For example, Figure 2 shows that 80 per cent of the sample in 2002 had wealth of $1,000,000 or less. By 2010, that population share had fallen to 65 per cent. The figure shows a clear shift to the right in the distribution of wealth from 2002 to 2006, followed by a smaller further shifter from 2006 to 2010. The sample also indicates a concentration of high-net-worth households. In 2010 there are a number of households with negative net worth. These observations may be explained by depressed house prices following the GFC.

Figure 3 shows that housing wealth increased substantially over the observation period. Even after GFC, we observe a major rightward shift of the total housing wealth distribution. The right panel of the figure plots the financial wealth distribution. It is clear that the cumulative distribution for financial wealth increased from 2002 to 2006, although the distributions for 2006 and 2010 overlap, indicating no general change.

Figure 3: Distribution of housing and financial wealth of home owners: 2002, 2006 and 2010

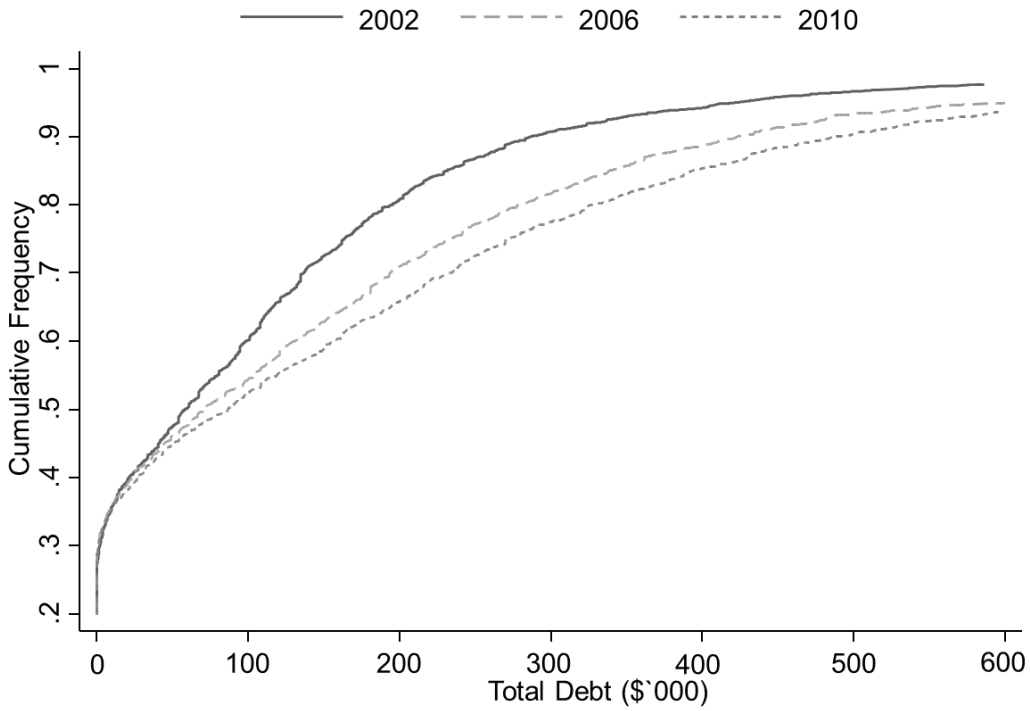


Source: Author calculations from HILDA panel data (2002, 2006 and 2010)

Figure 4 shows that approximately 30 per cent of home owners had no outstanding debt. The distribution shifts to the right, consistent with new home owners taking on progressively larger mortgages (in constant dollar terms). We observe a large shift

between 2002 and 2006 and a moderate shift from 2006 to 2010. Thus, overall it is clear that there has been an increase in debt amongst the population of home owners.

Figure 4: Distribution of total debt of home owners: 2002, 2006 and 2010

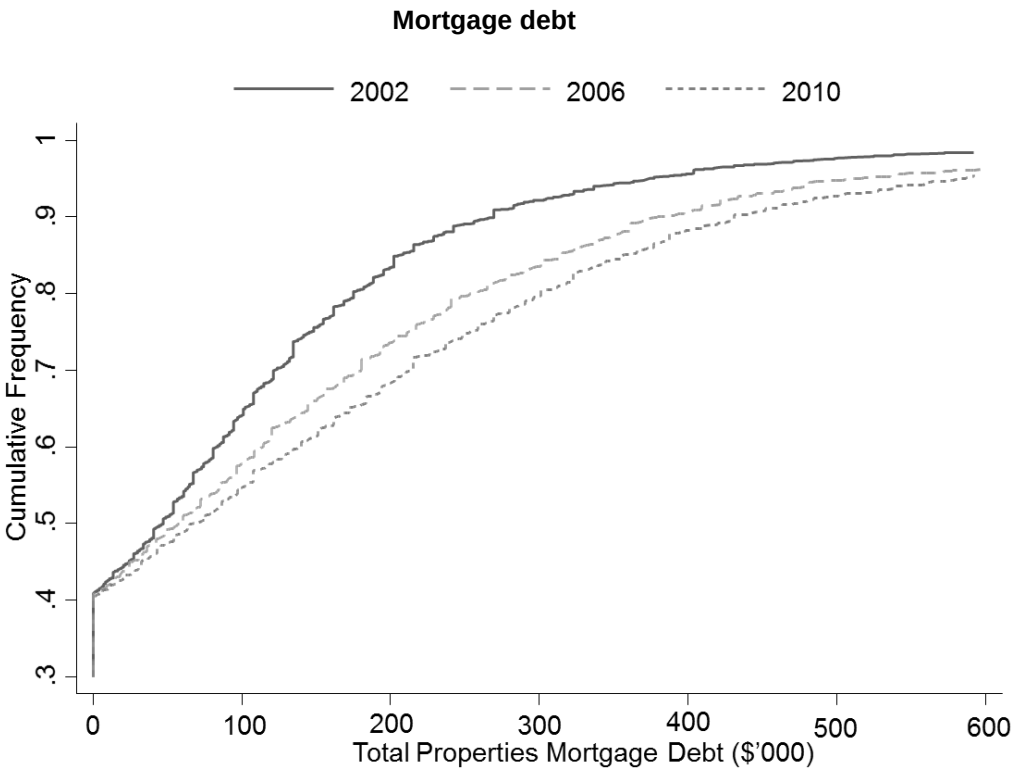


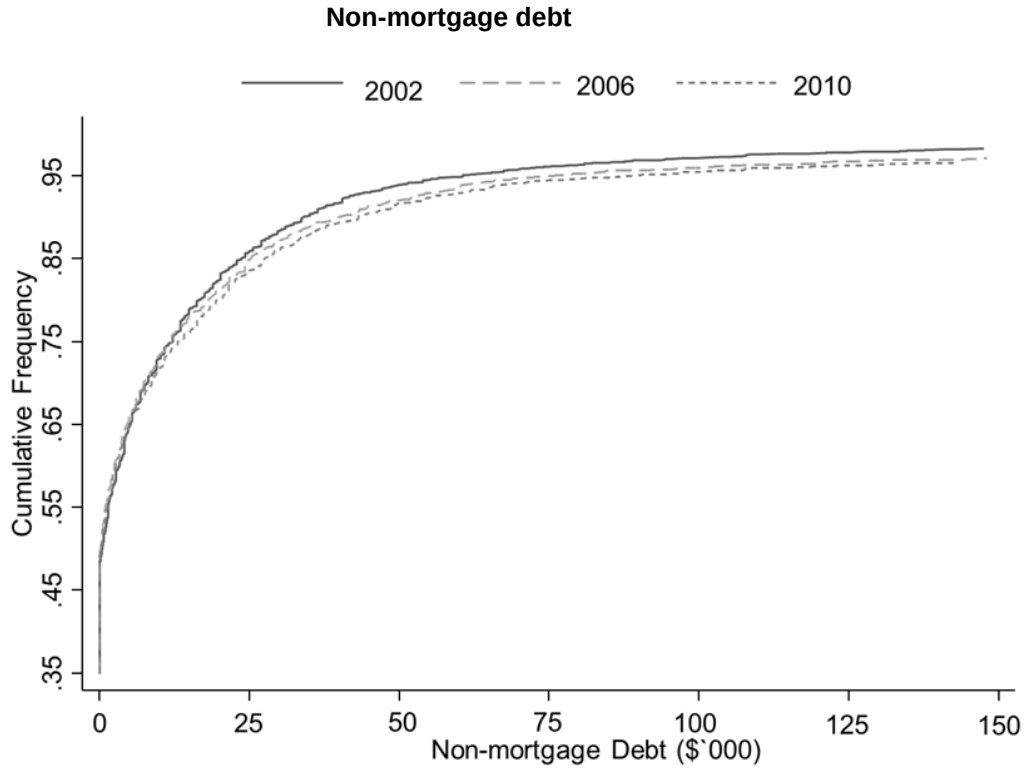
Source: Author calculations from HILDA panel data (2002, 2006 and 2010)

This trend is clearer when we consider mortgage debt, shown in the top panel of Figure 5. This figure shows that the distribution of mortgage debt shifts to the right, and becomes more concave, across successive waves of the survey. The changing shape of the distribution implies an increasing concentration of debt, with greater mortgage debt held by a smaller fraction of the population. There is no significant change over time for non-mortgage debt.

We also present the life-cycle profiles of debt and its components—mortgage and non-mortgage debt—in the appendix (see Figures A1 to A3). We observe a 'noisy' life-cycle pattern. For mortgage debt, the age profile is hump-shaped over the life-cycle. This picture is consistent with households purchasing homes when young via a mortgage and then repaying the mortgage over the course of their working life. Households often upsize their dwelling in the middle phase of their working life and downsize later, once their children leave home or when they retire. Another clear pattern is that the mortgage debt of each successive generation, or 'birth cohort,' is rising. These trends indicate that a growing proportion of households will likely be 'collateral' or 'credit-constrained' during their middle-ages (35–49 years).

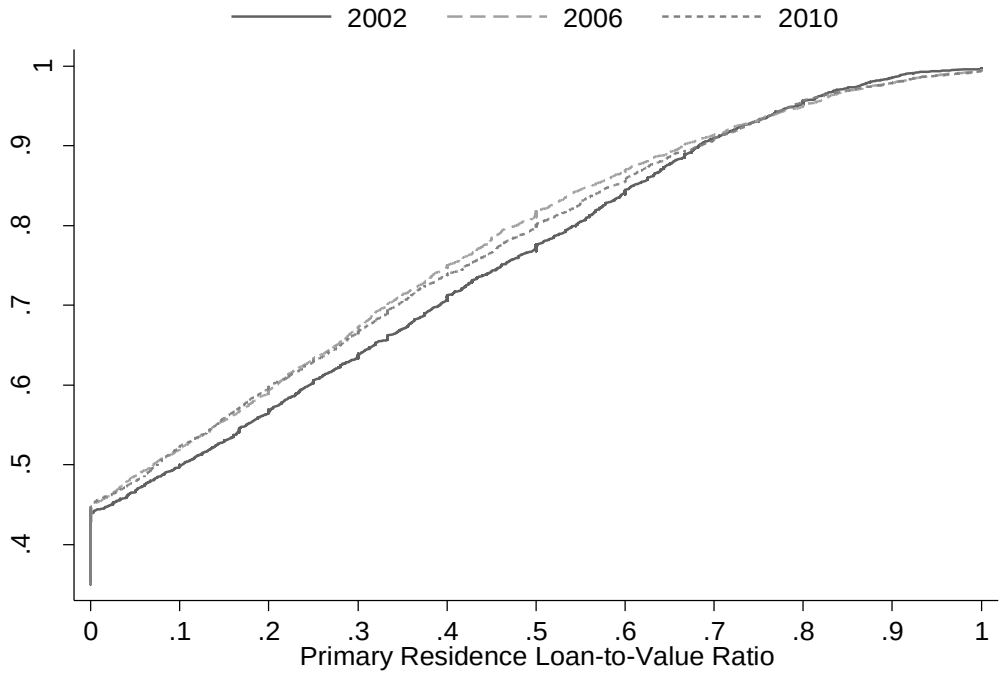
Figure 5: Distribution of mortgage and non-mortgage debt of home owners: 2002, 2006 and 2010





Source: Author calculations from HILDA panel data (2002, 2006 and 2010)

Figure 6: Distribution of loan to value ratios of home owners: 2002, 2006 and 2010



Source: Author calculations from HILDA panel data (2002, 2006 and 2010)

Figure 6 plots the cumulative distributions of LTV ratios from 2002 to 2010. It is apparent that increases in housing debt were generally outweighed by increases in housing wealth, as an increasing share of home owners faced lower LTV ratios. For example, 72 per cent of the sample in 2002 had an LTV at most equal to 0.5, whereas by 2010 that share had increased to 80 per cent. The figure shows a clear shift in the distribution of LTV from 2002 to 2006 but a small change between 2006 and 2010. The statistical significance of these trends is confirmed by stochastic dominance tests. Importantly, the LTV distributions reveal that 8 per cent of households had ratios greater than 0.9 in 2002, and that by 2010 it was significantly larger. The growing share of home owners with very high LTV ratios does suggest an increase in the prevalence of collateral-constrained households following the GFC.

2.3.2 Summary of findings from descriptive statistics

In summary, the descriptive statistics from the wealth modules of the HILDA survey (2002, 2006 and 2010) confirm the following:

- → There is an increase in household debt and housing wealth for Australian households in the 21st century. Even following the GFC, house values continue to rise and are accompanied by increases in household debt, specifically mortgage debt.
    1. Home owners are increasing their mortgage debt levels over time either because of the increase in initial mortgage debt or because of equity withdrawals.
    2. The empirical findings indicate a close relationship between house prices and household debt. The data reveal that households vary greatly in their collateral positions as measured by the LTV ratio.
    3. An important proportion of households were collateral constrained during the 2000s, and their share in the population increased following the GFC.

These findings suggest a close relationship between house prices and household debt, although there are likely to be many other factors in addition to house prices that influence household borrowing and debt. In the next section we use regression methods to control for these factors to isolate the link between house prices and household debt, and the mortgage and non-mortgage components of debt.

2.3.3 Regression results

In this section, our regression analysis considers the impact of house prices on the debt portfolio of households. We use cross-sectional and panel data regressions to answer two research questions.

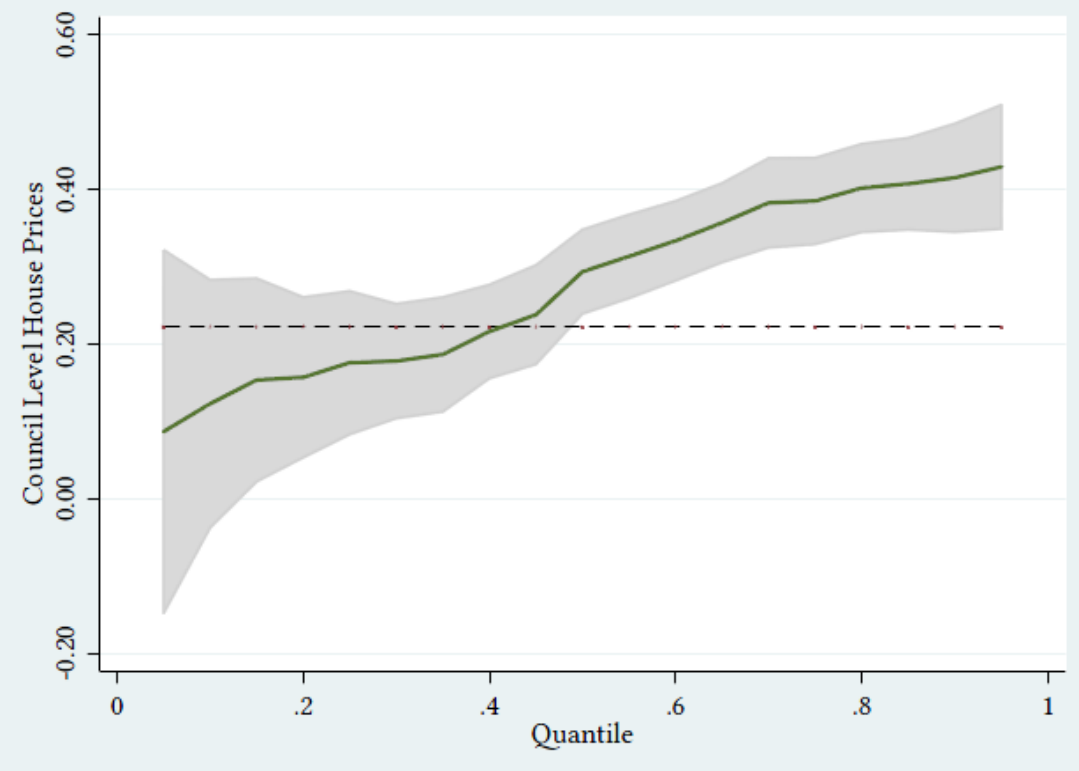
- *(RQ-1)*: What is the nature and magnitude of the relationship between house prices and household debt, and between the mortgage and non-mortgage components of debt?
- *(RQ-3)*: How large are these effects, and are some types of households more responsive than others?

Cross-sectional results

Our preliminary cross-sectional analyses in the Atalay, Barrett et al. (2015) Positioning Paper investigates the effect of house prices on *total debt holdings*, which partly addresses RQ1. The preliminary findings of the Positioning Paper are summarised in Figure 7. The figure plots the estimated effect of the house prices on total debt holdings. The dashed line indicates the Ordinary Least Squares (OLS) regression line, and the solid line shows the quantile regression estimates starting from the 5th percentile to the 95th percentile at a 5-point increment.

The figure suggests that after controlling for macroeconomic factors and household characteristics, LGA-level house prices are positively and significantly associated with the total debt of households. The OLS coefficient estimate indicates that a 1 per cent increase in house prices is associated with a 0.223 per cent increase in total debt, ceteris paribus. The effect is larger at the upper part of the conditional debt distribution, and for middle-aged and older households. The figure also shows that there are significant effects at the lower end of the debt distribution, suggesting that the relationship between house prices and debt is not solely driven by home purchases.

Figure 7: The effect of house prices at different quantiles of the total debt distribution



Notes: The dashed line plots the OLS estimate of the coefficient of the housing price on total debts. The green solid line plots the quantile estimates of the coefficient starting from the 5th quantile to the 95th at a 5-point increment. The shaded region is the 95 per cent confidence interval of the quantile estimated using robust standard errors. See Table 8 in the Positioning Paper source material for the full results.

Source: Atalay, Barrett et al. 2015

Building on these preliminary findings in this Final Report, we initially used the same methods to examine the effect of house prices on the *non-mortgage* (or unsecured) debt. Our cross-sectional analysis is based on the following regression:

$$NONMortDebt_{ikt} = \beta_0 + \beta_p \Delta p_{kt} + X'_{it}\beta_x + \epsilon_{ikt} \quad (1)$$

where $NonMortDebt_{ikt}$ is the logarithm of non-mortgage debt for household *i* in region *k* at period *t*. P_{kt} is the logarithm of council-level (LGA) house prices collected by RP data. Δp_{kt} is the growth rate of LGA-level house prices. X'_{it} is a set of household characteristics including age, age squared, age cubed, home ownership and education 'indicators' (completed a university or higher degree; completed a diploma; completed year 12), with high-school dropouts as the education reference group. Household income is grouped into four categories: less than $35,000 (reference group), between $35,000 and $49,999, between $50,000 and $99,999 and more than $100,000. For survey wave indicators, the first wealth module (wave 2, collected in 2002) is the reference group.

We estimate this specification using the wealth modules in 2002, 2006 and 2010. In this specification, we treat each module as an independent cross-section and control general time effects by including time dummies. Our next model uses the data as a panel and investigates the changes in debt due to changes in house prices at the household level.

Before we discuss the results, it is important to recall two econometric concerns. In the Positioning Paper these issues are discussed in detail. Here, we summarise the main problems to aid readers in understanding our empirical strategy. First, Equation (1) assumes a relationship *from* changes in house values *to* changes in debt. However, households may invest in renovations that increase the value of their home. Debt-financed home improvement can lead to a positive relationship between growth in house values and growth in indebtedness with debt as the driving variable. As a solution, we use the RP data to generate LGA median house price changes rather than self-reported house prices in the data. Second, there is a selection issue in the estimation of Equation (1). Since we only observe debt for households with positive debt, we are faced with a 'sample selection' issue. For example, if an individual owns a house with a mortgage or if she is paying a HECS/HELP debt, we will observe positive debt. However, for some outright home owners we may not observe any debt. Ignoring this selection (of only positive debt levels) regression estimates will tend to be biased. The standard solution for this issue is to use the 'Heckman sample selection correction model' (or 'Heckit procedure'), which we employ in our analysis.

While correcting for these factors, Equation (1) is estimated by using the ordinary least squares regression method, which summarises the average relationship between the dependent variable and the explanatory variables. Further, as we are interested in the relationship between the dependent variable and the explanatory variables at different points in the distribution of the dependent variable (here, the debt distribution), we also use quantile regression methods.

The estimates of (1) are presented in Table 2. The results show that there is a negative and marginally significant association (p-value=0.089) between house prices and non-mortgage debt for all households. The coefficient of interest is the local house price variable, with a coefficient estimate of -0.163, (significant at the 10% level). This coefficient implies that a 1 per cent increase in local house prices is associated with a 0.163 per cent decrease in non-mortgage debt. Note that this sample does include renters, and we should be careful in interpreting this effect. As discussed in the Positioning Paper, changes in the house prices might have different effects on renters and home owners (Atalay, Barrett et al. 2015). For renters, price changes are associated with the changes in their rents and, hence, their cost of living. Rent increases for renters are effectively a reduction in their wealth, which is the opposite of the positive wealth effect that home owners experience. Consequently, in the second column of Table 2, we restrict our sample to home owners. In addition to the control variables in column 1, we include as an indicator variable for whether the household owns more than one property, and another variable that indicates the self-reported year of expecting to finish paying the mortgage debt. The results indicate large and strongly statistically significant effects. In particular, a 1 per cent increase in local house price growth is associated with a 0.321 per cent decrease in the non-mortgage debts of home owners. This effect is significant at the 1 per cent level.

Table 2: Cross-sectional non-mortgage debt regression results

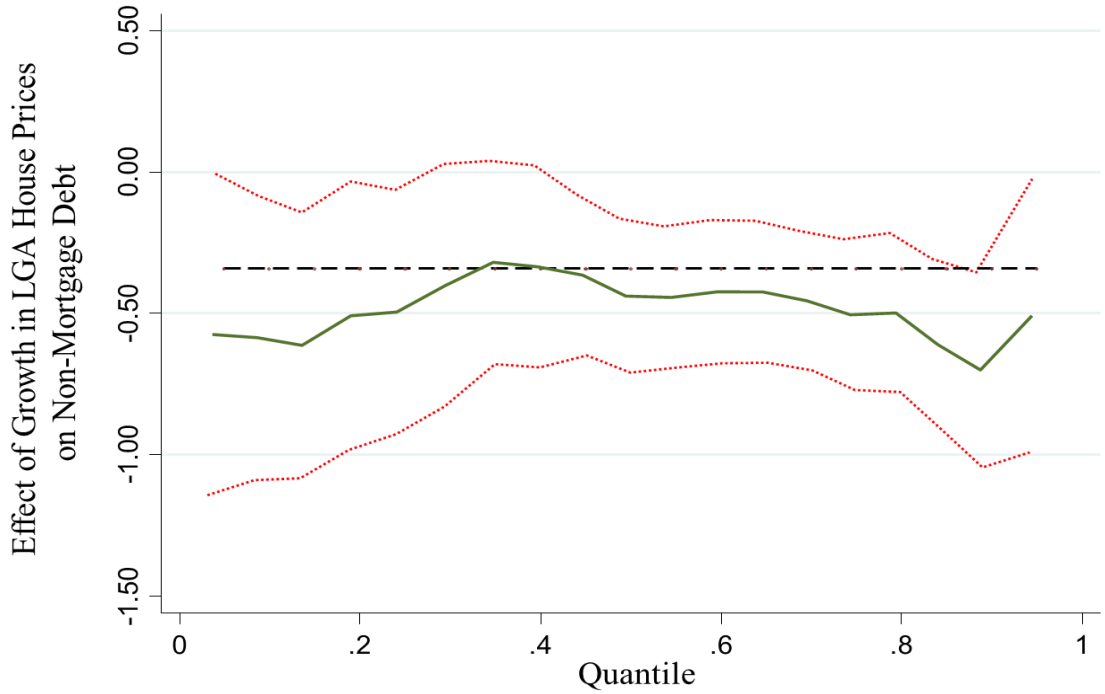
	(1)	(2)
House price growth (LGA level)	-0.163*	-0.321***
	[0.098]	[0.135]
Real interest rate	-0.293	-0.338
	[0.195]	[0.253]
Unemployment rate	-0.127***	-0.162***
	[0.033]	[0.042]
Household income		
$35,000 to $49,999	0.301**	0.332*
	[0.128]	[0.189]
$50,000 to $99,999	0.666***	0.474***
	[0.099]	[0.146]
More than $100,000	1.161***	0.846***
	[0.100]	[0.147]
Household head's age	-0.135***	-0.059
	[0.036]	[0.037]
Household head's age squared	0.002	-0.002**
	[0.001]	[0.001]
Household head's education		
Bachelor Degree or higher	0.614***	0.504***
	[0.039]	[0.103]
Diploma	0.292***	0.205**
	[0.035]	[0.097]
Completed year 12	0.310***	0.273**
	[0.046]	[0.137]
Owning two or more properties		0.874***
		[0.114]
Years left to pay mortgage		-0.017***
		[0.003]
Observations	8,228	5,998
Year—Quarter controls	Y	Y
State controls	Y	Y
Heckman selection method	Y	Y

Notes: 1. Standard errors are obtained from 99 bootstraps. They are reported in brackets. 2. *** p<0.01, ** p<0.5, * p<0.10. 3. Additional covariates include changes in HECS/HELP debt, household head gender, household income squared, household assets squared, education dummies, number of children and lagged values of HECS/HELP debt and household assets.

Source: Author calculations from HILDA panel data (2002, 2006 and 2010)

Figure 8 illustrates the quantile regression estimates for non-mortgage debt. The quantile regressions have the same independent variables as the specification in the second column of Table 2. We also restricted our sample to home owners. Figure 8 shows that a negative coefficient on the house price variable is common across the whole non-mortgage debt distribution, though the effect is less significant at the lowest percentiles (households with low non-mortgage debt). The negative effects become larger as we move up the conditional non-mortgage debt distribution. Our finding of a statistically and economically significant impact for the top end of the distribution indicates that the relationship between house prices not only impacts households via the wealth effect but may also operate through the collateral effect discussed previously.

Figure 8: The effect of house prices at different quantiles of the non-mortgage debt distribution



Notes: The dashed line plots the OLS estimate of the coefficient of the housing price on total debts. The green line plots the quantile estimates of the coefficient starting from the 5th quantile till the 95th at a five-point increment. The dotted red line region is the 95 per cent confidence interval of the quantile estimated calculated using robust standard errors.

Source: Author calculations from HILDA panel data (2002, 2006 and 2010)

Summary of cross-sectional results

In summary, our analysis indicates the following:

- There is strong positive effect of house prices on overall household indebtedness.
- There are important differences in the relationship between house price and household indebtedness across high- and low-debt households.
- There is a strong effect of house prices on outright home owners' borrowing behaviour: We find an impact on households located further down the debt distribution, indicating a positive wealth effect flowing from house price increases.

→ There is a negative impact of house prices on non-mortgage debt of home owners. This indicates that home owners adjust their debt portfolio when their house price increases.

Panel data results

Another way to investigate the impact of rising house values on household debt is to take advantage of the panel nature of HILDA and examine the changes in house prices and debt at the household level. Because panel data include repeated observations of the same individual over time, it is possible to control for unobserved factors (or 'omitted variables') through the use of econometric techniques. In addition, since panel data contain time series as well as cross-sectional variation, one can study life-cycle transitions in housing and debt decisions.

In addition, further analysis using panel data is necessary to examine whether home owners with higher levels of mortgage debt relative to house values actually exhibit a stronger positive association between subsequent movements in house prices and household debt. This investigation may help us uncover the exact transmission mechanism that links house prices and household debt. As discussed in the Positioning Paper, the collateral mechanism implies different responses to house price changes depending on whether the home owner is borrowing-constrained in the previous period (Atalay, Barrett et al. 2015).

Our panel data empirical model is similar to that of Disney and Gathergood (2011) and Disney, Bridges et al. (2010). Namely, we regress the change in household non-mortgage debt on the change in house prices and a set of financial, labour market and demographic controls:

$$\Delta Debt_{i,t} = \beta_0 + \beta_1 \Delta Homevalue_{i,t} + X'_{it}\beta_2 + u_{i,t} \quad (2)$$

where $\Delta Debt_{i,t}$ is the change in the total or non-mortgage debt of household *i* in two consecutive wealth modules, for example, between 2002 and 2006. Δ represents the changes, hence $\Delta Homevalue_{i,t}$ represents the change in housing wealth. In Equation (2), we explicitly control for changes in household income, financial assets and demographic characteristics of the household X'_{it}.

In the Positioning Paper, Equation (2) was used to examine the impact of house price changes on the total debt holdings of Australian home owners in general. In this Final Report, we will augment our baseline specification by introducing LTV thresholds in order to distinguish between the wealth and collateral transmission mechanisms between house prices and household debt. A collateral mechanism suggests that households' responses to house prices differ depending on their initial collateral positions (i.e., whether they are constrained in the previous period or not). Specifically, if the initial collateral position of the household is binding, an increase in house prices allows these credit-constrained households to borrow more money using their houses as collateral. In addition, some of these households may readjust their debt portfolios and, hence, reduce their debt service ratio. In our empirical specification below, we differentiate the collateral-constrained households by looking at their initial LTV ratios. In this model, we interact the change in house value with a series of dummy variables that distinguish households by their initial LTV (i.e., at the beginning of the four-year period between wealth measures). To test the collateral effect, the model in Equation (3) estimates different conditional coefficients for households with initially high LTVs compared to the rest of the sample. The equation states:

$$\Delta TotalDebt_{i,t} = \beta_0 + \beta_1 \Delta HVal_{i,t} x\, I\left(LTV_{i,t-1} > c\right) + \beta_2 \Delta HVal_{i,t} x\, I\left(LTV_{i,t-1} \leq c\right) + + X'_{it}\beta_3 + u_{i,t} \quad (3)$$

As presented in Equation (3), in the regression we will use different threshold values *c* for high LTV. Our base specification sets the threshold for high LTV equal to 0.8, but we will use 0.7 and 0.9 as alternatives. In addition to this extended specification, we also employ alternative liquidity-constrained measures utilised in the consumption literature. These include indicators for high non-mortgage debt, high debt-to-income ratios and a financial hardship measure. We estimate equations (2) and (3) with the dependent variable as non-mortgage debt. This is particularly interesting because collateral-constrained households, by definition, are more likely to borrow non-mortgage debt than other households. When these households experience increases in the value of their housing wealth, they are more likely to re-mortgage to refinance this relatively more expensive unsecured non-mortgage debt. Hence, examining the responses in the non-mortgage debt changes provides another test for the collateral effects.

It is important to note that similar to our cross-sectional models, our panel data model faces some econometric issues. First, using self-reported house values as an independent variable may be problematic if reported house values are sensitive to changes in the household debt (reflecting 'reverse causation'). As a solution, we use an instrumental variable technique, and 'instrument' self-reported house price changes with the council-level RP house prices changes. This strategy extracts the independent variation in house values based on local area sales, resolving the reverse causality problem.[2] Second, moving residence tends to be associated with changes in household financial situation and because of data limitations, we are unable to decompose the change in debt into non-housing consumption use and debt used for housing purchases. Hence, we limit our sample to the subsample of non-moving home owners. To control for the non-random nature of non-movers, we again estimate the Heckman selection model on movers and non-movers. The details of Heckman selection are discussed in the Positioning Paper.

In summary, our panel data strategies test whether home owners' responses to house price changes differ according to:

1. the household's initial LTV ratio
2. the household's self-reported financial situation
3. whether the household actually moves or not
4. the household's amount of non-mortgage debt.

Table 3 presents the estimates in which the dependent variable is total household debt. There are 3 columns, and in each column, we present regression results corrected for selection using the Heckman method. In all specifications, instrumented house prices are used as a key explanatory variable.[3] The results of the first stage of the Heckman method, the selection equation, show that the likelihood of the household being a non-mover decreases (coefficient -0.989, standard error 0.185) with its intention to move in the next year, and it significantly increases with the household liking its neighbourhood (coefficient 0.025, standard error 0.006). The coefficients on the exclusion restrictions are jointly significant at 1 per cent, which supports our use of this specification.

[2] Reverse causality may exist if, for example, households increase their debt to invest in home renovations that will increase the value of their homes. This debt-financed home improvement can cause a positive relationship between growth in house values and growth in indebtedness.

[3] Please see the Positioning Paper for the results of the simple OLS and different specifications in which self-reported and LGA house prices are used for Equation (2).

The first column of Table 3 establishes a strong relationship between house price movements and household indebtedness. The coefficient of 0.240 is significant at the 1 per cent level. The effect indicates that a $1,000 increase in house values is associated with a $240 increase in household debt (at the mean of the data). We also observe a significant positive relationship with household income and household debt and a negative significant relationship between financial asset holdings and household indebtedness. The coefficients on the age variables verify a hump-shaped life-cycle profile. As expected, owning a second house, refinancing and having longer to pay off the mortgage are all associated with an increase in the total debt.

Columns 2 to 4 illustrate results from our Equation (3), which includes the interaction terms of house values with a series of dummy variables that distinguish households by their initial LTV positions (i.e. their LTV at the beginning of the four-year period between waves). In Column 2, the initial LTV threshold is 0.8, in Column 3, it is 0.7, and in the last column, it is 0.5. The magnitudes of the coefficients imply that households with high LTVs have a positive relationship between house price movements and household indebtedness that is approximately two times stronger than households with lower LTVs. The results in Column 2 imply that for households with an initial LTV over 0.8, a house price gain of $1,000 is associated with an increase in total indebtedness of $681. For households with an initial LTV below 0.8, the equivalent value is $255. In Column 3, these values become $621 and $255, respectively, and in Column 4, $385 and $255, respectively. In each case, the differences between the coefficients on each interaction term are statistically significantly different from one another at the 1 per cent level. These results suggest that households with initially higher LTVs exhibit a stronger relationship between changes in house values and total debt.

Table 4 provides further estimates for age sub-groups. Our sample is restricted to home owners, and the three age groups are 20 to 35, 35 to 49 and over 49. In all the columns, we use the instrumented house prices and present selectivity-corrected estimates (based on the Heckman selection model). For brevity, we do not present all the coefficients, though all the models contain the same explanatory variables as presented Table 3. The odd-numbered columns (1, 3 and 5) present the results for model 2. It is clear that for all subgroups considered, house price increases are associated with a statistically significant increase in total indebtedness. The largest impact belongs to the middle-age group, where the coefficient of 0.637 is significant at the 1 per cent level. The effect indicates that a $1,000 increase in house value is associated with a $637 increase in household debt (at the mean of the data) for middle-aged home owners. The coefficient for the old age group shows a much smaller impact—only one-fourth of the impact for the middle-aged.

Columns 2, 4 and 6 illustrate the results from our Equation (3), which includes the interaction terms of instrumented house values with a series of dummy variables that distinguish households by their initial LTV positions. Again, the results are presented for three age groups. Two important patterns are revealed in this table. First, the middle-age group exhibits the same trend as our full sample. The magnitudes of the coefficients imply that middle-age home owners with high LTVs have a positive relationship between house price movements and household indebtedness that is more than twice as strong as that of households with lower LTVs. This is not surprising, as these households are in the middle of their life-cycle and are less likely to downsize in the near future (and, hence, less likely to liquidate their assets). The wealth effect for such households is therefore limited. However, the collateral effect has a large impact on their borrowing decisions because an increase in their dwelling prices allows them to refinance and borrow more money for current consumption.

When we examine the young (20 to 35) and older (45 plus) age groups, we find the opposite pattern. The signs and magnitudes of the coefficients imply that young and old home owners with low LTVs have a positive and significant relationship between house price movements and household indebtedness. However, the effect is insignificant and close to zero for young and old home owners with high LTV ratios. By virtue of young home owners being at an earlier stage in their life-cycle, they are more likely to face an income (as well as a wealth) constraint. If this is the case, they might be less able to respond to the relaxation of the collateral constraint because they are also liquidity constrained (e.g., because of their low earning profile, their credit rating is not strong). For old home owners, we expect a stronger wealth effect, especially given the flexibility they have to move or downsize their home. In sum, we find a significant impact of house price growth on indebtedness. Additionally, there are clear differences in responses across the age groups, which indicates the importance of collateral and wealth effects on household debt holdings in Australia.

Table 3: House price changes and growth in total indebtedness: selectivity corrected estimates

	Full	c= 0.8	c= 0.7	c= 0.5
	(1)	(2)	(3)	(4)
Δ *Home value*	0.240***			
	(0.0107)			
Δ *Home value x* ($LTV_{t-1} > c$)		0.681***	0.621***	0.385***
		(0.0989)	(0.0902)	(0.0514)
Δ *Home value x* ($LTV_{t-1} \leqslant c$)		0.255***	0.255***	0.255***
		(0.0116)	(0.0116)	(0.0116)
Δ *Assets*	-0.005	-0.007	-0.008	-0.007
	(0.008)	(0.009)	(0.009)	(0.009)
Δ *Income*	-0.080	-0.093	-0.089	-0.092
	(0.056)	(0.060)	(0.060)	(0.060)
Δ *HECS debt*	1.191	0.905	0.918	0.907
	(0.890)	(0.619)	(0.619)	(0.621)
Income square	0.523***	0.615***	0.645***	0.611***
	(0.071)	(0.078)	(0.068)	(0.085)
Refinance home	35,389***	41,835***	41,009***	39,821***
	(10,956)	(11,436)	(11,438)	(11,461)
Own a second home	30,590**	68,518***	68,037***	68,332***
	(14,621)	(14,984)	(14,994)	(15,027)
Years left to pay mortgage	1,266**	569	565	637
	(642)	(673)	(674)	(675)
Age	-1,377	-206	-189	-175
	(2,879)	(3,041)	(3,043)	(3,053)
Age squared	16.54	0.212	0.086	0.483
	(25.99)	(27.44)	(27.45)	(27.53)
Observations	6,743	6,743	6,743	6,743
Censored observations	3,471	3,471	3,471	3,471
Joint sig. test	757	748	614	689
Regional dummies		Yes		
House prices		Instrumented house price		
Heckman selection model		Yes		

Notes: 1. Standard errors are obtained from 99 bootstraps. They are reported in brackets. 2. *** p<0.01, ** p<0.5, * p<0.10. 3. Additional covariates include changes in HECS/HELP debt, household head gender, household income squared, household assets squared, education dummies, number of children and lagged values of HECS/HELP debt and household assets. 4. There are 3,471 censored observations. These are households who moved homes between the 4-year waves.

Source: Author calculations from HILDA panel data (2002, 2006 and 2010)

Table 4: House price changes and growth in total indebtedness: estimates for age sub-groups

	Age 20–34 Coef. / SE		Age 35–49 Coef. / SE		Age 49+ Coef. / SE	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Δ *Home value*	0.207**		0.637***		0.162***	
	(0.0958)		(0.0299)		(0.00860)	
Δ *Home value* x ($LTV_{t-1} > 0.8$)		-0.271		1.374***		-0.0609
		(0.242)		(0.160)		(0.114)
Δ *Home value* x ($LTV_{t-1} \leqslant 0.8$)		0.222**		0.525***		0.184***
		(0.0956)		(0.0329)		(0.00950)
Observations	773	773	2,503	2,503	3,472	3,472
Censored observations	686	686	1,471	1,471	1,320	1,320
Joint sig. test	71.462	80.305	946.134	1,096.062	504.073	654.073
House prices	Instrumented house prices					
Heckman selection model	Yes					

Notes: 1. Standard errors are obtained from 99 bootstraps. They are reported in brackets. 2. *** p<0.01, ** p<0.5, * p<0.10. 3. Models control for covariates listed in Table 3 as well as additional covariates including changes in HECS/HELP debt, household head gender, household income squared, household assets squared, education dummies, number of children and lagged values of HECS/HELP debt and household assets.

Source: Author calculations from HILDA panel data (2002, 2006 and 2010)

It may be argued that the LTV ratio is an incomplete measure of collateral constraints and therefore we consider alternatives. The additional indicators examined are:

1. The household has unsecured, non-mortgage debt greater than $2,000.
2. The household has zero financial assets.
3. The household is in the top 10 per cent of the debt-to-income ratio distribution.

One by one, each of these three indicator terms are then interacted with the house price–LTV interaction terms in Equation 3. Hence, our model is modified to:

$$\begin{aligned}\Delta TotalDebt_{i,t} = \beta_0 + \beta_1 \Delta HVal_{i,t} x\, I\left(LTV_{i,t-1} > c\right) + \beta_2 \Delta HVal_{i,t} x\, I\left(LTV_{i,t-1} \leq c\right) \\ + \gamma_1 \Delta HVal_{i,t} x\, I\left(LTV_{i,t-1} > c\right) x\, SR_{Indicator} \\ + \gamma_2 \Delta HVal_{i,t} x\, I\left(LTV_{i,t-1} \leq c\right) x\, SR_{Indicator} \\ + X'_{it}\beta_2 + u_{i,t} \quad (4)\end{aligned}$$

With this regression, two models are estimated with the results presented in Table 5. In the left panel, a threshold LTV value of 0.8 (c=0.8) is used, while for the right panel a 0.5 threshold (c=0.5) is used. For each model, we estimated three specifications. Column (a) shows results from the 'zero financial asset' interaction term. This indicator variable ($SR_{Indicator}$) takes a value of 1 if the household reported zero financial assets and 0 otherwise. In this specification, γ_1, which captures both high LTV and zero assets, is very close to zero and statistically insignificant, and the second interaction term, which captures zero assets is negative and insignificant.

Column (b) of each model shows results from the unsecured (non-mortgage) debt interaction term. The indicator variable takes a value of 1 if the household is observed to have more than $2,000 of unsecured debt and 0 otherwise. The coefficient on the interaction of high LTV and high unsecured debt is positive, with a value of 0.436, and it is statistically significant at the 1 per cent level. The first interaction term now represents the effect of house prices of high LTV, but low unsecured debt becomes negative and insignificant. This pattern indicates that there is a stronger positive relationship between house price movements and household indebtedness for households with both high LTVs and high unsecured debt (combining the interaction term yields a magnitude of 0.508.) The coefficient on the low-LTV interaction term, which captures households with more than $2,000 of unsecured debt but an LTV below 0.8, is also positive and statistically significant, but the magnitude is smaller.

In Column (c), the indicator variable takes a value of 1 if the household's debt-to-income ratio is in the top 10 per cent of the debt-to-income ratio distribution and 0 otherwise. The estimates of γ_1 and γ_2 are both positive, statistically significant and large in magnitude for interactions that capture households with only high (low) LTVs. For high-LTV-ratio households, the original interaction effect becomes insignificant; this indicates that the large response is driven by home owners with limited collateral and liquidity.

In the right panel, we observe similar patterns in the three specifications, although the effects are more moderate due to having an LTV threshold of 0.5. Overall, these results suggest that house price movements are positively associated with household indebtedness for households, even when we incorporate a range of indicators for being liquidity constrained as well as collateral constrained, as defined by the various measures used.

Table 6 provides further estimates for age sub-groups for the model with the unsecured debt interaction term. In all the estimates, we use the instrumented house prices and present selectivity-corrected estimates (based on the Heckman selection

model). For brevity, we do not present all the coefficients, though all the models contain the same explanatory variables as presented in Table 5. The results by age group show the same pattern as that for the whole sample. Middle-aged home owners captured in the LTV ratio and unsecured debt interactions exhibit a stronger response to house price movements compared to older households. However, due to sample size, the estimates for this sample are imprecise. A pattern in the estimated coefficients is evident: home owners with greater values of unsecured debt together with higher LTV ratios have a stronger positive association between house price movements and indebtedness compared to the wider sample.

We now consider the direct impact of relaxing LTV ratios on the level of *secured* debt, that is, mortgage debt. We use equations (2) and (3) with the change in a household's secured debt as the dependent variable. This approach complements the above findings—recall that the relaxation of collateral constraints has a significant impact on the indebtedness of constrained households with *unsecured* debt. By using mortgage debt as a dependent variable, we aim to gain more insight into the relationship between debt and house prices. In particular, the collateral constraints model implies that the relationship between changes in house values and debt varies across households depending upon their initial collateral position. Home owners who initially exhibit low LTVs would not necessarily be expected to respond to rising house values by extending their secured debt. Should such households have desired additional borrowing, we might expect them to have already utilised leverage on their initial housing collateral. In contrast, households with high LTVs can be considered collateral-constrained. Thus, we expect a stronger relationship between house price growth and additions to household debt, particularly among those households who can reduce their debt service costs by refinancing outstanding unsecured debts into their home mortgage.

The estimates presented in Table 7 display a strong relationship between changes in house values and secured debt. In Column 1, the coefficient on the instrumented change in house value is positive and significant at the 1 per cent level, which implies that a $1,000 increase in house value is associated with an increase in secured debt of $200. In Columns 2 and 3, we again interact changes in instrumented house values with dummy variables distinguishing the household's initial LTV ratio. Households with initially higher LTVs exhibit a stronger relationship between changes in house values and secured debt, and the result is statistically significantly stronger at the 1 per cent level. The next two columns look at the subgroup of individuals who are middle-aged (35–49). In column 3, we find that the impact is strongest for the middle-aged group by $400. Examining the LTV interaction terms indicates that this effect is driven by both high-LTV- and low-LTV-ratio middle-aged home owners, although the impact is much stronger for high-LTV households. This finding underlines the impact of collateral-constraints on households' responses to house price movements. The last two columns suggest that older home owners are less responsive to house price changes and that households with high LTV ratios are not increasing their secured debt by refinancing. Column 6 also shows that old home owners with relatively low LTV ratios do in fact increase their secured debt. A $1,000 increase in house prices is associated with a $175 increase in the secured debt. This effect can be attributed to the wealth effect discussed in the literature. The results also support the recent findings by Ong, Haffner et al. (2013) and Judd, Liu et al. (2014), which present evidence of the rising share of older households with mortgages and the increasing incidence of home equity withdrawal in Australia.

Table 5: House price changes and growth in total indebtedness: selectivity corrected estimates, alternative proxies for liquidity constrained

	$(LTV_{t-1} > 0.X) = (LTV_{t-1} > 0.8)$			$(LTV_{t-1} > 0.X) = (LTV_{t-1} > 0.5)$		
	(a)	**(b)**	**(c)**	**(a)**	**(b)**	**(c)**
Δ *Home value* x ($LTV_{t-1} > 0.X$) x (*FinAsset* = 0)	0.007			0.347		
	(0.452)			(0.263)		
Δ *Home value* x ($LTV_{t-1} \leqslant 0.X$) x (*FinAsset* = 0)	-0.0949			-0.184*		
	(0.103)			(0.112)		
Δ *Home value* x ($LTV_{t-1} > 0.X$) x (*USecDebt* > 2000)		0.436***			0.318***	
		(0.167)			(0.0804)	
Δ *Home value* x ($LTV_{t-1} \leqslant 0.X$) x (*USecDebt* > 2000)		0.261***			0.214***	
		(0.027)			(0.0296)	
Δ *Home value* x ($LTV_{t-1} > 0.X$) x (*DebttoInc*)			1.099***			0.629***
			(0.286)			(0.0870)
Δ *Home value* x ($LTV_{t-1} \leqslant 0.X$) x (*DebttoInc*)			0.352***			0.347***
			(0.0185)			(0.0190)
Δ *Home value* x ($LTV_{t-1} > 0.X$)	-0.294	0.102*	-0.101	-0.227***	0.290***	0.237***
	(0.268)	(0.059)	(0.120)	(0.0795)	(0.0392)	(0.0425)
Δ *Home value* x ($LTV_{t-1} \leqslant 0.X$)	0.0174	0.187***	0.218***	0.0241	0.174***	0.218***
	(0.0167)	(0.010)	(0.0114)	(0.0168)	(0.0118)	(0.0117)
House prices			Instrumented house price			
Heckman selection model	Yes	Yes	Yes	Yes	Yes	Yes

Notes: 1. Standard errors are obtained from 99 bootstraps. They are reported in brackets. 2. *** p<0.01, ** p<0.5, * p<0.10. 3. All columns include control variables listed in Table 3 and additional covariates include changes in HECS/HELP debt, household head gender, household income squared, household assets squared, education dummies, number of children and lagged values of HECS/HELP debt and household assets.

Source: Author calculations from HILDA panel data (2002, 2006 and 2010)

Table 6: House price changes and growth in total indebtedness: selectivity corrected estimates for age sub-groups

	Age 20–34	Age 35–49	Age 49+
	Coef. / SE	**Coef. / SE**	**Coef. / SE**
Loan to value threshold is 0.8			
$\Delta\, Home\ value\ \times (LTV_{t-1} > 0.8)$	-0.024	0.116	0.119
	(0.155)	(0.128)	(0.085)
$\Delta\, Home\ value\ \times (LTV_{t-1} \leq 0.8)$	0.14	0.155***	0.189***
	(0.121)	(0.024)	(0.01)
$\Delta\, Home\ value\ \times (LTV_{t-1} > 0.8) \times (USecDebt > 2000)$	0.266	0.886***	-0.67**
	(0.378)	(0.186)	(0.286)
$\Delta\, Home\ value\ \times (LTV_{t-1} > 0.8) \times (USecDebt > 2000)$	-0.172	0.425***	0.059
	(0.139)	(0.051)	(0.04)
Loan to value threshold is 0.5			
$\Delta\, Home\ value\ \times (LTV_{t-1} > 0.5)$	0.205	0.263***	0.298***
	(0.149)	(0.071)	(0.067)
$\Delta\, Home\ value\ \times (LTV_{t-1} \leq 0.5)$	0.151	0.159***	0.179***
	(0.129)	(0.024)	(0.01)
$\Delta\, Home\ value\ \times (LTV_{t-1} > 0.5) \times (USecDebt > 2000)$	-0.022	0.705***	-0.74***
	(0.164)	(0.13)	(0.198)
$\Delta\, Home\ value\ \times (LTV_{t-1} \leq 0.5) \times (USecDebt > 2000)$	-0.470**	0.530***	0.085**
	(0.184)	(0.053)	(0.041)
House prices	Instrumented house price		
Heckman selection model	Yes		

Notes: 1. Standard errors are obtained from 99 bootstraps. 2. *** p<0.01, ** p<0.5, * p<0.10. 3. Models control for covariates listed in Table 3 as well as additional covariates including changes in HECS/HELP debt, household head gender, household income squared, household assets squared, education dummies, number of children and lagged values of HECS/HELP debt and household assets.

Source: Author calculations from HILDA panel data (2002, 2006 and 2010)

Table 7: House price changes and growth in secured debt: estimates by age group

	Full sample Coef. / SE		Age 35–49 Coef. / SE		Age > 49 Coef. / SE	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\ Home\ value$	0.203***		0.441***		0.152***	
	(0.00834)		(0.0210)		(0.00719)	
$\Delta\ Home\ value\ \times (LTV_{t-1} > 0.X)$		0.272***		0.456***		0.0400
		(0.0542)		(0.0800)		(0.0717)
$\Delta\ Home\ value\ \times (LTV_{t-1} \leq 0.X)$		0.209***		0.351***		0.175***
		(0.00862)		(0.0230)		(0.00781)
Observations	6,747	773	3,474	6,747	773	3,474
Censored observations	3,477	686	1,317	3,477	686	1,317
Joint sig. test	970.420	80.305	637.295	1,850.420	180.305	837.295
House prices	Instrumented house prices					
Heckman selection model	Yes					

Notes: 1. Standard errors are obtained from 99 bootstraps. They are reported in brackets. 2. *** p<0.01, ** p<0.5, * p<0.10. 3. Models control for covariates listed in Table 3 as well as additional covariates including changes in HECS/HELP debt, household head gender, household income squared, household assets squared, education dummies, number of children and lagged values of HECS/HELP debt and household assets.

Source: Author calculations from HILDA panel data (2002, 2006 and 2010)

2.4 Summary

Our aim in this section was to answer following research questions:

- *(RQ-1)*: What is the nature and magnitude of the relationship between house prices and household debt and between its mortgage and non-mortgage components?
- *(RQ-3)*: How large are these effects, and are some types of households more responsive than others?

We have estimated the impact of house price movements on household indebtedness using the HILDA survey data. Our analyses show a strong relationship between house prices and household debt in Australia. In particular, our cross-sectional analyses show that:

1. There are clear differences 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 by more than low-debt households.
2. There is a negative impact of house prices on the *non-mortgage* debt of home owners. A 1 per cent increase in the local house price is associated with a 0.321 per cent decrease in the non-mortgage debts of home owners. This statistically and economically significant impact indicates that the relationship between house prices and house debt operates in part through the relaxation of collateral constraints and hence a reduction in borrowing constraints. That is, the increase in the value of their property (that can be used as security for a loan) may loosen borrowing constraints. As a result, home owners can reallocate their debt portfolios to reduce their debt servicing by reducing non-mortgage debt and increasing mortgage debt.

Building on these findings, our panel data models exploit the effect of house price changes on home owners while controlling for permanent unobserved and time-varying observed individual characteristics. The results from these models can be summarised as follows:

3. We confirm the strong relationship between house price movements and household indebtedness by using panel data methods that include controls for changes in household incomes, labour market status and a range of demographics as well as regional and individual fixed effects.
4. Our results show that a $1,000 increase in house values is associated on average with a $240 increase in household debt for home owners.
5. There are important differences among home owners in responses to house price changes. House price changes are associated with larger increases in total indebtedness for home owners with higher initial LTV ratios.
6. The indebtedness of home owners with larger values of non-mortgage debt as well as higher LTV ratios are more sensitive to house price movements compared to the rest of the population of home owners.
7. Middle-aged home owners exhibit a stronger response to house price movements compared to older and younger home owners.
8. Results from panel data regressions confirm the cross-sectional findings and are consistent with our baseline estimates.

Our analysis in this Final Report sheds light on the role collateral and wealth effects play in the borrowing decisions of Australians. We show that both effects have prominent roles for different subgroups of the population. Households' responses to house prices vary by housing tenure status and debt levels. Our results indicate that in response to increasing house prices, some home owners, especially home owners with low debt, engage in debt financing of consumption (involving extracting equity from their home). Other home owners, especially those with relatively high debt levels refinance existing mortgages or adjust existing debt portfolios. We will discuss the policy implications of these findings in Section 4.2.

3 HOUSE PRICES, HOUSING DEBT AND THE LABOUR SUPPLY DECISIONS OF AUSTRALIANS

In this chapter, we review the literature and present the findings of our empirical analysis addressing the second and third research questions of the project. Specifically, what is the relationship between house prices, housing debt and the labour supply of Australians? Does the relationship between house price, debt and labour supply differ by gender, age or marital status?

3.1 Conceptual framework

To guide our empirical analysis, our regression models are informed by the framework of the simple life-cycle model. As discussed in detail in the Positioning Paper (Atalay, Barrett et al. 2015), decision makers' reactions to a change in house prices will likely vary systematically depending on tenure status and age. For example, an unexpected increase in house prices may lead to a range of reactions:

1. An owner-occupier household that is not planning to move is likely to increase consumption or reduce labour supply.
2. An owner-occupier household that is planning to move to a larger house may need to decrease consumption and increase labour supply to ensure they have the required wealth for the more expensive larger house.
3. A renting household planning to purchase a home may also need to decrease consumption or increase labour supply in order to accumulate assets for the required deposit.
4. An owner-occupier household that is borrowing-constrained may use the positive house price shock to relax the constraint. This may also lead to an increase in consumption or a decrease in labour supply.

We can also consider an explicit per-period borrowing constraint as originally presented in Fortin (1995). This constraint mimics the type often imposed by lending institutions in the form of a maximum gross debt service ratio. This is simply a limit on the amount borrowed of a specific multiple of income.

The LCM framework highlights that a decision maker's response to a house price shock will depend on their current housing tenure and their stage in the life-cycle. The discussion also raises a potential reverse causality issue—do households increase their labour supply to save for a future housing purchase, or is the change in labour supply a response to a prior change in housing wealth? The LCM also points towards a solution to this issue. If we can measure unexpected changes in house prices, then these will be 'exogenous' to labour supply, and hence the driver of the change in labour supply and consumption. We will return to this issue in Section 3.4 below.

3.2 Literature review

Australian evidence on the relationship between house prices, household debt and labour supply is limited to descriptive studies and aggregate analyses based on macroeconomic time series data. The macroeconomic analyses—such as Connolly (1996) and Connolly and Kirk (1996)—use a high level of aggregation, and, as a consequence, are unable to examine the distribution of responses by income or by demographic groups. On the other hand, cross-sectional analyses—for example, Kidd and Ferko (2001)—are problematic because of 'unobserved heterogeneity' or omitted variable bias. An unobserved characteristic (e.g. preferences or the discount rate of

an individual[4]) associated with debt choices may also be directly related to the labour supply decisions. It is difficult to disentangle the causal effect of indebtedness in cross-sectional studies. An alternative is to utilise panel or longitudinal data. As panel data include repeated observations of the same individual over time, it is possible to control for static unobserved factors using statistical techniques. Further, since panel data combine time series and cross-sectional variation, one can study life-cycle differences in labour supply, housing and debt choices.

To the authors' knowledge, there are two existing studies that use Australian panel data to investigate the relationship between housing debt and labour supply. Drago, Wooden et al. (2009) show that the total household debt-to-income ratio has a positive effect on the propensity to work long hours. Belkar, Cockerall et al. (2007) examine the importance of household indebtedness to labour force participation (LFP) for married males and females, finding a small, positive effect of debt on LFP. Both studies have several shortcomings. In addition to being somewhat dated, the analyses cover the short period from 2001 to 2005. As a result, the time series variation is limited, yet this variation is crucial in addressing econometrics issues and isolating the causal effects. Most importantly, the observation period for both studies does not include periods in which there are major changes in house prices, debt and labour supply behaviour (e.g. after the 2008 GFC).

There are two main strands in the international literature. The earlier strand, including studies by Fortin (1995), Worswick (1999), Aldershof, Alessie et al. (1999), Del Boca and Lusardi (2003) and Bottazzi (2004), examine the relationship between housing debt and labour supply in a range of countries using cross-section and panel data. Many of these papers focus on the labour supply of partnered females and find that debt and debt servicing have the expected positive and significant effect on labour supply.

The latter strand is expressed in more recent work by Disney and Gathergood (2014) and Milosch (2014), and is motivated by the declines in housing prices experienced in 2008/9 in the UK and the US, respectively. The authors study the impact of housing wealth shocks on labour supply for both men and women, married and single, using panel data along with local house price variation. Married, young to middle-aged women and men close to retirement respond to housing wealth shocks in both studies. Milosch (2014) separately considers the effect of positive and negative shocks to housing wealth. She finds that positive house price shocks cause married women to decrease their labour supply, while negative house price shocks lead older males to increase their labour supply as they delay retirement. Our approach is informed by this strand, and adopts an empirical approach developed in Disney and Gathergood (2014) and Milosch (2014).

3.3 Descriptive statistics

As in Chapter 2, the HILDA survey is used for the below analysis. However, in this chapter we use all waves 1–12 of HILDA rather than being restricted to the three waves with wealth modules. In this section, the key features of the sample used in the empirical analysis in this chapter will be described. Our sample is restricted to individuals between 20 and 75 years of age. Summary statistics are shown in Table 8. Across all 12 waves, we have 138,500 observations in an unbalanced panel of 15,978 individuals.

[4] For example, those individuals who tend to be more patient or with a longer time horizon will tend to borrow more and will supply more labour, ceteris paribus.

Across the sample and all 12 waves, the respondents have an average age of 48 years. Just over 50 per cent are female, and 57 per cent have more than a high school education. Some 76 per cent are married or cohabiting, and accompanied by an average of 0.19 children four years of age or younger and 0.77 children over the age of five years per household. The average annual household income is $144,000 (in 2013 Australian dollars), 76 per cent of respondents are in the labour force and respondents work an average of 25 hours per week, or 38 hours per week when excluding those who do not work.

Turning to their housing tenure status, across all ages, 75 per cent of the respondents are owner-occupiers with an average outstanding mortgage of almost $171,000. The self-reported home value is approximately $645,000 on average, somewhat higher than the average of the local area median house price of $435,000.

As Table 8 indicates, our estimation sample is a sub-sample of the available HILDA survey data. Columns 3 and 4 provide the summary statistics for the broader full sample available in the HILDA survey. We have selected our estimation sample to exclude observations for respondents in years in which there were fewer than 30 home sales in their postcode (per year) as recorded in the RP house price data. We do so to ensure that the median house prices recorded in the RP house price database are a reliable measure for each local area. The final column of the table provides the p-values for the t-test of differences in means between the estimation and full samples. None of the p-values are close to indicating a statistically significant difference in means between the complete sample and the sample used for the analysis. Therefore, the analysis sample is representative of the full HILDA survey.

Table 8: Sample summary statistics HILDA: 2001–12

	Estimation sample Waves 1–12		Full sample Waves 1–12		Test of differences in means
	Mean	**Std. dev.**	**Mean**	**Std. dev.**	**p-value**
Age (in years)	48.28	13.16	48.28	13.17	1.00
Gender (female=1)	0.53	0.50	0.53	0.50	0.91
Education, University	0.26	0.44	0.26	0.44	0.65
Education, Diploma	0.31	0.46	0.31	0.46	0.98
Education, Yr 12	0.12	0.32	0.11	0.32	0.96
Education, Less than Yr 12	0.32	0.46	0.32	0.47	0.62
Annual household income ($)	144,488	126,194	144,140	126,497	0.55
Partnered	0.76	0.43	0.76	0.43	0.64
Divorced	0.08	0.26	0.08	0.26	0.91
In the labour force	0.68	0.47	0.68	0.47	0.75
Weekly work hours	24.97	21.64	24.93	21.65	0.71
Spouse in the labour force	0.70	0.46	0.70	0.46	0.80
No. of children 0–4yrs of age	0.19	0.51	0.19	0.51	0.94
No. of children 5yrs and older	0.77	1.10	0.77	1.10	0.76
Home owners	0.75	0.43	0.75	0.43	0.45
Renters	0.25	0.43	0.25	0.43	0.45
Self-reported home value ($)	645,912	496,917	644,578	497,930	0.61
Local area median house price ($)	435,011	238,196	433,914	238,140	0.23
Outstanding mortgage ($)	170,452	267,495	169,898	267,252	0.70
Number of observations. (*i x T*)	138,500		139,638		
Number of individuals (*i*)	15,978		16,044		

Notes: The estimation sample comprises males and females from Waves 1–12 of HILDA between the ages of 20–75 years. The estimation sample is a subset of the full HILDA Survey sample in which we exclude observations for respondents in years in which there were fewer than 30 home sales in their postcode recorded in the RP House Price data.

Financial variables are reported in 2013 Australian dollars. Outstanding Mortgage ($) is the self-reported value of home loans with the exception of those reported in waves 2, 6, 10, where we use the Melbourne Institute's imputed home loan values.

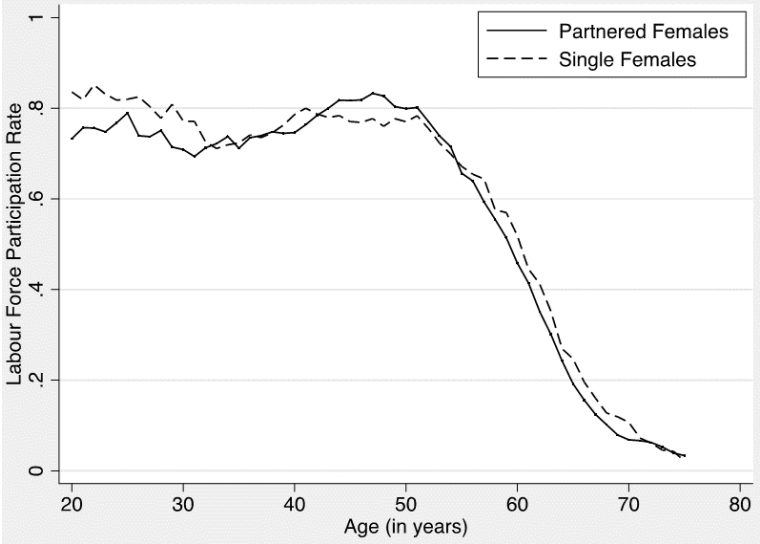
Source: Author calculations from HILDA panel data

Figure 9 explores the labour supply of men and women over the life-cycle by marital status. The figures in the left column show labour force participation rates for the analysis sample by age (in years), while those in the right-hand column show the average number of hours worked for those working positive hours.

For all women we observe the expected M-shaped variation in labour supply over the life-cycle, although this feature is stronger in hours worked than in participation, especially among partnered women. Partnered women tend to work approximately three to four fewer hours per week than single women during their prime childbearing years, while the gap in hours remains but narrows to approximately 1.5 hours later in the life-cycle. Turning to the labour supply of men, we observe that partnered men both participate in greater numbers and work longer hours, compared to single men. Male participation rates start to decline for partnered men when they are in their mid-50s and earlier still for single males. Average hours of work for those who do work are approximately 44 hours, until around 60 years of age when they progressively decline, reflecting the transition to retirement.

Figure 9: Labour supply (participation and weekly hours) over the life-cycle—women and men, partnered and single

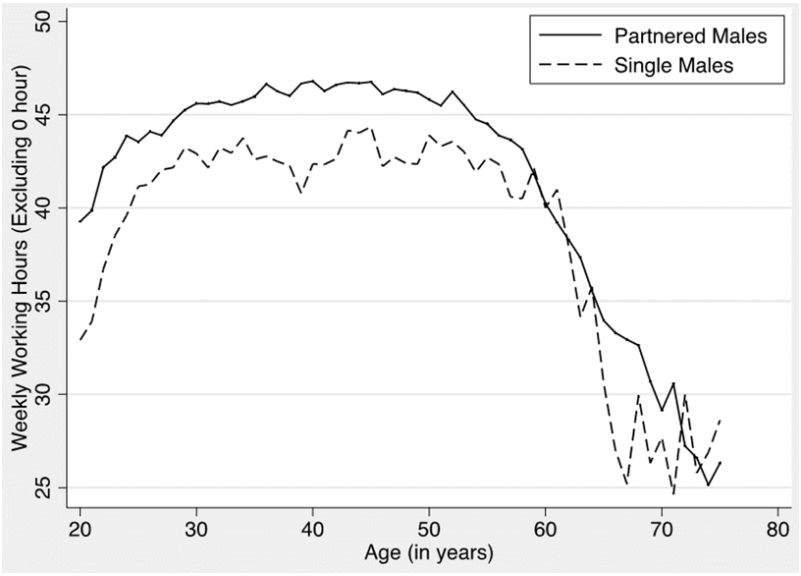
Female labour force participation rate



Female weekly working hours

Male labour force participation rate

Male weekly working hours



Source: Author calculations from HILDA panel data (2002, 2006 and 2010)

The sequence of Tables 9 to 11 present in more detail how housing wealth and debt vary by population groups defined by gender, partnership status and stage of the life-cycle. Table 9 presents summary statistics for the sample grouped by gender. It is apparent that the male subsample, on average, has higher levels of educational attainment and labour supply (in terms of both participation and weekly hours of work). The final column of Table 9 indicates that the differences in means across the male and female subsamples are generally highly statistically significant.

Table 9: Summary statistics by gender: 2001–12

	Males Waves 1–12		Females Waves 1–12		Test of differences in means
	Mean	**Std. dev.**	**Mean**	**Std. dev.**	**p-value**
Age (in years)	48.81	13.16	47.83	13.17	<0.00
Education, University	0.25	0.43	0.26	0.44	<0.00
Education, Diploma	0.40	0.49	0.23	0.42	<0.00
Education, Yr 12	0.10	0.30	0.13	0.34	<0.00
Education, Less than Yr 12	0.25	0.43	0.37	0.48	<0.00
Annual household income ($)	149,033	129,765	139,859	123,409	<0.00
Partnered	0.79	0.41	0.74	0.44	<0.00
Divorced	0.06	0.24	0.09	0.29	<0.00
In the labour force	0.75	0.43	0.61	0.49	<0.00
Weekly work hours	31.71	22.50	19.00	18.99	<0.00
Spouse in the labour force	0.63	0.48	0.77	0.42	<0.00
No. of children 0–4yrs of age	0.19	0.51	0.19	0.51	0.15
No. of children 5yrs and older	0.70	1.07	0.82	1.11	<0.00
Home owners	0.75	0.43	0.74	0.43	0.06
Renters	0.25	0.43	0.24	0.43	0.06
Self-reported home value ($)	646,430	513,560	642,945	483,747	0.35
LGA median house price ($)	432,218	246,173	437,580	231,882	<0.00
Outstanding mortgage ($)	170,451	267,495	169,898	267,253	<0.00
Number of individuals (*i*)	7,492		8,486		

Table 10 presents summary statistics for the sample by partnership status. Not surprisingly, there are substantial average differences among the subsamples of single and partnered adults in terms of annual income, tenure status, housing wealth and mortgage debt. The differences in means by partnership status are highly statistically significant.

Table 10: Summary statistics by partnership status: 2001–12

	Single Waves 1–12		Partnered Waves 1–12		Test of differences in means
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**	**p-value**
Age (in years)	49.40	14.11	47.93	12.84	<0.00
Gender (female=1)	0.58	0.49	0.52	0.50	<0.00
Education, University	0.22	0.41	0.27	0.44	<0.00
Education, Diploma	0.30	0.46	0.31	0.46	<0.00
Education, Yr 12	0.12	0.32	0.11	0.32	<0.00
Education, Less than Yr 12	0.37	0.48	0.30	0.46	<0.00
Annual household income ($)	80,033	74,557	164,468	132,922	<0.00
In the labour force	0.62	0.48	0.69	0.46	<0.00
Weekly work hours	22.32	21.64	25.75	21.63	<0.00
Spouse in the labour force			0.70	0.46	<0.00
No. of children 0–4yrs of age	0.04	0.23	0.24	0.56	<0.00
No. of children 5yrs and older	0.38	0.81	0.89	1.14	<0.00
Home owners	0.55	0.50	0.81	0.39	<0.00
Renters	0.45	0.50	0.19	0.39	<0.00
Self-reported home value ($)	509,819	376,828	674,906	516,701	<0.00
LGA median house price ($)	347,595	177,110	454,748	242,850	<0.00
Outstanding mortgage ($)	97,624	205,045	185,712	276,933	<0.00
Number of individuals (*i*)	2,794		13,184		

A final, and very illuminating, sample breakdown is by age, as presented in Table 11. Age is grouped into three segments corresponding to different stages of the life-cycle. The summary statistics are consistent with the 20–39-year group forming families, with the family growing and purchasing or upgrading their housing. In the 40–54-year group, the majority of households are more likely to be upgrading their housing and paying down mortgage debt, while for the age 55+ year group, decisions around retirement are likely to be a major influence on labour supply, tenure and mortgage debt. The average values by age segment in Table 11 confirm these life-cycle trajectories. For instance, the share of households that are owner-occupiers increases from 60 per cent to 84 per cent for the older group, and the corresponding average mortgage debt declines.

Table 11: Summary statistics by age group: 2001–12

	Age 20–39 Years Waves 1–12		Age 40–54 Years Waves 1–12		Age 55–75 Years Waves 1–12	
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Age (in years)	32.68	4.71	46.78	4.26	63.68	5.90
Gender (female=1)	0.56	0.50	0.53	0.50	0.52	0.50
Education, University	0.31	0.46	0.28	0.45	0.18	0.39
Education, Diploma	0.31	0.46	0.33	0.47	0.29	0.46
Education, Yr 12	0.17	0.37	0.11	0.31	0.08	0.27
Education, Less than Yr 12	0.22	0.41	0.29	0.45	0.44	0.50
Annual household income ($)	147,964	97,800	171,308	127,968	109,987	139,153
Partnered	0.78	0.41	0.78	0.42	0.73	0.45
Divorced	0.03	0.16	0.09	0.28	0.11	0.31
In the labour force	0.82	0.39	0.84	0.37	0.36	0.48
Weekly work hours	30.16	20.36	31.69	19.71	12.45	19.43
Spouse in the labour force	0.84	0.36	0.84	0.36	0.39	0.49
No. of children 0–4yrs of age	0.53	0.75	0.09	0.35	0.00	0.07
No. of children 5yrs and older	0.72	1.06	1.25	1.22	0.24	0.63
Home owners	0.60	0.49	0.79	0.41	0.84	0.37
Renters	0.40	0.49	0.21	0.41	0.16	0.37
Self-reported home value ($)	556,909	382,927	684,347	515,095	659,162	536,740
LGA median house price ($)	434,745	179,976	438,196	247,246	435,201	257,635
Outstanding mortgage ($)	292,384	274,980	207,256	288,982	54,690	180,209
Number of individuals (*i*)	3,873		6,496		5,609	

The above differences in labour supply, housing wealth and mortgage debt over the life-cycle, as well as by gender and marital status, prompted our decision to conduct our empirical analysis of labour supply responses to housing wealth and debt separately for these sub-groups.

3.4 Empirical methods

In line with the framework outlined in Section 3.1, we take two approaches to examining the relationship among house prices, housing debt and labour supply. First, we assess the impact of changes in housing wealth, measured by unexpected variation in local house prices, on labour supply. Second, we assess whether there is evidence some households' labour supply is constrained by their mortgage debt.

Given the descriptive statistics above, we consider the effect of house price shocks and mortgage debt separately for men and women, partnered and single and in three different stages of the life-cycle, namely, for those aged 20–39, 40–54, and 55–75 years.

The main focus is the impact of changes in housing wealth on labour supply. We follow Disney and Gathergood (2014) and Milosch (2014) by examining the impact of unexpected, and thus 'exogenous', changes in housing wealth on labour supply.

These unexpected changes in housing wealth are measured using variation in local area house prices. Below we briefly describe each of these approaches in more detail.

Next, we examine the relationship between labour supply and debt. We explore the conditional correlations between labour supply and debt for the main demographic groups; separately for men and women, by stage of the life-cycle and by marital status.

The final part of our analysis in this section refines the regression to assess the causal effect of housing debt on labour supply for these groups. These refinements address the concern for possible reverse causation. As for the previous section, this is based on using instrumental variable methods, where we use local area variation in house prices as an instrument for house price shocks.

3.4.1 Estimating the causal effect of changes in housing wealth on labour supply

Our empirical approach follows Disney and Gathergood (2014) and Milosch (2014). The empirical specification can be represented by:

$$ls_{ict} = \beta X_{ict} + \gamma HP_{ict} + \delta \widehat{W}_{ict} + ld_{ict} + a_i + \eta_c + \varphi_t + u_{ict}$$
$$\widehat{W}_{ict} = \theta Z_{ict} + e_{ict} \quad (5)$$

This approach uses a fixed effects panel regression to examine the effect of house prices on labour supply ls_{ict} for person *i* in year *t* residing in local area *c*. Labour supply is examined at both the extensive margin (labour force participation) and the intensive margin (hours of work). We control for individual characteristics which change over time (X_{ict}) such as number of children, health status, marital status, spousal employment status and non-labour income. The standard instrumental variable approach is used to control for the individual's wage ($\widehat{W}_{it}$) as self-reported hourly wages may be endogenous to labour supply. The instruments for the wage, Z_{it}, will include age, age squared and indicator variables for the highest level of education achieved. This approach and the choice of instrumental variables is standard in the literature, and is firmly based on a human capital model. We also control for local labour demand ((ld_{ict}) at the LGA level using the unemployment rate and average earnings. Time (φ_t), local area (η_c) and individual-specific (a_i) fixed effects are included to control for aggregate time trends and time-constant unobserved individual characteristics.

In this regression, house prices HP_{ict} are measured using the log of the local area median house price, MHP_{ict}, at an annual frequency. The key source of variation in house prices (which remains after controlling for the other factors in the regression) is the changes in local house prices over time *relative* to national trends. We control for (time constant) local area amenities with the LGA fixed effects. We examine how an individual's labour supply responds to a change in houses price (which is equivalent to a change in housing wealth) when the change differs from the national trend. For example, a 5 per cent increase in your house price is assumed to not affect your labour supply if the prices of all other houses in the nation on average also increase by 5 per cent.

With the regressions we also examine whether responses differ by housing tenure status, as detailed in Section 3.1, unexpected changes in house prices may lead to a range of reactions depending on whether a household owns, rents, is planning to purchase, or planning to move. For this analysis we expand the sample to include renters. This extension enables us to analyse the difference in the effect of housing price shocks on the labour supply of owner-occupiers and renters.

3.4.2 Housing debt and labour supply

The empirical analysis will then be extended by examining the correlations between housing debt and labour supply. The analysis is based on the following regression:

$$ls_{it} = \beta X_{it} + \gamma D_{it} + \delta \widehat{W}_{it} + a_i + \varphi_t + u_{it}$$
$$\widehat{W}_{it} = \theta Z_{it} + e_{it} \quad (6)$$

This regression is analogous to Equation (5), with the house price measure (our proxy for wealth shocks) replaced by housing debt. This regression provides an assessment of the link between changes in labour supply ls_{it} for person *i* in year *t* and housing debt D_{it}. Housing debt is measured using the natural log of the outstanding loan value. Controls (X_{it}) will include time-varying individual-level demographic and socio-economic characteristics, as used in the analysis of housing wealth and labour supply.

3.5 Empirical findings

3.5.1 Labour supply and housing wealth

Labour force participation

The panel regressions are used to first examine the effect of house prices on labour force participation. The regressions are estimated separately for men and women by age group. Each regression includes controls for the socio-economic characteristics, weekly wage, tenure status, local area unemployment rate, number of dependent children who are infants (aged zero to four years) or older (aged five years and over), health status, spousal labour force status, and log of household non-labour income, as well as year and location (state and capital city) fixed effects. As the observed weekly wage is potentially endogenous, a quadratic in age and indicator variables for educational attainment are used as instrumental variables for the wage.

Table 12 presents the results for partnered men and women. Column (1) presents the estimates for key variables for the subsample of married men aged 20–39 years. The coefficient on the log-house price interacted with the home owner indicator variable is -0.0415, indicating that within this group, higher prices are associated with a lower probability of labour force participation, other things equal, among home owners. The direction of this effect is consistent with the wealth effect of higher house prices as predicted by a simple life-cycle model. The magnitude implies that 10 per cent higher house prices, other things equal, reduces LFP by approximately 0.42 percentage points. At the mean level of LFP for this age group (0.50), this implies an elasticity of labour force participation with respect to house prices of almost 0.1. While statistically significant, this elasticity is a practically small response, which is unsurprising given that the wealth effect is not expected to have a large impact on labour force withdrawal at this stage of the life-cycle.

The estimates presented in column (1) of Table 12 show that changes in house prices have no effect on the labour force participation of partnered young men who are renters. This is in line with the basic economic framework, as there is no direct impact on household wealth from housing price changes for renters. The small magnitude and insignificance of the coefficient on the house price–renter interaction term provides support for the house price variable measure as a component of household wealth and not something reflecting general local area or labour market demand factors.

Looking across the regressions presented in Table 12 suggests that there is no response at the extensive margin of labour supply for middle-aged and old age (age 55 or older) male home owners to changes in house prices. However, for female

home owners, there is a significant decline in labour force participation due to house price growth among the old age group. This response is consistent with earlier retirement among home owners following strong increases in local house prices. The implied elasticity is -0.81 (=-0.029/0.36), which is economically significant.

Interestingly, the results in column (5), for partnered women aged 40–54 years, indicate a significant increase in participation among renters in response to house price growth. As explained above, this positive response in participation is not a pure wealth effect by virtue of being renters. However, it may reflect a response of renters seeking to move into the local housing market as owners, and hence, it may reflect a response by families to accumulate savings in order to satisfy deposit and servicing requirements by mortgage institutions. This is consistent with the findings of Fortin's (1995) study in Canada, where partnered women in this age segment increased their labour force participation in order to meet lending requirements and to 'help pay-off the mortgage' in strong housing markets.

Table 12: Panel regression results for labour force participation, partnered men and women

	Males			**Females**		
	Age 20–39	**Age 40–54**	**Age 55+**	**Age 20–39**	**Age 40–54**	**Age 55+**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Ln(house price) for Owner	-0.0415*	0.003	-0.0123	-0.003	-0.014	-0.029*
	(0.022)	(0.012)	(0.018)	(0.020)	(0.019)	(0.016)
Ln(house price) for Renter	-0.005	-0.008	-0.001	0.018	0.058**	0.001
	(0.017)	(0.016)	(0.103)	(0.019)	(0.023)	(0.033)
Unemployment rate	0.001	0.005*	0.008*	0.001	0.003	-0.003
	(0.098)	(0.003)	(0.004)	(0.021)	(0.004)	(0.005)
Socio-economic controls	Y	Y	Y	Y	Y	Y
Year controls	Y	Y	Y	Y	Y	Y
State controls	Y	Y	Y	Y	Y	Y
Observations	9,159	13,862	12,119	12,232	14,856	10,813
Individuals	2,116	2,816	2,254	2,777	3,034	2,060

Notes: 1. Robust standard errors are in parantheses. 2. *** p<0.01, ** p<0.5, * p<0.10.

Source: Author calculations from HILDA panel data

The responses in labour force participation to house price variation were then considered for the sample of single men and women. The panel regression results for the key variables of interest are presented in Table 13. Reading across the columns, there is no change in labour force participation by home owners (nor renters) in response to the above trend in house price growth among most groups. The important exception is the group of single women aged 55–75, for whom a 10 per cent increase in house prices is associated with a 0.54 percentage point decline in labour force participation, other things equal. The implied elasticity of participation with respect to house prices is -1.6, double the magnitude of that found for partnered women in the same age cohort. This response is consistent with housing forming a larger share of

the assets of single female home owners compared to partnered female home owners. Thus, the wealth effect of the house price growth is stronger, and the resulting labour supply response is consequently greater. Overall, the panel regression estimates indicate that there is an economically important response in labour force participation among female home owners in the older age cohort due to the wealth effect precipitating early retirement.

Table 13: Panel regression results for labour force participation, single men and women

	Males			Females		
	Age 20–39	Age 40–54	Age 55+	Age 20–39	Age 40–54	Age 55+
	(1)	(2)	(3)	(4)	(5)	(6)
Ln(house price)*Owner	0.029	0.015	-0.011	-0.019	-0.017	-0.054**
	(0.030)	(0.033)	(0.043)	(0.040)	(0.040)	(0.021)
Ln(house price)* Renter	-0.008	0.030	-0.032	0.022	-0.009	0.028
	(0.027)	(0.029)	(0.031)	(0.031)	(0.038)	(0.024)
Unemployment rate	-0.003	-0.001	0.014*	0.001	-0.013	0.022***
	(0.008)	(0.008)	(0.008)	(0.011)	(0.009)	(0.005)
Socio-economic controls	Y	Y	Y	Y	Y	Y
Year controls	Y	Y	Y	Y	Y	Y
State controls	Y	Y	Y	Y	Y	Y
Observations	2,985	3,545	3,067	3,099	4,670	5,501
Individuals	830	800	582	832	915	982

Notes: 1. Robust standard errors are in parantheses. 2. *** p<0.01, ** p<0.5, * p<0.10.

Source: Author calculations from HILDA panel data

Hours of work

The panel regressions were then estimated with hours of work, conditional on participating in the labour force, as the dependent variable. This part of the empirical analysis focuses on the intensive margin of labour supply. Table 14 presents the model estimates for partnered males and females by age group.

The estimates show a significant reduction in hours of work by home owners in response to house price growth among the younger cohort, aged 20–39. In this age group, partnered men (on average) reduce their hours of work by 0.39 per cent, and partnered women by 0.26 per cent, due to a 1 per cent increase in house prices. These are practically significant responses and are consistent with either partner in the family devoting additional time to non-market activities (e.g. in caring roles). This age cohort has the highest incidence of dependent children and infants present in the household, and this represents a formative stage of the life-cycle for these families. Among partnered home owners in this age group, unexpectedly high house price growth and the resulting gain in household wealth effectively funds time away from work to undertake non-market activities.

Table 14: Panel regression results for hours of work, partnered men and women

	Males			Females		
	Age 20–39	**Age 40–54**	**Age 55+**	**Age 20–39**	**Age 40–54**	**Age 55+**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Ln(house price)*Owner	-0.118**	0.017	0.038	-0.055*	-0.012	0.085
	(0.046)	(0.015)	(0.044)	(0.031)	(0.032)	(0.063)
Ln(house price)* Renter	0.003	0.001	0.030	0.031	0.020	0.073
	(0.033)	(0.025)	(0.068)	(0.030)	(0.041)	(0.090)
Unemployment rate	0.003	0.001	-0.009	0.008	-0.012*	0.001
	(0.010)	(0.005)	(0.011)	(0.009)	(0.007)	(0.099)
Socio-economic controls	Y	Y	Y	Y	Y	Y
Year controls	Y	Y	Y	Y	Y	Y
State controls	Y	Y	Y	Y	Y	Y
Observations	8,482	12,559	5,124	8,251	11,307	3,280
Individuals	1,998	2,606	1,300	2,171	2,484	885

Notes: 1. Robust standard errors are in parantheses. 2. *** p<0.01, ** p<0.5, * p<0.10.

Source: Author calculations from HILDA panel data

This pattern of reduced hours of work in following house price growth is not observed at later stages of the life-cycle. The prima-facie evidence is that the unexpected wealth gains provide a form of finance for further home caring activities.

The regressions were also estimated for the sample of single men and women, with the estimates presented in Table 15. As is clear from the table, the only statistically and economically significant responses are among single female home owners in the 40–54 and 55–75 age cohorts. Both groups exhibit large responses, with implied work hours elasticities of 0.42 and 1.1, respectively. The comparatively large response among the older group of female home owners is consistent with a large, positive wealth shock used to fund earlier transitions from the labour market into retirement. Interestingly, since this is for the sample of single adults, these labour supply responses are not attributable to a 'secondary earner' role within the family as studied by Fortin (1995). Rather, these responses are for sole and, hence, primary earners. Housing represents a key part of the wealth portfolio held by many Australian families, more so for single female home owners. Consequently, an unexpected increase in house prices for this group represents a major wealth gain that is found to have an important impact on both their labour market participation and hours of work.

Importantly, from a more methodological perspective, the estimates for the hours of work regressions indicate no systematic response among renters to house price gains. This provides evidence that the house price variable does not reflect potentially cofounding influences in the local labour market or the regional economic environment. The results for renters provide corroborating evidence that the estimated effects among home owners is reflective of pure wealth effects transmitted from the housing market.

Table 15: Panel regression results for hours of work, single men and women

	Males			Females		
	Age 20–39	**Age 40–54**	**Age 55+**	**Age 20–39**	**Age 40–54**	**Age 55+**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Ln(house price)*Owner	-0.059	0.053	-0.092	-0.0455	-0.134**	-0.142**
	(0.074)	(0.066)	(0.157)	(0.071)	(0.059)	(0.068)
Ln(house price)* Renter	-0.090	0.011	-0.042	0.067	-0.0457	0.003
	(0.063)	(0.051)	(0.108)	(0.055)	(0.089)	(0.089)
Unemployment rate	0.004	0.002	0.0220	0.013	-0.009	0.017
	(0.021)	(0.014)	(0.029)	(0.019)	(0.015)	(0.016)
Socio-economic Controls	Y	Y	Y	Y	Y	Y
Year Controls	Y	Y	Y	Y	Y	Y
State Controls	Y	Y	Y	Y	Y	Y
Observations	2,557	2,646	855	2,129	3,418	1,778
Individuals	755	658	237	674	743	404

Notes: 1. Robust standard errors are in parantheses. 2. *** p<0.01, ** p<0.5, * p<0.10.

Source: Author calculations from HILDA panel data

3.5.2 Labour supply and mortgage debt

The empirical analysis of labour supply effects was extended to consider alternative measures of housing wealth and debt obligations. The panel regression models were re-estimated with local house price variable replaced with alternative measure of debt obligations.

Table 16 presents the estimates for model specification (6). For this subsection, the panel regression models are estimated using the sample of home owners only (renters are excluded from the sample). The first row presents the results using the log of outstanding mortgage debt as an independent variable in place of house prices. The second row of estimates uses the debt servicing ratio, defined as yearly repayments on mortgages as a fraction of household income, as the key explanatory variable. For brevity, only the coefficient on the explanatory variable of interest is reported (each coefficient estimate is from a separate panel regression). The full set of results is available from the authors upon request.

The estimates presented in Table 16 reveal a further dimension of how housing market developments impact labour market activity. The estimated coefficients for the mortgage debt variable show that middle-aged and older men, and younger and older women, work more intensively the greater their outstanding debt. Likewise, older women home owners who have a greater part of their unearned income devoted to mortgage debt servicing also work more hours on average (as well as having higher participation). This interaction between mortgage debt and labour market activity may reflect a causal response to these housing finance factors. Alternatively, this pattern may partly reflect ‘preference differences’, whereby men and women with a stronger commitment to the labour market plan for longer work careers and, hence, take on greater mortgage obligations. We do not have a credible instrument variable to capture independent variation in mortgage obligations. Our analysis of house price effects on labour supply used local area house price changes relative to national

trends to capture independent variation in housing wealth. There is no comparable measure for mortgage debt. Although interest rates are one possible source, these have been shown to be weak instruments, lacking the statistical power to reliably capture significant responses. An important area for future research is to separate the competing explanations for this pattern of economic behaviour.

Table 16: Panel regression results for hours of work with debt measures—only home owners

	Males			Females		
Model with independent variable	**Age 20–39 (1)**	**Age 40–54 (2)**	**Age 55+ (3)**	**Age 20–39 (4)**	**Age 40–54 (5)**	**Age 55+ (6)**
Mortgage debt	0.002	0.001*	0.004**	0.004*	0.0004	0.006***
	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)
Debt servicing ratio	0.062	0.001	0.002	0.019	-0.002	0.104**
	(0.039)	(0.002)	(0.009)	(0.038)	(0.005)	(0.049)
Socio-economic controls	Y	Y	Y	Y	Y	Y
Year controls	Y	Y	Y	Y	Y	Y
State controls	Y	Y	Y	Y	Y	Y

Notes: 1. Robust standard errors are in parantheses. 2. *** p<0.01, ** p<0.5, * p<0.10.

Source: Author calculations from HILDA panel data

3.6 Summary

The analysis of the impact of house price movements on labour market activities found important differences according to partnership status, gender and stage of the life-cycle. In light of this, panel regressions for labour force participation and hours of work were estimated separately for each of these demographic groups. Careful attention was devoted to using appropriate measures of house prices, relying on RP House Price sales data by LGA. The regressions revealed economically significant responses to above-average changes in house prices among home owners. The most important responses were in labour participation and hours of work by women (both partnered and single). The effect was strongest among the older cohort of women and is associated with early retirement for those experiencing above-average housing wealth gains. Another important response was observed among younger partnered men and women who exhibited a reduction in hours of work in response to the gain in housing wealth. The evidence suggests that, at a formative stage of the family life-cycle, the housing wealth gains effectively subsidized non-market caring activities for this group. The analysis also considered the role of mortgage debt obligations, and there is consistent evidence that greater mortgage debt obligations are associated with higher hours of market work. Overall, the analysis provided robust evidence that house price movements have clear and consistent impacts on individual and family wealth and on their labour market activities. The magnitude of that effect clearly varies by gender and life-cycle stage.

4 CONCLUSION AND POLICY CONTEXT

This Final Report presents evidence on the relationship among house prices, household debt and employment decisions for Australian households by using micro-level data from the HILDA survey for the period 2001 to 2012 (waves 1–12).

While many commentators recognise the role that the housing market had in fuelling consumption and economic growth over the previous decade (Case, Quigley et al. 2006), the GFC exposed the potential for significant negative spill overs between the housing market and the broader economy. Although Australia was not hit particularly hard by the GFC in comparison to the US and the UK, 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 about future economic and financial instability (OECD 2012).

The goal of this project is to examine the contemporary effects of house prices on household debt and employment decisions in Australia. In particular, the project addresses three distinct, though interrelated, questions:

- *(RQ-1)*: What is the nature and magnitude of the relationship between house prices and household debt, and between house prices and the mortgage and non-mortgage components of household debt?
- *(RQ-2)*: Does labour supply respond to changes in house prices and mortgage debt? If so, is there a causal link?
- *(RQ-3)*: How large are these effects? Are some types of households more responsive to house price changes than others?

4.1 Main conclusions

In Chapter 2, we addressed the first and third research questions by examining the effect of house price movements on household indebtedness using regression methods with the HILDA survey data. Our cross-sectional analyses show a strong relationship between house prices and household debt and its mortgage and non-mortgage components. Our panel regressions focus on the effect of house price changes on home owners while controlling for permanent unobserved and time-varying observed individual characteristics. The results from the panel regression models confirm the cross-sectional findings.

Our cross-sectional results also indicate clear differences in the relationship between house price and total household debt across high- and low-debt households. Further analysis using panel methods confirms this finding. Specifically, we find that house price changes have larger effects on total indebtedness for home owners with higher initial LTV ratios and with greater values of non-mortgage debt. As discussed in Chapter 2 and in the Positioning Paper (Atalay, Barrett et al. 2015), the 'collateral mechanism' implies differential responses to house price changes depending on whether the home owner is constrained in the previous period or not. The results from the panel regressions reinforce the importance of the collateral channel linking house prices to household indebtedness. Our panel regressions also identify an effect of house prices on outright home owners' borrowing choices and we find an impact on households located further down the debt distribution. This indicates a wealth effect flowing from house price increases.

The GFC exposed important links between housing markets and the broader economy that in part reflected house price-related wealth effects. Our results underline the importance of house prices for monetary policy in Australia. In addition, a role for housing as a providing a form of insurance for older outright home owners is highlighted by the finding that debt held by this demographic responds to increases in house prices. This, in turn, underscores the role of housing in supporting the consumption and wellbeing of the elderly.

Our results also indicate that households' responses to house prices vary by tenure status and debt positions. Our results indicate that some home owners engage in debt financing of consumption in response to increasing house prices (i.e., by withdrawing some of the gain in their housing equity). These home owners tend to have lower levels of mortgage debt. Other more highly indebted households refinance their existing mortgages, or adjust the composition of their debt, in response to the gains in housing wealth. These findings complement the existing research in related areas, specifically: *Housing wealth and consumer spending* (Yates and Whelan 2009); *Downsizing amongst older Australians* (Judd, Liu et al. 2014); and *Housing equity withdrawal* (Ong, Jefferson et al. 2013).

These findings also complement recent research undertaken by the Federal Reserve Boards in the US that has shown a strong connection between household indebtedness and house prices (Mian and Sufi 2014; Glick and Lansing 2010; Jordà, Schularick et al. 2014). An analysis of housing markets and debt in the US from a boom period to 2007 and the downturn from 2007 to 2012 suggest that meaningful wealth effects of the housing market on consumption are only evident during the boom period, but that collateral effects apply throughout (Brown, Stein et al. 2013). The impact of falling income, consumption and house prices on aggregate demand, combined with a high proportion of distressed mortgages, has led to policy discussions on modifying mortgages in an effort to limit the negative influences (e.g., Eberly and Krishnamurthy 2014).

Our results show that the house price effect is larger at the upper part of the debt distribution (households with higher debt levels) and for middle-aged households with high LTV ratios. These households are the most vulnerable to income shocks, such as unemployment. The results are in contrast to the general belief in Australia that debt is held by those most able to service it—higher-income and high-wealth households. Macroeconomic policy-makers should interpret high levels of debt and rising household income-to-debt ratios in Australia carefully. In a number of countries with similar situations, macro-prudential regulations have been implemented to limit the growth of household indebtedness.

Chapter 3 addresses the second and third research questions concerning the link between labour supply, house prices and mortgage debt. Consistent with international findings, our analysis of the Australian micro data reveals important differences in the patterns of labour supply and housing wealth and debt over the life-course and between partnered and single Australians. Our panel regressions for labour supply reveal economically significant responses to changes in house prices by home owners. The most quantitatively important responses are in labour participation and hours of work by women (both partnered and single). The effect is the strongest for the older cohort of women and is associated with early retirement among those experiencing above-average housing wealth gains. Another important response is observed among younger partnered men and women who both exhibit a reduction in hours of work following strong gains in housing wealth.

4.2 Policy implications

Our empirical analysis of the relationship between house prices, household debt and labour supply informs policy-making along a number of dimensions. The broader policy implications of the economic relationships examined relate to labour force productivity growth, the performance of the retirement incomes system and the stability of the macroeconomy. In this section, we discuss each of these policy areas in turn.

4.2.1 Implications for labour force productivity

Productivity growth is the foundation of sustained improvements in the standard of living and hence represents a prime concern of policy-makers. The results of the research presented in this report highlight two avenues through which housing and housing finance related policies may influence productivity growth. First, we find higher debt to income levels are associated with longer working hours for middle aged and older men, and for younger and older women (see Section 3.5.1: 49. Second, we find that higher house price growth leads to a reduction in labour market participation and hours of work for older women (precipitating early retirement) and younger partnered couples (substituting from market work to non-market carer activities) through a positive wealth effect (see Section 3.5.1: 50. Both of these responses have implications for labour force productivity and provide potential levers for government policy. For example, housing and tax policies that support debt financing of home ownership will tend to encourage greater work effort and hence higher labour productivity. Similarly, as house price growth tends to reduce labour supply, while simultaneously making it more difficult for renters to become home owners, policies that dampen house price inflation (e.g. new housing supply) may also contribute to labour force productivity growth.

4.2.2 Implications for Retirement Incomes

Our empirical findings on the relationship between house prices, household debt and labour supply also have direct implications for the Australian retirement income system. Housing represents an important component of household wealth and is a key form of retirement saving for many Australian families. Our analysis reveals that higher house price growth is associated with early retirement for women (though not for men). Consequently, public policies that contribute to house price growth can induce earlier retirement among home owners, particularly if equity withdrawal to fund consumption is facilitated.

Importantly, our detailed analysis by housing tenure status and debt position reveals a more complex and nuanced pattern of responses to house price growth (see Section 2.3: 22. Households with lower levels of debt are more likely to finance consumption through equity withdrawals while other, more highly geared, households are more likely to refinance their mortgage (and replace more expensive, unsecured forms of debt with mortgage debt). The evidence shows that drawing down on housing wealth to fund consumption is more commonly used by wealthier households (home owning partnered women who experienced unexpected high house price growth). At the same time, those with higher debt, who reconfigure their debt portfolio more heavily toward mortgages, continue to face important risks related to future house prices and employment security. These issues are relevant for policy-makers in considering the adequacy of the current retirement income system.

4.2.3 Implications for macroeconomic stability

The findings presented in this report are also relevant for policy-makers considering macroeconomic stability in Australia. The take-up of further mortgage debt among

highly leveraged households (through the ‘collateralisation effect’) exposes those households to the risk of significant loss if house prices fall or if interest rates rise. This, in turn, may pose a systemic risk for the macroeconomy. An economic shock, emanating in either financial, labour or housing markets, may lead to widespread defaults that would cause the shock to spread across markets and threaten the performance of the aggregate economy. This risk is all the more important as households cannot hedge, or fully insure themselves, against house price volatility as considered in the report by Wood, Smith et al. (2013). Therefore, policy-makers may need to consider limits on, or regulate the risks associated with, the continued collateralisation of debt in a potential deflationary environment.

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APPENDIX

Figure A1: Life-cycle profile of total debt for home owners

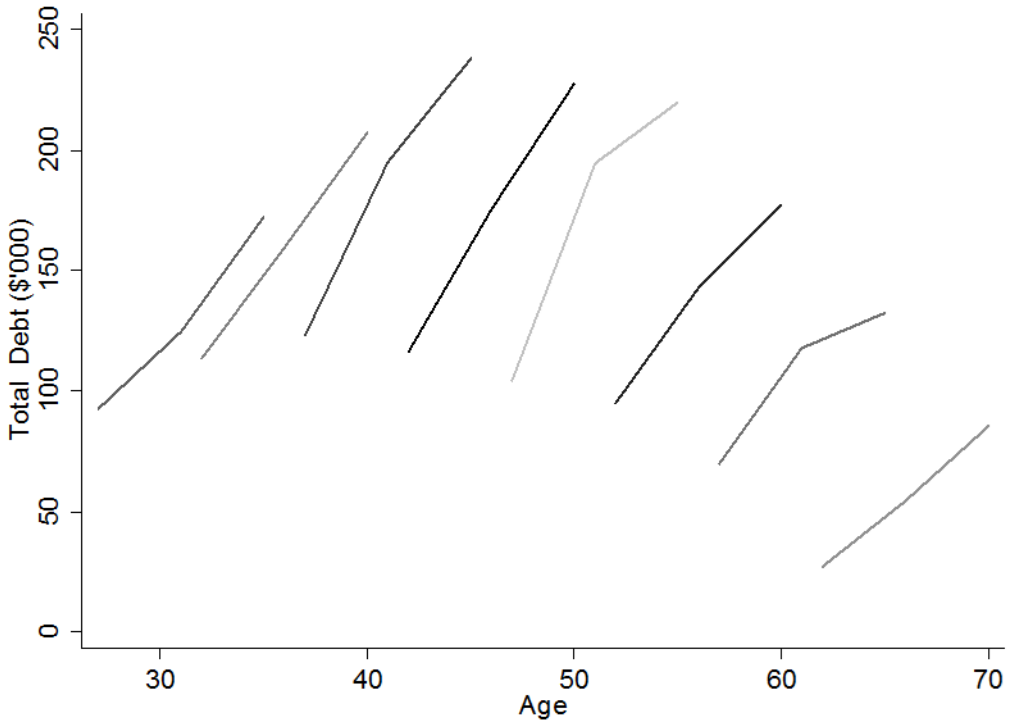


Figure A2: Life-cycle profile of mortgage debt

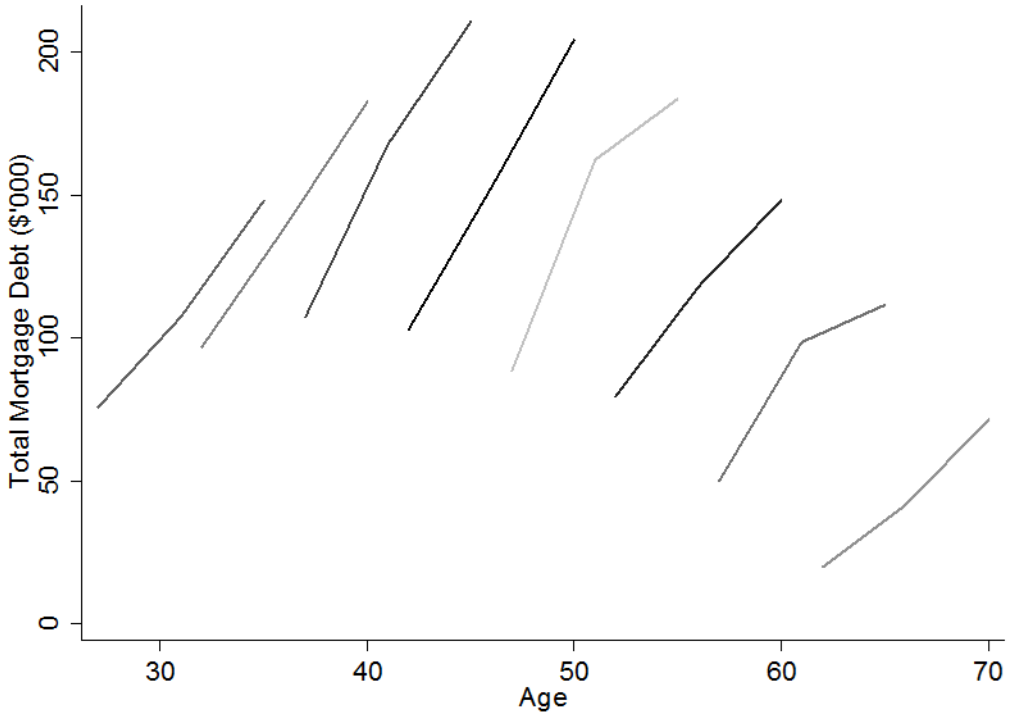
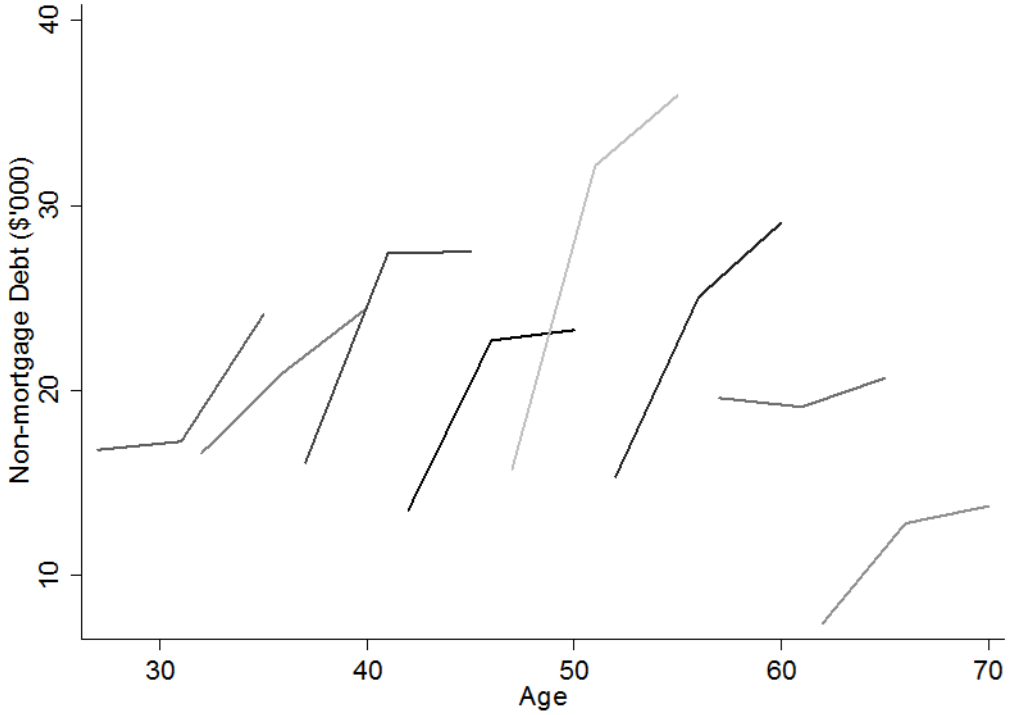


Figure A3: Life-cycle profile of non-mortgage debt for home owners



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