House price and household consumption
micro-data approach

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I would like to dedicate this thesis to my parents.

Declaration

I hereby declare that except where specific reference is made to the work of others, the contents of this dissertation are original and have not been submitted in whole or in part for consideration for any other degree or qualification in this, or any other University. This dissertation is the result of my own work and includes nothing which is the outcome of work done in collaboration, except where specifically indicated in the text.

Bowen Fu

January 2015

Acknowledgements

And I would like to acknowledge ...

Abstract

This paper investigates the relationship between house prices and consumption by using data from the HILDA (Household, Income and Labour Dynamics in Australia) survey over the period of 2003 to 2012. We find young households have the largest changes in consumption in response to changes in house prices. We also find renters (homeowners) have negative (positive) changes in consumption in response to changes in house prices. Under the permanent income hypothesis and the life-cycle model frameworks, these two main findings suggest that the co-movement between house prices and household consumption in Australia may be mainly explained by the credit constraint channel.

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Chapter 1

Introduction

Australia has experienced one of the most rapid increases in house prices. Atalay, Whelan and Yates (2013) report that house prices grew modestly until 1990, and then stagnated in 1990s, house prices grew fast in the 2000s even after 2008.

With the rapid increases in house prices, housing also became a dominant part of wealth for a typical Australian household. Finlay (2012) reports that, in 2010, real estate's share of household assets already reached 60%; however in 2002, real estate accounted for 40% of household assets.

In Australia, house prices and consumption tend to move together. Atalay, Whelan and Yates (2013) suggest that a strong consumption growth is observed over the late 1990s and 2000s. In the same period they also observe strong increases in house prices.

At an aggregate level, many economists have estimated the relationship between house prices and consumption. Most suggest that surging house prices have had a significantly positive effect on consumption (see, for example, Case, Quiley, and Shiller (2005); Calomiris, Longhofer, and Miles (2012); Dovrnak and Kohler (2007)). However, due to the limitations

of macroeconomic data, these studies have difficulty in explaining the reasons behind this co-movement.

There are four main channels for the synchronized movement between house prices and consumption in the literature: the direct wealth effect channel; the credit constraint channel; the common factor channel; and the precautionary saving channel. Many economists use microeconomic data to distinguish these four channels. However, due to the divergence in data qualities for different countries and methodologies, economists have still not reached a consensus on which channel mainly explains the close co-movement between house prices and consumption.

Given the important role of housing (the largest proportion of Australian households' wealth) and the close co-movement between house prices and consumption, the aim of this study is to examine households' consumption behaviours when facing fluctuations in house prices and to distinguish the channels for this co-movement.

This study adds to this debate by using the latest HILDA survey over period of 2003 to 2012 and a life-cycle model . We confirm the finding that house prices have important impact on consumption. In particular, (1) the consumption responses of old homeowners are negative when house prices increase; (2) the positive consumption responses of young households are highest when house prices increase; (3) renters have significantly negative consumption responses to increases in house prices, on the other hand, homeowners have significantly positive consumption responses when house prices increase.

Therefore, we conclude that the credit constraint channel is the main explanation for the co-movement between house prices and household consumption in the case of Australia for recent 10 years. This result holds even after we explicitly consider precautionary effects.

The remainder of this thesis is structured as follows. Chapter 2 provides a comprehensive theoretical background for analysing the relationship between house prices and consumption. Chapter 3 discusses the main empirical studies in the literature. Chapter 4 introduces the methodology and describes the data we used in this thesis. Chapter 5 presents the main results and Chapter 6 concludes.

Chapter 2

Theoretical background

In this chapter, we provide a comprehensive theoretical background for investigating the relationship between house prices and consumption. We first discuss why households' wealth (such as housing wealth) affects consumption in general; and then investigate why the effect of housing wealth on consumption is important by comparing it with the effect of financial wealth. Specifically, we discuss the theoretical competing channels on how housing prices are correlated with consumption, and we propose hypotheses for testing these alternative channels.

2.1 Does wealth affect consumption?

The effect of wealth on household consumption has been traditionally analysed under the permanent income hypothesis (PIH) and the life cycle hypothesis framework (Friedman, 1957, and Ando and Modigliani, 1963). In this framework, the level of consumption depends on the level of current income, the flow of future expected income, and the stock

of wealth. The stock of wealth is usually divided into two categories for a typical household, with non-financial wealth such as housing wealth and financial wealth such as stock wealth. Wealth affects consumption usually through two main channels. First, households can finance their consumption through directly selling their assets. Second, to raise their consumption, households may be able to borrow against their wealth, and their ability to borrow not only depends on their financial situation but also on the state of financial markets' development and the financial system.

2.2 Housing wealth v.s. financial wealth

The effects of housing wealth on consumption and the effects of financial wealth on consumption are different due to the different characteristics of housing wealth and financial wealth and the different types of financial system. The characteristics of housing wealth suggest the effects of housing wealth on consumption may dominate financial wealth.

- Firstly, equity prices are more volatile than house prices. Thus, banks have more difficulties in distinguishing whether a change in equity prices is permanent or temporary and assessing the risk of taking equity as collateral. Therefore, households are likely easier to find it easier borrow against increases in housing wealth than to borrow against increases in financial wealth. This suggests a higher effect of increases in housing wealth on consumption.

- Secondly, the liquidity of housing wealth is improving. Usually equity gains are easier to realize than house price gains, since equities are divisible and traded in very liquid markets. However, it is increasingly easier to borrow against housing wealth through home equity loans. Increasing housing prices may affect consumption not only through higher realized home values, but also by the household's higher ability

to refinance a mortgage or expand home equity loans due to higher property values. The increasing liquidity of housing wealth suggests that the sensitivity of consumption to housing price movements is increasing.

2.2.1 Bank-based and market-based financial system

Although, the effect of housing wealth on consumption may dominate the effect of financial wealth on consumption, the difference in the effect of housing wealth on consumption and the effect of stock wealth on consumption may vary according to the differences in the nature of financial systems. Depending on the different level of importance of bank loans and financial markets in a financial system, a financial system can be divided into two categories: a bank-based financial system and a market-based financial system. A bank-based financial system is a financial system where financial intermediaries such as banks play a crucial role in the allocation of loanable funds from lenders to borrowers. A market-based financial system on the other hand is a financial system that has a greater reliance on financial markets for the allocation of loanable funds. The US, UK and Australia are often referred to as market-based system while Germany, Japan and France are often referred to as bank-based system. There are two main differences between these two systems:

- Firstly, households in the market-based system tend to hold a larger share of their wealth in financial assets, especially equities, compared with those households in the bank-based system.

- Secondly, it is generally easier for households to get access to financial market to borrow against their assets in market-based systems, because in market-based systems financial markets for mortgage-backed securities are more available, due to earlier and more widespread financial deregulation.

Compared with countries having a bank-based financial system, for countries having a market-based financial system, financial wealth effects and housing wealth effects will both be stronger, because of more convenience of getting access to financial markets. In countries having a market-based financial system, financial wealth may have stronger wealth effects than housing wealth due to larger shares of equities wealth relative to those of housing wealth.

2.3 Why are house prices and consumption synchronized

Given the increasingly stronger effects of housing wealth on consumption, we discuss the possible four channels for the co-movement between house prices and consumption.

2.3.1 Direct wealth effect channel

The direct wealth effect channel says that increasing house prices raise housing wealth, which in turn, increase consumption. It is tempting to attribute the co-movement between house prices and consumption to this direct wealth channel. However, this channel should be examined further for the following reasons.

Firstly, the aggregate effects of house prices on consumption may be ambiguous since changes in house prices have different wealth effect on households with different housing needs. For households who plan to trade down, they may increase their consumption when house prices increase, since they can earn the gains resulting from increase in house prices. The wealth effect for households who are willing to trade up their house may be ambiguous, since the increases in the house price they plan to purchase can offset the gains resulted from selling their current house. Long-term renters will decrease their consumption, if rents are

in line with increasing house prices.

Secondly, there may not be direct wealth effects for some households. Housing, for households who plan to live in their current dwellings, is only a hedge against fluctuations in house prices and rents, with no substitute effects, thus house price changes may not affect those households' consumption (Sinai and Soules, 2003). As Mishkin (2007) suggests, if older people bequeath their wealth including their home to their offspring and/or if younger people anticipate these bequests, then the young and old people together may not perceive the changes in value of the house to be available for spending, and the real effect of changes in house prices may not affect those households' consumption. Given these limitations of the direct wealth effect channel, economists have proposed alternative channels.

2.3.2 Credit constraint channel

Changes in house prices also influence households' consumption by altering the degree of their credit constraint. Aoki, Proundman and Vlieghe (2004) propose that an increase in house prices and hence net housing wealth may relax the credit constraint that households face, allowing access to cheaper credit and therefore lead to higher household consumption. Buiter (2008) expresses a similar opinion as Aoki, Proundman and Vlieghe (2004), and further, suggests that the current spending of credit-constrained homeowners has quite large increases when house prices increase.

2.3.3 Common factor channel

No matter whether house prices directly or indirectly affect households' consumption, the above two channels imply there is a causal relationship between house prices and consump-

tion. However, there may not be a casual relationship between house prices and consumption if they are stimulated by common factors.

One common factor is increasing expected future income. King and Pagano (1990) propose a competing channel that higher expected future incomes resulting from either current or expected productivity gains increase house prices by increasing the demand for housing services and consumption simultaneously.

The other common factor is financial liberalization. Muellbauer and Williams (2011) show that financial liberalization affects consumption and the housing market through the following channels. First, financial liberalisation strengthens the ability of all households to smooth housing and non-housing consumption across periods. Second, financial liberalization reduces the mortgage down-payment constraint on the young who are usually first-time home-buying households, which in turn increases demand of housing. Third, financial liberalization provides a collateral channel from housing capital gains to economic activity. House-holds with existing housing wealth can extract capital gains through mortgage refinancing or home equity withdrawal products. These three channels show that financial liberalization can drive up house prices by increasing the demand for housing, and consumption.

2.3.4 Precautionary saving channel

The precautionary saving channel says increasing house prices also affect consumption by reducing the precautionary saving motive. Carroll and Kimball (2001) point out that liquidity constraints increase the precautionary saving motive around levels of wealth where the constraint becomes binding. Their findings indicate that reductions in the credit constraint may accompany reductions in precautionary saving, thus increase consumption. However,

Gan (2010) argues the implications of precautionary saving channel and credit constraint channel are very different. The credit constraint channel is limited to credit constrained households such as these who refinance their housing, while the precautionary channel can potentially affect all households. Gan (2010) discusses four implications of precautionary saving channel. First, precautionary saving channel implies that without refinancing household's consumption will still increase when house price increase. Second, precautionary saving channel implies that less leveraged households' consumption responses will be higher, since higher leveraged households are likely to have less precautionary saving. Third, precautionary saving channel implies consumption only responds to unexpected house prices, since predicted house prices are already factored into households' consumption and saving plan. Fourth, precautionary saving channel implies that households' discretionary consumption responses are higher than non-discretionary consumption responses, since when households save less, their discretionary consumption will increase.

2.4 Hypotheses

As discussed in section 2.3, there are competing theories that can explain the positive co-movement between consumption and home prices. In this section, we develop 3 hypotheses for testing these competing theories using.

We first test whether the direct wealth effect explains the observed co-movement between consumption and house prices. Since old homeowners tend to have more housing wealth, we expect to find a higher consumption response than the younger homeowners. Thus, we have the following hypothesis:

- **Hypothesis 1:**

Direct wealth channel: If the direct wealth effect drives the co-movement between house prices and consumption, older homeowners should have higher consumption responses than younger homeowners.

We investigate whether the credit constraint channel or the common factor channel also explain the co-movement. Increases in house prices may tighten the credit constraint for renters, thus the more credit constrained renters should have a negative consumption response. Renters anticipate buying a house in the future, an increase in house prices tightens the credit constraint they face. In particular, they will now need higher savings to meet any deposit or down payment requirement. Hence if credit constraint channel is the reason for the observed co-movement of consumption and house prices we might expect to see the consumption of renters to fall when house prices increase. If instead, a common factor, such as improving productivity, stimulate both house prices and consumption, then renters and homeowners will both increase their consumption, when house prices increase. Hence, we have following hypothesis:

- **Hypothesis 2:**

  (2a) Credit constraint channel: If the credit constraint effect drives the co-movement between house prices and consumption, renters consumption will decrease, when house prices increase.

  (2b) Common factor channel: If the common factor effect drives the co-movement between house prices and consumption, renters and homeowners will both increase their consumption, when house prices increase.

The credit constraint channel and the precautionary saving channel are related, since decreases in credit constraint usually accompany decreases in precautionary saving motive. Nevertheless, these two channels have different implications, thus we distinguish precau-

tionary channel and credit constraint channel. As the credit constraint channel suggests, housing wealth is treated as collateral for borrowing, thus consumption will respond to realized house price changes which are either from the expected component or from unexpected component of house prices. In contrast, the precautionary saving channel suggests that consumption should only respond to changes from the unexpected part of housing prices, because expected changes in housing wealth have already been factored into household consumption and saving plans. Hence, we have the following hypothesis:

- **Hypothesis 3:**

  (3a) Credit constraint channel: If the credit constraint effect drives the co-movement between house prices and consumption, consumption will respond to either the expected or unexpected level of house prices.

  (3b) Precautionary saving channel: If precautionary saving effect drives the co-movement between house prices and consumption, consumption will only respond to the unexpected change in the level of house prices.

We will test these hypotheses in Chapter 5 using Australia data.

Chapter 3

Empirical literature review

In this section, we survey key macroeconometric and microeconometric evidence on the relationship between house prices and consumption. We discuss the strength of using microeconomic data in explaining this house price-consumption co-movement, and compare two key Australian studies.

3.1 Macroeconometric evidence

One of the most cited studies using macroeconomic data on housing wealth effect is Case, Quigley, and Shiller (2005). Using a panel of 14 countries observed annually during the past 25 years and a panel of U.S. States observed quarterly during the 1980s and 1990s, Case, Quigley, and Shiller (2005) find that a 10 percent increase in housing wealth leads to a roughly 1.1 percent increase in consumption for 14 countries; a 10 percent increase in housing wealth raises consumption by 0.4 percent for the US. They also show that housing wealth effects on consumption dominate stock wealth effects on consumption at an interna-

tional level, while housing wealth and stock wealth have similar effects on consumption for the US.

However, the literature does not always reach the same conclusions. In contrast with Case, Quigley and Shiller (2005), Ludwig and Slok (2004) find larger effects of financial wealth than housing wealth in a panel of 16 OECD countries. Using Australian data at the state level and a similar model to Case, Quigley and Shiller (2005), Dvornak and Kohler (2007) find larger financial wealth effects than housing wealth effects.

Considering omitted variables and stickiness, there may be some limitations of these different results. First, many of the same factors will affect both asset prices and consumption at a macroeconomic level, such as credit conditions and demographic features. Muellbauer and co-authors (Aron, Muellbauer, and Murphy 2006, Muellbauer, 2008, Aron, Duca, Muellbauer, Murata, and Murphy, 2012) estimate housing wealth effects including control variables for credit market liberalizations. They point out that omitting variables that both affect asset prices and consumption, such as credit market liberalization, will overestimate housing wealth effects on consumption. Considering demographic features such as age composition and poverty rates, Calomiris, Longhofer, and Miles (2012) find that a $1 increase in housing wealth raises current consumption by roughly $0.08 on average, while the stock wealth effect is insignificant. Second, given stickiness, the immediate change of consumption respond to shock may not be obvious, and the eventual change of consumption response to a shock may be ignored. Carroll, Otsuka and Slacalek (2011) distinguish house prices' immediate and eventual effect on consumption. They find that, in the US, the immediate MPC out of housing wealth is 2%, with a 9% final eventual MPC out of housing wealth. They also find housing wealth has larger effects on consumption, compared to stock wealth.

3.2 Microeconometric evidence

3.2.1 Advantages of microeconomic data

Compared with using macroeconomic data, as Campbell and Cocco (2007) point out, using microeconomic data has several advantages in investigating the relationship between house prices and consumption. First, micro data enable economists to identify those households who have particularly large or small house wealth effects on consumption. For example, the direct wealth effect of house prices for young homeowner who are likely to have less housing wealth and may trade their housing wealth up in the future, could be smaller than for the older generation. Second, micro data allow economists to distinguish the effects of local and national movements in house prices. Financial liberalization tends to operate through national house prices to affect household consumption, while direct wealth effects on consumption, and collateral effects on consumption operate through local house prices. Third, microeconomic data allow distinguishing between predictable and unpredictable movements in house prices, thus enabling economists to distinguish wealth effects from other effects, such as collateral effects.

3.2.2 Divergence of different empirical studies

However, the results of these studies using microeconomic data are quite heterogeneous and support different channels, due to the different microeconomic data sets and methodologies applied. There are three main categories of microeconomic data used in the literature: pseudo-panel data which is from a time series of cross-sections; panel data, for which individual households are tracked through the total sample period; and cross-sectional data

which are collected by observing many subjects at the same point of time, or without regard to differences in time. The way to construct a pseudo-panel was first introduced by Deaton (1985). In the approach developed by Deaton (1985), Deaton (1985) groups the individuals sharing common characteristics such as date of birth in repeated cross-sectional surveys into different cohorts. Then he treats the averages within the cohorts as observations in the pseudo-panel. For the different methodologies, some studies use reduced-form regression for analyzing the relationship between house prices and consumption, while others use models considering the permanent income hypothesis and life cycle hypothesis as a rationale.

3.2.3 Evidence about the direct wealth effect channel

Campbell and Cocco (2007) use a pseudo-panel data constructed from UK FES data and Nationwide house prices data over the period from 1988 to 2000 and apply the reduced form regression to estimate the response of household consumption to changes in house prices. In general, they find that a 1% increase in the value of houses is associated with a 1.22% increase in real non-durable consumption. For the life-cycle pattern, they find the largest house price elasticity of consumption for older homeowners and the smallest elasticity for younger renters. By controlling for interest rates, household income and other demographic variables, the estimated elasticity for the older homeowner group is about 1.7; however, the elasticity for younger renters is insignificantly different from zero.

Sierminska and Takhtamanova (2007) employ microdata from the Luxembourg Wealth Study, which is cross-sectional for different countries such as Canada, Italy and Finland, and use a reduced-form regression to investigate whether there are differences in wealth effects from different types of wealth and across age groups. They find that the effect of housing wealth on consumption is strongest for the oldest group in Canada and the late

middle-aged groups in Finland and Italy. In addition, they find that the overall wealth effect out of housing is stronger than the effect out of financial wealth for all the countries in their sample.

Smith (2007) uses pseudo-panel data derived from the Household Expenditure Survey in New Zealand over the period of 1984 to 2007 and the life-cycle model to test which channel on house prices and consumption is more consistent with the New Zealand data. He finds that a positive correlation between real house prices and real household expenditures is significant for most tenure and age groupings. He suggest that the house prices and consumption relationship is most likely to be due to direct wealth effects because they find that the expenditure responses to house prices tend to increase by the age of the homeowners.

However, the evidence on this wealth effect channel is not universally supported. In the US, using PSID over the period from 1968 to 1993, which is a panel data set, and applying the reduced-form regression, Lehnert (2004) finds that total sample MPC out of housing wealth is between 1.9 and 3.1 cents per dollar. He also finds that the effect of housing wealth on consumption is the greatest for the youngest group.

Bover (2005) estimates housing wealth effects on consumption by using a cross-sectional survey of Spanish Household Finances (EFF), which contains information on different types of wealth and expenditure and oversamples wealthy households, using a reduced-form model. He uses local house prices and inheritance information from the survey as instruments to identify a causal effect of housing wealth on consumption. He finds the largest and statistically significant housing wealth effects for young households, and thus cannot support the direct wealth effect channel.

Browning, Gørtz and Søren (2008) use a Danish panel data set and a life-cycle model, they find no significant relationship between house prices and consumption before 1993,

but a positive and significant relationship between both anticipated and realized house price shocks after 1993. Moreover, they find that the consumption response for younger households is larger than the response for older households.

Recently Kahn and Ribon (2013) construct a pseudo-panel data based on the Household Expenditure Survey in Israel over a period from 2003 to 2011, and use a reduced-form model to examine the effect of changes in house prices on private consumption. The estimation results of the study show that a 1% increase in house prices leads to a 0.18% increase in consumption for owner-occupier households. A strong and significant effect is found for the middle-aged group, which accounts for 43 percent of owner-occupier households. The effect of house prices on the consumption of young and old households is smaller and insignificant.

3.2.4 Evidence on credit constraint channel

A group of studies find that relaxation of credit constraint due to increases in house prices can help increasing consumption (Windsor, Jaaskela, and Finlay, 2013, Atalay, Whelan, and Yates, 2013); on the other hand, using US zip code–level house prices and consumption data, Mian, Rao, and Sufi (2013) find a large decline in housing wealth due to the global financial crisis of 2008 reduces large amount of households' consumption through tightening their credit constraint.

3.2.5 Evidence on the common factor channel

Attanasio et al. (2009) employ a life-cycle model and use a pseudo panel constructed from FES data over the period of 1978 to 2002 to investigate the co-movement between house

prices and consumption, but their conclusion is opposite to that of Campbell and Cocco (2007). Attanasio et al (2009) find that young homeowners respond more strongly to house price changes than older homeowners, and the consumption responses due to change of house prices for homeowners and renters are not significantly different. Therefore, they conclude that common factors such as increasing future expected income can mainly explain the close co-movement between house prices and consumption in UK from 1978 to 2002. The divergences in results may be attributed to different methodologies applied by Campbell and Cocco (2007) and Attanasio et al (2009). On the basis of a comparison exercise, Sevilla and Cristini (2011) suggest that the results of the study of Attanasio et al (2009) are more robust to methodological differences.

3.2.6 Evidence on precautionary saving channel

Using Hong Kong data, Gan (2010) finds that there exists a significant consumption response to changes in housing wealth even without refinancing. This finding suggests the precautionary saving channel can be also important in explaining the co-movement between house prices and consumption. This is because credit constraint channel is limited to those who refinance their housing wealth, but precautionary saving channel is not[1] . A rise in housing wealth relaxes borrowing constraints, resulting in increased consumption. However, if households do not sell their houses to get the capital gain, housing wealth relaxes the credit constraints only through refinancing, which is costly and occurs infrequently. Thus, credit constraints predict greater consumption-housing wealth sensitivity for those who actually refinance, whereas a significant consumption response among households that did not refinance if more consistent with a reduction in precautionary saving. Gan (2010)

[1] Refinancing means that refinancing with a new loan from another bank to replace the existing loan, which can be rate refinancing (to get a lower loan rate) or cash-out refinancing. Both have consumption implications:rate refinancing through reduced monthly payments and cash-out refinancing through a one-time cash award

provides further evidence supporting precautionary saving channel. For example, she finds that consumption only responds to the unexpected component of house prices; less leveraged households' consumption responses are stronger; discretionary consumption responses are higher than non-discretionary consumption responses.

3.2.7 Empirical studies for Australia

In Australia, there are two studies using microeconomic data to identify the main channel explaining the correlation between house prices and consumption. These two studies both support the credit constraint channel, using a similar methodology as in Attanasio et al. (2009).

Atalay, Whelan, and Yates (2013) construct a pseudo-panel data set from repeated Household Expenditure Surveys in Australia to identify the transmission mechanism that links house prices and household consumption and their results suggest that the relaxation of credit constraints can be the main explanation for the co-movement between house prices and household consumption. However, because of the repeated cross-section nature of the data (each household is interviewed only once), Atalay, Whelan, and Yates (2013) is subject to the endogeneity problem of changing homeownership, when they estimate the consumption responses for renters and homeowners. For example, negative shocks on homeowners may make them reduce consumption and change their homeownership from homeowners to renters; on the other hand, positive shocks to renters may make them increase consumption and change their homeownership from renters to homeowners, thus if households change their homeownership during the sample period, the estimation may be biased.

Compared with Atalay, Whelan, and Yates (2013), the main advantage of Windsor, Jaaskela, and Finlay (2013) is that they apply a panel data set from the Household, Income and Labour Dynamics in Australia (HILDA) survey over a period of 2003 to 2010. Therefore, they can track the homeownership of households over the whole sample period. To solve the endogeneity problem, they can drop the households who change their homeownership during the sample period. Windsor, Jaaskela, and Finlay (2013) find that pseudo-panel data can well substitute panel data, and the effect of moving home on households' consumption is not

obvious.

Our study is most related to Windsor, Jaaskela, and Finlay (2013), using similar methodology and data. Our study confirms the credit constraint is the most important channel that explains the co-movement between house prices and consumption, even after we explicitly consider the precautionary saving channel. We also extend Windsor, Jaaskela, and Finlay (2013), by considering alternative measures of home prices, including the level of house prices, house price growth rates and unexpected house prices.

Chapter 4

Data and Methodology

We use the HILDA dataset and the framework proposed by Attanasio and Weber (1994) to investigate the relationship between house prices and consumption. In this chapter, we first describe the data used in this thesis. Second, we briefly introduce the panel data econometrics. Third, we present a simple baseline life cycle model and then introduce house prices into the model.

4.1 Data description

4.1.1 The HILDA survey data

The HILDA survey is a household-based panel study. It began in 2001 with 7682 households and 19,914 individuals. HILDA survey contains detailed information about economic and subjective well-being, labour dynamics and family dynamics. Wealth modules for household wealth are provided every four years. In this study, we use the household wealth

modules of 2006 and 2010.

We construct three balanced panels from HILDA survey over the period of 2003 to 2012. In these panels, each household is represented by the head of household who make main financial decisions. The strategy to identify the head of a household is to identify the household member who has the highest income.

- **PANEl 1:** Households respond in every wave, maintain the same homeownership tenure (homeowner or renter), and do not split into different households during the sample period. Household splitting, such as divorce, is associated with significant fluctuations in households' wealth and consumption. So in panel one, observations with households splitting are dropped. Changing homeownership and changes in consumption may both be affected by the same factor. Thus, to deal with this endogeneity problem, observations who change their homeownership tenure are dropped. To track through households every wave, we also drop observations that do not respond in every wave. The observations for those who born before 1981 and after 1919 are also dropped.

- **PANEL 2:** Only homeowners are included. We obtain panel two by dropping renters from panel one.

- **PANEL 3:** Homemovers are dropped. Housing transactions may be related to higher spending, if households purchase new goods and services when moving home. To study housing transactions' effects on household consumption, we get panel three by dropping households who move home from panel two.

The criteria for constructing different panels and the number of observations for different panels are shown in Table 4.1.

Table 4.1 The panels 2003-2012

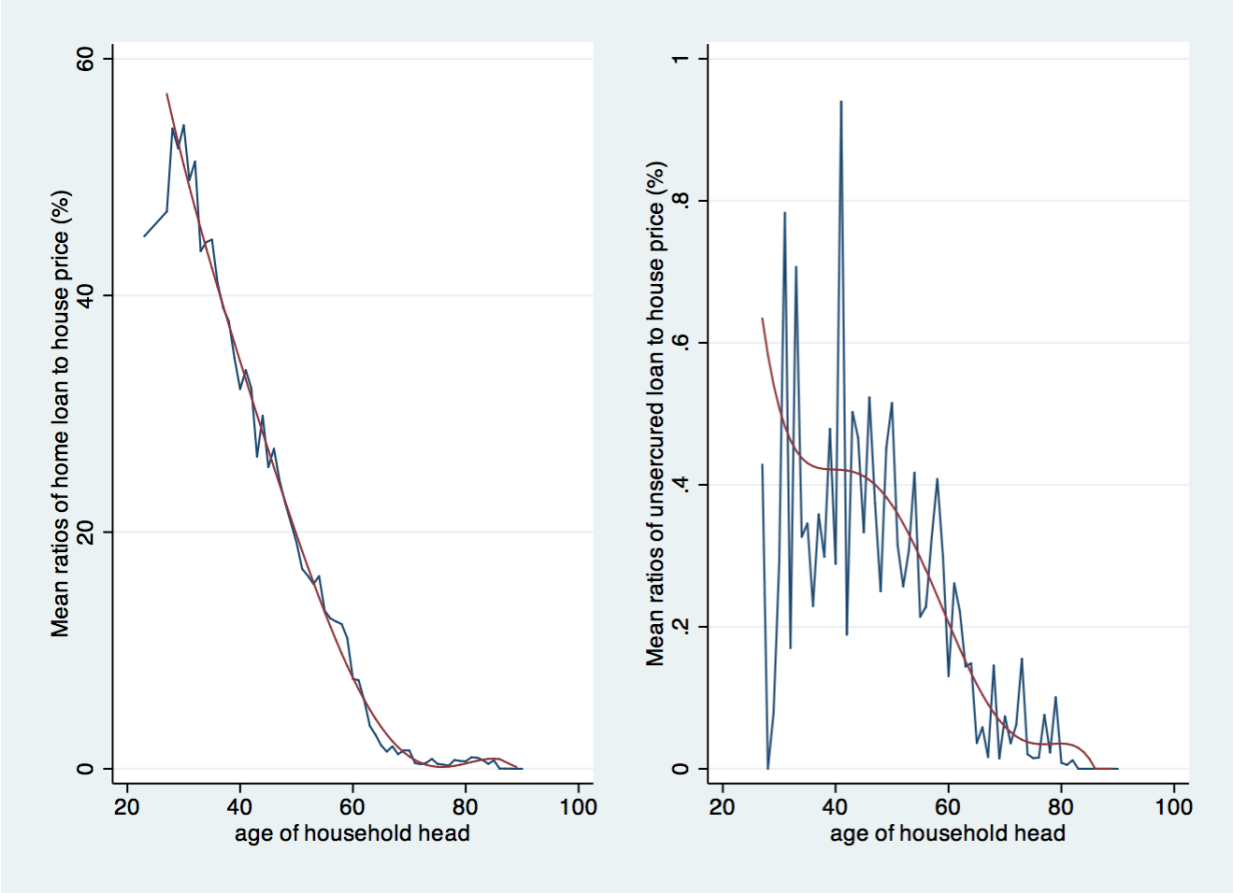
	Number of observations	
	Dropped	Remaining
Selection criteria for panel one		
Responded in any given year		76820
Responded in every wave without household splitting	51610	25210
Do not change home tenure type	5650	19560
Born before 1981 and after 1919	225	19335
Sample Size		19335
Selection criteria for panel two		
Home owner	3076	16250
Sample size		16250
Selection criteria for panel three		
Did not move	4928	11322
Sample size		11322
Sources: HILDA Release 12.0; authors' calculations		

Demographic variables contained in these panels are the age of the household head who is more likely to make financial decisions, the number of children and adults in the household, the highest level of education of the household head, occupation of the household head, the region of residence and the labour force status.

The credit constraint situation of homeowners is important if we are to distinguish the credit constraint channel from the direct wealth channel and the common factors channel. Figure 4.1 shows that mean ratios of home loans to home prices and mean ratio of unsecured loan to house prices against age. From the two panels of the figure, we can see younger homeowner has both a higher home loans to house prices ratio and an unsecured loans to house prices ratio than older homeowners. Both of these two variables decrease as the age of the household head increases. Because the cost of unsecured loans is more expensive, if young homeowners are at least as credit constrained as older homeowners, they are more likely to have secured loans such as home loans instead of unsecured loans and their amount of unsecured loan should be similar to that of older homeowners, thus the right hand panel

of figure 4.1 should be almost flat. Hence, the age pattern of the mean ratio of the unsecured loan to house prices shown in Figure 4.1 indicates that younger homeowners are more credit constrained than older homeowners. The finding that young homeowners seem to be more credit constrained is important. As the credit constraint channel suggests, households who are more constrained are likely to borrow more to finance their consumption, and young homeowners seem to be this type of households.

Fig. 4.1 Credit constraints by age



Notes: Calculated using all homeowners in panel two, defined in Table 1; fitted line obtained by regressing ratios on a polynomial in age; mean ratios of home loan to home price calculated over 2003 to 2012; mean ratios of unsecured debt to home price calculated using the wealth module years 2006 and 2010.
*Soure:*HILDA Release 12.0; authors' calculations

4.1.2 HILDA spending estimates

To ensure our results can draw inferences of aggregate trend between house price and consumption, we check for the consistency between the HILDA data and the aggregated data. Figure 4.2 shows the growth rates of consumption from the aggregate consumption and implied from HILDA. The correlation for these two growth rates is 0.63 indicating these two growth rates are strongly correlated.

Fig. 4.2 Real spending growth per household

Soure: authors' calculations from HILDA Release 12.0 and ABS

Over the period of 2006 to 2010, we calculate the HILDA spending as the sum of 25 self-reported spending categories, which is defined based on the usual amount spent weekly, monthly and annually. However, from 2003 to 2005 HILDA only records three spending categories: meals eaten out, groceries, and child care costs; in 2011 and 2012, durable spending is not recorded. We use the relationship between real spending on meals eaten

out, groceries, and child care costs; age of the head of household and real total expenditure in the years 2006 to 2010 to impute real total spending for households from 2003 to 2005 and from 2011 to 2012. Firstly, we regress total spending on meals eaten out, groceries and child care costs from 2006 to 2010 to get the predicted model for total spending. Secondly, we substitute meals eaten out, groceries, and child care costs from 2003 to 2005 and 2011 to 2012 into the predicted model to get imputed total spending.

Table 4.2 shows detailed estimated imputation regressions for panel two. $totalspending_{it}$ is real total spending of household i at time t; meo_{it} is real spending on meals eaten out; gro_{it} is real grocery spending; cc_{it} is real child care spending; age_{it} is the age of household head. The first column shows the estimated coefficients from a linear specification, and the second column shows the estimated coefficients from a log-linear specification. The fit of the log-linear model is 0.51 which is higher than that of the linear model[1], and the fit of this log-linear model is also consistent with other papers using similar imputation methods (see, for example, Lehnert (2004) and Windsor et al(2013)), so we use the log-linear model for imputation.

Table 4.2 Spending imputation

$totalspending_{it} = \alpha_0 + \alpha_1 meo_{it} + \alpha_2 gro_{it} + \alpha_3 cc_{it} + \alpha_4 age_{it} + \alpha_5 age_{it}^2 + E_{it}$		
	Linear model	Log-linear model
Meal eaten out	4.30***	0.000069***
Groceries	1.82***	0.000049***
Childcare costs	0.57	0.000009***
Age	926.48***	0.04***
Age^2	-10.57***	-0.0004***
Constant	-1277.6	9.02***
N	5673	5672
adj. R^2	0.37	0.51

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

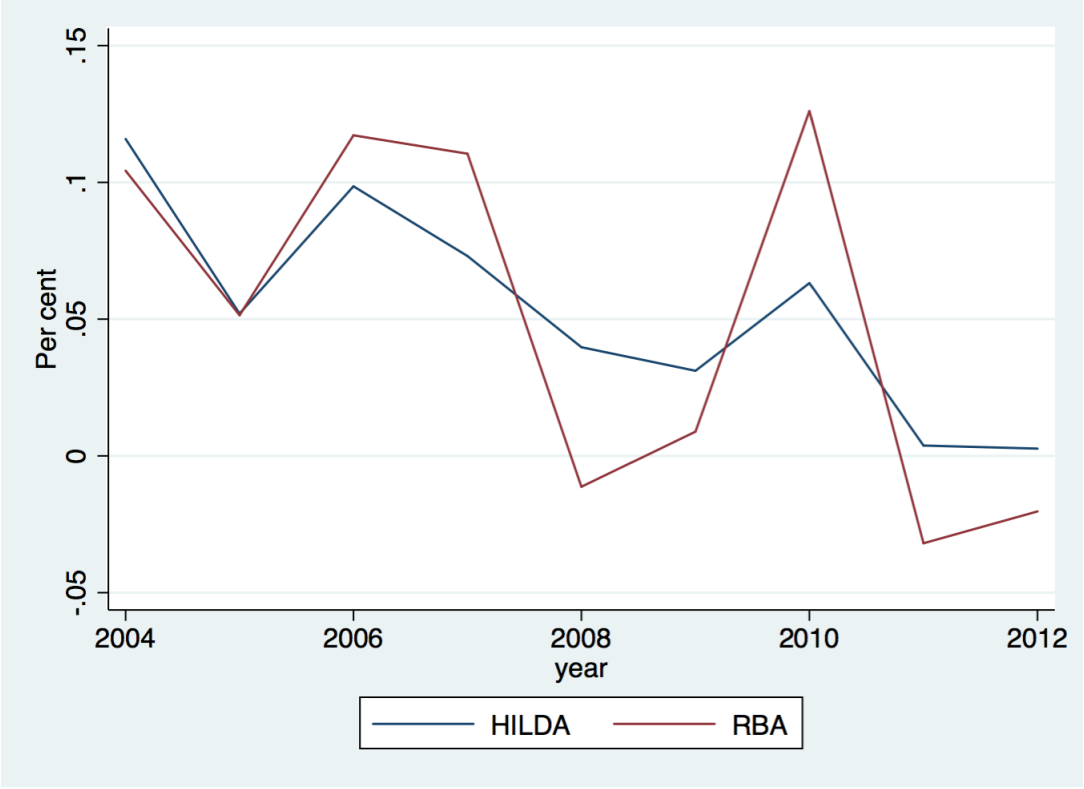
Source: HILDA 12.0

[1] For panel 1 and panel 3, the fit of the log-linear model is still higher than that of the linear model

4.1.3 HILDA Self-reported Home Prices

We use self-reported house price data from 2003 to 2012. In figure 4.3, we compare the growth rate of HILDA house price and that of independent nationwide house price to check whether they are consistent. We can see they have similar trends during the sample period. The correlation between growth in self-reported house price data and aggregate house price is around 0.87 which indicates the growth trends of these two house prices are very strongly correlated.

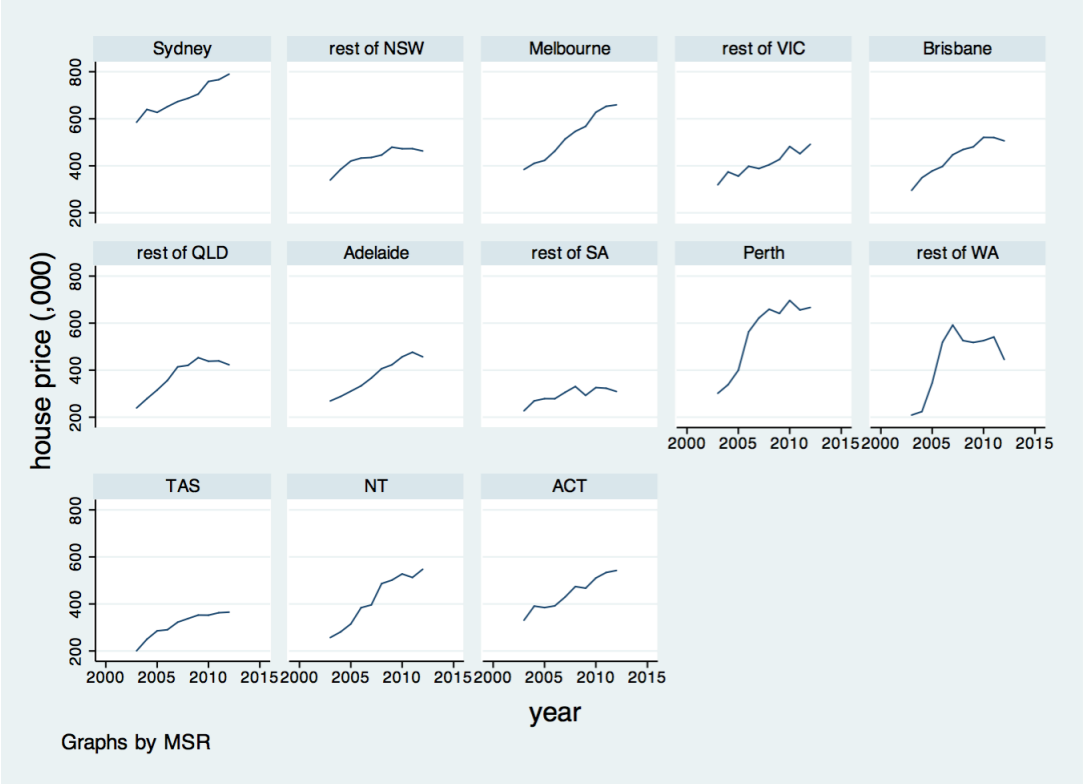
Fig. 4.3 Real house price growth per household



*Soure:*HILDA Release 12.0 from authors' calculations and RBA

Figure 4.4 plots the mean value of HILDA self-reported house prices for different major statistical regions. From figure 4.4, we can see large variations over time and across regions.

Fig. 4.4 Self-reported home prices by major statistical region



*Soure:*HILDA Release 12.0; authors' calculations

4.1.4 HILDA financial assets

In HILDA financial assets are the sum of household equity investments, cash investments, trusts, bank accounts and superannuation. Because in our sample period HILDA only records financial wealth in 2006 and 2010, financial wealth is imputed for every household in years 2003 to 2005 , 2007 to 2009 and 2011 to 2012. First, we interpolate linear growth rate for all households' financial assets between 2006 and 2010. Second, we obtain the annual percentage point deviation of the ABS aggregate household sector financial asset series from its trend. Third, we adjust the linear growth rates for each household according to the annual percentage point deviation of the ABS aggregate household sector financial asset series from its trend. Fourth, we compute real financial assets according to the imputed

growth rates.

4.2 Panel data Econometrics

Since by construction HILDA is a panel dataset, we briefly introduce the methods we employ in the thesis.

4.2.1 Panel data

Panel data are data where multiple respondents are observed over time, thus we have x_{it} where i denotes cross section unit representing household, consumer, individual etc. and t denotes time period.

The advantages of panel data

Compared with cross sectional data, panel data have three main advantages. Firstly, panel data can improve precision in estimation because of an increase in the number of observations by pooling several time periods of data for each individual. Secondly, panel data can consistently estimate fixed effects model which allows unobserved individual heterogeneity to be related with regressors, while for cross sectional data, unobserved individual heterogeneity can cause omitted variables bias. Thirdly, panel data can model the dynamics of individual behaviour.

Balanced panel v.s unbalanced panel

Panel data are said to be balanced if each cross section individual has been observed over the same time periods, $t = 1, .., T$. In other words, data are available for every individual in every time period.

For some panel surveys, some individuals may drop off during sample period or miss one or more periods but return later, thus we have unbalanced panel data. A panel is said to be unbalanced panel if the time dimension, denoted by T_i, is specific to each individual.

It may be convenient to convert unbalanced panel data into a balanced panel data by excluding individuals whose data is not available in all years from the sample. However, this can reduce efficiency because of the loss of many observations. Furthermore, this may lead to a non-representative sample, if the unbalanced panel data are not randomly missing.

Short panel v.s long panel

A short panel data set is a panel where the individual dimension $N \to \infty$ and the time dimension T is not. In the microeconometric applications, short panel data are the major concern. On the other hand, a long panel data set is a panel where the time dimension $T \to \infty$ and the individual dimension N is not.

4.2.2 Models of Panel data

Notation

We let y_{it} denote the dependent variable of the ith subject at the tth time point. A set of explanatory variables is associated with each dependent variable. We assume there are k explanatory variables $x_{it,1}, x_{it,2}, \ldots, x_{it,k}$ that may vary by subject i and time t. By expressing the k explanatory variables as a $k \times 1$ column vector, we have a compact notational form:

$$X_{it} = \begin{pmatrix} x_{it,1} \\ x_{it,2} \\ \vdots \\ x_{it,k} \end{pmatrix} \quad i = 1,2,\cdots,N;\ t = 1,2,\cdots,T.$$

With this notation, the data for the ith subject consists of:

$$\begin{pmatrix} x_{i1,1} & x_{i1,2} & \cdots & x_{i1,k} & y_{i1} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ x_{iT,1} & x_{iT,2} & \cdots & x_{iT,k} & y_{iT} \end{pmatrix} = \begin{pmatrix} X_{i1}^{'} & y_{i1} \\ \vdots & \vdots \\ X_{iT}^{'} & y_{iT} \end{pmatrix} \quad i = 1,2,\cdots,N;\ t = 1,2,\cdots,T.$$

Individual-specific effects model

This model allows each cross-sectional unit to have a different intercept term and restricts all slopes to be same, thus we have:

$$y_{it} = c_i + X_{it}^{'}\beta + u_{it} \quad t = 1,...,T,\ i = 1,...,n \tag{4.1}$$

where u_{it} is a iid error term over i and t, and c_i is random variable that capture individual unobserved heterogeneity.

Fixed effects and random effects model

If we allow c_i to be correlated with the observed regressors, model 4.1 becomes fixed effects model:

$$y_{it} = \alpha_i + X_{it}^{'}\beta + u_{it} \quad t = 1,...,T,\ i = 1,...,N \tag{4.2}$$

where α_i=c_i and u_{it} is a *iid* error term over i and t.

If we assume that c_i is distributed independently of the regressors, thus model 4.1 becomes random effects model:

$$y_{it} = \mu + X_{it}^{'}\beta + \alpha_i + u_{it} \quad t = 1,...,T,\ i = 1,...,N \tag{4.3}$$

where $\alpha_i + \mu = c_i$, μ is the average of y_{it} for entire population, α_i is *iid* and u_{it} is a *iid* error term over i and t.

Taking expectation on both fixed effects model 4.2 and random effects model 4.3 with respect to c_i and X_{it}, we will have the same equation:

$$E[y_{it}|c_i, X_{it}] = c_i + X_{it}^{'}.$$

However, we cannot estimate $E[y_{it}|c_i, X_{it}]$, as the individual-specific effect c_i is unknown. Instead, we can estimate the following equation as a result of eliminating c_i by taking the expectation with respect to c_i,

$$E[y_{it}|X_{it}] = E[c_i|X_{it}] + X_{it}^{'}.$$

Random effects model assumes that $E[c_i|X_{it}] = \mu$, so $E[y_{it}|X_{it}] = \mu + X_{it}^{'}$ and hence it is

possible to identify $E[y_{it}|X_{it}]$. However, fixed effects model allows $E[c_i|X_{it}]$ to vary with X_{it}, moreover, it is not known how $E[c_i|X_{it}]$ varies with X_{it} , so we cannot identify $E[y_{it}|X_{it}]$. Nonetheless, it is possible to consistently estimate β in the fixed effects model with short panels, thus, even though the conditional mean is not identified, fixed effects model can identify the marginal effect:

$$\beta = \partial E[y_{it}|c_i, X_{it}]/\partial X_{it}.$$

In short panels the fixed effects model permits only identification of the marginal effect β for time variant regressors, while the marginal effect of time invariant regressors, such as race and gender, cannot be not identified by fixed effects model. The random effects model permits identification of all components of β and $E[y_{it}|X_{it}]$, but the essential random effects model assumption that $E[c_i|X_{it}]$ is constant does not hold in many microeconometrics applications.

Two-way fixed effects model

Begin with model (4.1) , if we allows for fixed time-specific effects γ_t, thus we have two-way fixed effects model:

$$y_{it} = c_i + \gamma_t + X_{it}^{'}\beta + u_{it}, i = 1, ..., N, \ t = 1, ..., T.$$

For short panels, we usually estimate the fixed time-specific effects as the coefficients of time dummies that are included in the regressors.

Pseudo-panel data models

An alternative of the panel model is the pseudo-panel in cases where we lack of a true panel data. The following will show how this model is constructed.

We start with model (4.1) but we assume the observed individuals are potentially different in each period , thus subscript i should be denoted as $i(t)$ to make these individuals time-dependent, but for simplicity, we still use the subscript i and assume that the same number of households N is randomly surveyed each period. We then define a set of cohorts which have fixed characteristics that remains same through the entire sample period such as birth year. Each individual observed in the survey belongs to exactly one cohort.

We take average of model (4.1) over individuals in each cohort, thus we have:

$$\bar{y}_{ch,t} = \bar{X}'_{ch,t}\beta + \bar{c}_{ch,t} + \bar{u}_{ch,t} \quad ch = 1,...,C; t = 1,...,T. \tag{4.4}$$

where $\bar{y}_{ch,t}$ is the average of y_{it} over all individuals belonging to cohort ch at time t, $\bar{X}'_{ch,t}$ is the average of X'_{it} over all individuals belonging to cohort ch at time t, $\bar{c}_{ch,t}$ is the average of c_i over all individuals belonging to cohort ch at time t.

$\bar{c}_{ch,t}$ now varies with t, thus these $\bar{c}_{ch,t}$ are potentially correlated with the X_{it}, and therefore, treating $\bar{c}_{ch,t}$ as random effect will lead to inconsistent estimates. On the other hand, assuming the $\bar{c}_{ch,t}$ as fixed effects leads to an identification problem, unless $\bar{c}_{ch,t} = \bar{c}_{ch}$ which is time invariant. The latter assumption is credible if the number of observations in each cohort is very large. In this case,

$$\bar{y}_{ch,t} = X'_{ch,t}\beta + \bar{c}_{ch} + \bar{u}_{ch,t} \quad ch = 1,...,C; t = 1,...,T. \tag{4.5}$$

One concern of pseudo panel is a trade-off in construction of pseudo panel. If we increase the number of cohorts, the number of individuals in each cohort will decrease, thus sample cohort averages become less precise estimates of the population cohort means; on the other hand, if we increase the number of individuals in each cohort, the number of cohorts will decrease, thus have less precision in estimation of the cohort-level model. Another concern is the importance of choosing appropriate cohorts. Within each cohort, the individuals should be as homogeneous as possible to minimize the measurement error variance. Between cohorts, the different cohorts should be as heterogeneous as possible to maximize the variation in the pseudo-panel, and get precise estimates.

4.2.3 Panel data estimators

We introduce several commonly used panel data estimators. These estimators differ in how cross-section and time-series variation in the data are used, and their properties vary according to whether or not the fixed effects model is the appropriate model.

Pooled estimator

The pooled OLS estimator is obtained by packing the data over i and t into regression with $N \times T$ observations, then estimating β in the following model by OLS and using variation over both time and cross-sectional units

$$y_{it} = c + X_{it}^{'}\beta + u_{it} \quad t = 1,...,T,\ i = 1,...,N. \tag{4.6}$$

where assume the intercept term c is constant and slopes β are same. If the true model is the pooled model (4.6) and regressors are uncorrelated with the error term, the pooled OLS estimator is consistent.

The pooled OLS estimator is inconsistent if the true model is the fixed effects model. We can show this by rewriting the model (4.1) as

$$y_{it} = c + X_{it}^{'}\beta + (c_i - c + u_{it})$$

then pooled OLS regression of y_{it} on $X_{it}^{'}$ and an intercept leads to an inconsistent estimator of β if the individual effect c_i is correlated with the regressors $X_{it}^{'}$, because such correlation indicates that the combined error term $(c_i - c + u_{it})$ is correlated with the regressors.

Within or fixed effects estimator

We take the average of model (4.1) over time yields $\bar{y}_i = c_i + \bar{X}_i^{'}\beta + \bar{u}_i$. Subtracting this from y_{it} in (4.1) yields the within model

$$y_{it} - \bar{y}_i = (X_{it}^{'} - \bar{X}_i^{'})\beta + (u_{it} - \bar{u}_i), i = 1, ..., N, \ t = 1, ..., T. \tag{4.7}$$

Estimating equation (4.7) by OLS and using the variation in the data over time, we obtain the the within estimator, which yields consistent estimates of β in the fixed effects model, as c_i is eliminated. This estimator is also called the fixed effects estimator as it is the efficient estimator of β in the model (4.1). c_i are fixed effects and the error u_{it} is iid.

A main limitation of within estimation is that the within model cannot identify the coefficients of time-invariant regressors, since if $X_{it}^{'} = X_i^{'}$ then $\bar{X}_i^{'} = X_i^{'}$ so $(X_{it}^{'} - \bar{X}_i^{'}) = 0$.

4.3 The Attanasio and Weber (1994) life-cycle model

We use a simple life-cycle model as baseline model, which is proposed by Attanasio and Weber (1994) and is used by Attanasio and Weber (2009) and Windsor, Jaaskela, and Finlay (2013). This model predicts that real spending in each period is given by a proportion of lifetime wealth based on age. Attanasio and Weber (2009) suggest that it is difficult to obtain a closed-form solution for consumption from a standard life-cycle model, except under very strong and unattractive assumptions (such as quadratic utility), thus this model should be interpreted as approximation.

$$totalspending_{it} = k(age)_{it} w_{it} exp(\varepsilon_{it}) \tag{4.8}$$

where $totalspending_{it}$ is real total spending of household i at time t, w_{it} represents total life-time wealth including discounted lifetime earnings, net financial wealth and housing wealth. ε_{it} is the residual term. $k(age)_{it}$ captures the age composition of the household (and therefore the end of their lives), changes in household needs, and changes in discount factors.The residual term reflects innovations to permanent income, transitory shocks to current income and measurement errors in current income. It is assumed that the residuals are not correlated with explanatory variables, they average out to zero over the estimation period and are uncorrelated with deterministic trends. Taking logs of the above equation yields:

$$ln(totalspending_{it}) = ln(w_{it}) + ln(k(age_{it})) + \varepsilon_{it}. \tag{4.9}$$

We can estimate equation (4.9) using proxies for non-housing log lifetime wealth $ln(w_{it})$

and for the life-cycle function $ln(k(age_{it})$, yielding:

$$ln((totalspending_{it})) = \alpha_i + B'W_{it} + A'Z_{it} + E_{it}. \tag{4.10}$$

The proxies for non-housing log of life time wealth are: constants α_i; and a vector of variables, W_{it} which is total life-time wealth which includes dummy variables for highest education level achieved by the household head, the occupational classification of the household head, the log of real financial asset holding , and the log of real disposable income; B represents a log-level shift in spending for categorical variables and the elasticity of spending for continuous variables. The proxies for life-cycle function are Z_{it}, which includes the number of adults and the number of children in the household, a dummy for households with more two adults, labour force statues of the household head, and the region of residence.

4.4 Introducing house prices

To examine the effects on consumption due to changes in house prices is the main focus of this study. We use different measures of house prices in this study because these may be related to different factors that may affect household wealth and consumption.

4.4.1 House price growth

House price growth in our study is the percentage change in regional level change in house prices. We have two reasons to include house price growth in our baseline model and interact it with the three age groups. First, if house prices are interpreted by households as a gain in wealth, house price growth should be most related to homeowners, especially,

who are willing to trade down. These kinds of homeowners tend to be older households. Second, house price growth may capture shocks to the confidence for the future economy growth which is related to productivity and income growth, which are expected to be more important for younger households.

4.4.2 Level of house prices

First, the level of house prices may better capture pure wealth effects, because the PIH predicted that the level of resources that influences the level of consumption. Second, regional house price levels may be related to permanent income, which is affected by the level of productivity and economic activity in different regions. Thus, with the help of this variable, we can identify the common factor channel. Given these reasons, we also add the level of house prices to our baseline model, interacting with the three age groups.

4.4.3 Expected and unexpected house prices

We decompose the level of house prices into expected house prices and unexpected house prices. Expected house prices capture the component of the level of house prices that can be explained by regional trends in income and may be a proxy for changes in permanent income. Unexpected house prices may more likely capture the influence of the wealth effect of house price levels on consumption. We get unexpected house prices, which are the residual obtained by regressing the following equation with pooled estimator:

$$ln(HP_{it}) = \alpha_0 + f(age_{it}) + A'SD_{it} + B'Q_{FA(20)it} + C'Q_{HHDY(20)it} + \beta_1 \triangle ir_t + \beta_2 u_t + HP^E_{it} \tag{4.11}$$

where $ln(HP_{it})$ are self-reported home prices from HILDA; SD_{it} is the statistical subdivision region where household i resides at time t; $Q_{FA(20)it}$ denotes a vector of dummies for the financial asset vigintile; $Q_{HHDY(20)it}$ stands for a vector of dummies for the household disposable income vigintile; $\triangle ir_t$ is the percentage change in nominal average interest rates between time t and time $t-1$; u_t is the unemployment rate at time t; HP_{it}^{E} represents the residual or unexplained part of house prices. The difference between levels of house prices and unexpected house prices is expected house prices. [2]

We use a generic function $g(HP_{it})$ to represent these different house price variables, equation 4.10 becomes:

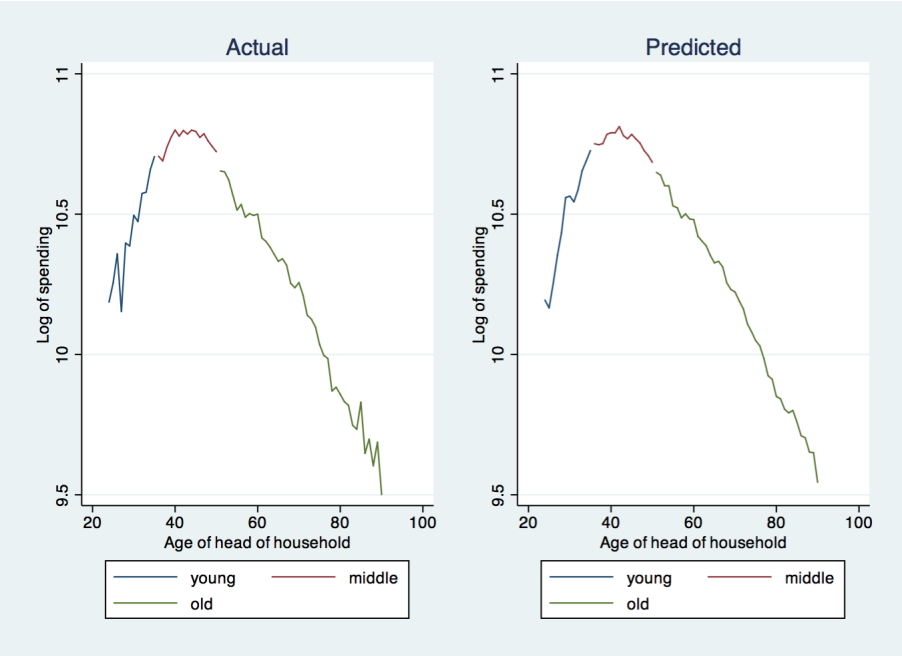
$$ln((totalspending_{it})) = \alpha_i + B'W_{it} + g(HP_{it}) \times Age + A'Z_{it} + E_{it} \tag{4.12}$$

where *Age* stands for dummies for different age groups for the household head in the first survey year as either young (23 to 35 years), middle (36 to 50 years) or old (over 50 years).

We estimate equation 4.12 using the unexpected level of self-reported house prices with panel two and plot the predicted and actual spending by age group. In Figure 4.5, the left panel describes the trend of actual log of spending from equation 4.12 and the right panel describes the predicted log of spending from equation 4.12. Fig 4.6 shows that the life cycle pattern of log of spending follows a bell-shape, which is widely reported in the literature (see, for instance, Attanasio and Browning (1993), Carroll (1996), and Gourinchas and Parker (2002)).

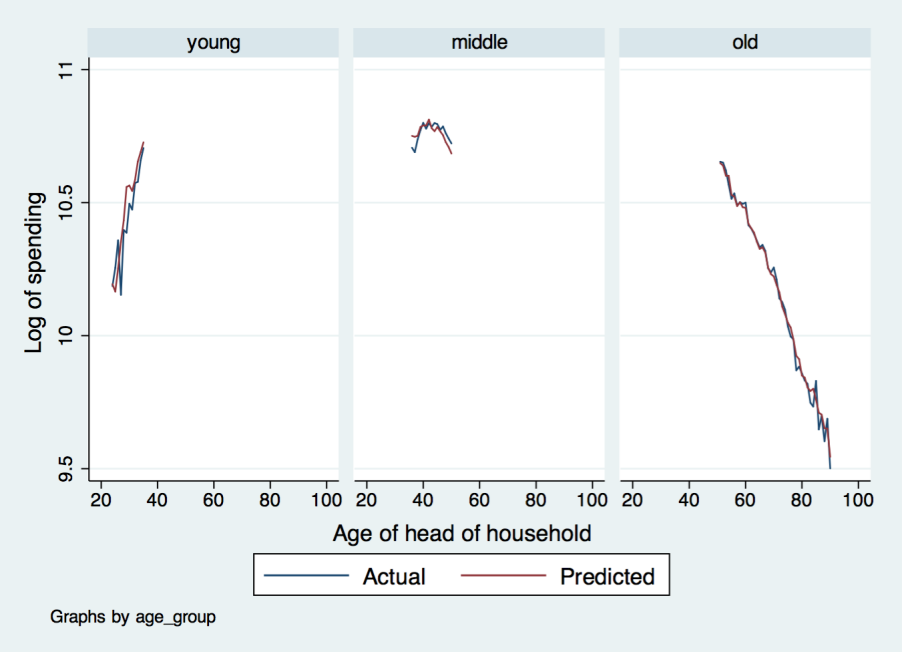
[2]The data fit this model well. Using panel 1 with ABS mean house prices, the R^2 ratio is 0.87; Using panel 2 with self-reported house price, the R^2 ratio is 0.54; Using panel 3 with self-reported house price, the R^2 ratio is 0.58.

Fig. 4.5 Real household spending (by age within age group)



*Soure:*HILDA Release 12.0; authors' calculations

Fig. 4.6 Real household spending (predicted vs actual spending)



*Soure:*HILDA Release 12.0; authors' calculations

Chapter 5

Results

In this section, we first demonstrate the importance of housing wealth's effects on consumption by comparing the consumption responses to changes in house prices with changes in financial assets. Second, we identify the main channel that house prices impact on consumption by testing the hypotheses proposed in section 2.4. Lastly, we test whether a pseudo-panel can well approximate a true panel.

5.1 Does housing wealth effects dominate financial wealth effects?

Considering household-fixed effects, time-fixed effects and not interacting house prices with dummies for age groups, decomposing W_{it} into financial and non-financial wealth, equation 4.12 becomes:

$$ln(totalspending_{it}) = \alpha_i + T_i + B'NW_{it} + C'FA_{it} + D'g(HP_{it}) + A'Z_{it} + E_{it} \tag{5.1}$$

where α_i are household-fixed effects that control for unobserved time-invariant differences between households, T_i are time-fixed effects, NW_{it} is the non-financial part of W_{it}, and FA_{it} is the financial part of W_{it}. We omit dummies for occupation and education since they are time-invariant and can be captured by household-fixed effects[1]. We estimate equation 5.1 using the level of self-reported house prices with panel 2.

If the effects of housing wealth on consumption dominate the effects of financial wealth on consumption, we expect the consumption responses to changes in house prices are higher than responses to changes in financial assets.

As shown in table 5.1, housing wealth's effects are much stronger than financial wealth's effects. A 1% increase in house prices is associated with a 0.04% increase in total spending; however, a 1% increase in financial assets is only associated with a 0.013% increase in total spending. For non-durable spending, the pattern of wealth effects is similar, but financial assets do not significantly affect non-durable spending. It should be noted that these significant wealth effects do not mean there is a causal relationship between wealth and consumption; these significant wealth effects may be caused by other common factors.

Table 5.1 Coefficients on level of house prices (self-reported house prices) and financial assets

	Total spending	Non-durable spending
$ln(HP_{it})$	0.04***	0.04***
FA_{it}	0.013***	0.01
$H_o : ln(HP_{it}) = FA_{it}^{(a)}$	F	F

Note: F refers to a failure to reject the null hypothesis H_o; ***, ** and * indicate significance at the 1, 5 and 10 per cent level, respectively
(a) H_o is that home-price wealth effects for homeowners and financial assets wealth effects for homowners are not statistically different.

Possible explanations for this dominating effect of housing wealth on consumption are ex-

[1]Occupation and education variables are categorical variables and do not change frequently. HILDA data allows me to track the individuals' education level and households who change their occupation and education level are deleted

plained in section 2.2. We now test the alternative channels in explaining the positive correlations between house price and consumption. The hypothesis tests are outlined in section 2.4.

5.2 How do house prices affect consumption?

Considering household-fixed effects and time-fixed effects, equation 4.12 becomes:

$$ln(totalspending_{it}) = \alpha_i + T_i + B'W_{it} + D'g(HP_{it}) \times Age + A'Z_{it} + E_{it} \tag{5.2}$$

where α_i are household-fixed effects that control for unobserved time-invariant differences between households and T_i are time-fixed effects. We omit dummies for occupation and education since they are time-invariant and can be captured by household-fixed effects. We base our discussions on the empirical results from estimating equation 5.2. We use the unexpected house prices as the benchmark measure of house prices, and compare the benchmark estimates with alternative measures of house prices.

5.2.1 Hypothesis 1: Direct wealth effects

If direct wealth effects explain the positive co-movement between house prices and consumption, then we expect to find old homeowner who typically has a larger housing wealth should have a higher consumption response compared with young homeowner. Our results reject the wealth effects as the main channel in explaining the positive house prices and consumption co-movement. These results are robust on different measures of house prices.

Benchmark: Unexpected house prices

For young homeowners, on average, a 1% increase in unexpected level of house prices is associated with a 0.14% increase in consumption. For middle age homeowners, a 1% increase in unexpected level of house prices is only associated with a 0.05% increase in consumption. For old homeowners, a 1% increase in the unexpected level of house prices is associated with a 0.04% decrease in consumption. The difference between wealth effects for young homeowners and middle age homeowners is significant. The wealth effects difference between young homeowners and old homeowners is also significant. There is a significant wealth effect difference between middle age homeowners and old homeowners. The second column shows that when we restrict spending to non-durable consumption items, the age distribution of home-price wealth effects is similar to the case when we use total spending except that the old's response is not significant.

Under the direct wealth channel, old homeowners should have the largest house price wealth effects on consumption; on the other hand, young homeowners should have the smallest house price wealth effects on consumption. In contrast, as Table 5.2 shows, young homeowners have the largest positive consumption response when house prices change, middle age homeowners have a positive consumption response but much smaller than that of young homeowners when house prices change, while old homeowners actually have a negative and significant consumption response when house prices change. The largest positive consumption response for young homeowners and the negative consumption response for old homeowners are not consistent with the wealth channel and indicate that the credit constraint channel or/and the common factor channel are more likely to explain the co-movement between house prices and consumption.

To check whether our results are reliable and to strengthen the ability of explanation for our

findings, we estimate the models with house price growth and the level of house prices.

House price growth

In Table 5.2, for young homeowners, on average, a 1% increase in house price growth is associated with a 0.04% increase in consumption. For middle age homeowners, the effect of house price growth on consumption is insignificant. For old homeowners, a 1% increase in house price growth is associated with a 0.02% decrease in consumption. The difference between house price growth effects for young homeowners and middle homeowners is insignificant. The difference between house price growth effects for young homeowners and old homeowners is also insignificant. There is significant house price growth effect difference between middle age homeowners and old homeowners. Again, from column 2, the results are almost the same, when we restrict spending to non-durable goods.

As Table 5.2 shows, when we use house price growth instead of the unexpected level of house prices, young homeowners still have the largest consumption response and old homeowners have negative consumption response. The difference is that the house price growth effect for middle homeowners is insignificant. The results are still not consistent with the direct wealth channel.

Level of house prices

We now estimate the model with the level of house prices. As Table 5.2 shows, the level of house prices effect for young homeowners and old homeowners is insignificant, but for middle age homeowners is significant but small. These results are again not consistent with direct wealth channel, because under the direct wealth channel we expect the consumption for old and middle age homeowners have significantly higher consumption responses than

young homeowners.

Table 5.2 Coefficients on different measures of house prices

	Total spending	Non-durable spending
Benchmark: unexpected house prices		
$HP^E_{it} \times Young$	0.14***	0.13***
$HP^E_{it} \times Middle$	0.05***	0.06***
$HP^E_{it} \times Old$	–0.04**	–0.03
$H^1_o : Young = Middle^{(a)}$	Reject ***	Don't reject
$H^2_o : Young = Old^{(b)}$	Reject***	Reject***
$H^3_o : Middle = Old^{(c)}$	Reject***	Reject***
House price growth		
$\triangle ln(HP_{it}) \times Young$	0.04***	0.06***
$\triangle ln(HP_{it}) \times Middle$	0.002	0.004
$\triangle ln(HP_{it}) \times Old$	–0.02**	–0.02**
$H^1_o : Young = Middle^{(a)}$	Don't reject	Don't reject
$H^2_o : Young = Old^{(b)}$	Don't reject	Don't reject
$H^3_o : Middle = Old^{(c)}$	Reject***	Reject***
Level of house prices		
$ln(HP_{it}) \times Young$	0.04	0.04
$ln(HP_{it}) \times Middle$	0.06***	0.07***
$ln(HP_{it}) \times Old$	–0.01	–0.01
$H^1_o : Young = Middle^{(a)}$	Don't reject	Don't reject
$H^2_o : Young = Old^{(b)}$	Don't reject	Don't reject
$H^3_o : Middle = Old^{(c)}$	Reject***	Reject***

Sources: HILDA Release 12.0; authors' calculations

Note: ***, ** and * indicate significance at the 1, 5 and 10 per cent level, respectively; We use F-test here.

(a) H^1_o is that home-price wealth effects for young and middle-aged homeowners are not statistically different from one another

(b)H^2_o is that home-price wealth effects for young and old homeowners are not statistically different from one another

(c)H^3_o is that home-price wealth effects for middle-aged and old homeowners are not statistically different from one another

Why do old homeowners' consumption fall?

We observe one counter-intuitive phenomenon that old homeowners' total spending decreases after a rise in house prices. When house prices rise, the costs associated with housing investment are expected to rise in future. These costs include mortgages, land tax, and council fees. Old homeowners who are close or already retired, expect a stable stream of income. Since the higher expected cost of serving the investment is not accompanied by

higher expected income, consumption for those people falls. One may argue increase in house prices may raise the rental price, thus have a higher wealth effect. However, this is not the case for Australia (kent, 2013), where the rental yield is quite stable over the past decade. If this cost story indeed drives the negative response for old homeowners, we expect to see a larger response for old non-investors than old investors.

To test this hypothesis, we generate dummies for old homeowners with and without investing in housing, and interact them with different measures of house prices. The estimates indicate that (1) for all measures of house prices, old housing investors and old homeowners without investing in housing will both have negative consumption responses when house prices increase; (2) for house price growth and the level of unexpected house prices, old investors' consumption responses are insignificant, while old non-investor have significant consumption responses; (3) for the level of house prices, both old investors and non-investors have insignificant consumption responses (see table 5.3). Although both old investors and non-investors have negative consumption responses, only old non-investors have significant negative consumption responses, thus the negative consumption responses may be contributed by old non-investors rather than old investors. Old investors are likely wealthier than old homeowners without investing in housing, so increasing costs of housing may not significantly affect their consumption.

Table 5.3 Wealth effects for old homeowners

	Level of unexpected house prices	House prices growth	Level of house prices
Old housing investors	-0.02	-0.01	-0.17
Old homeowenrs without housing investing	-0.04***	-0.03***	-0.16

Note: ***, ** and * indicate significance at the 1, 5 and 10 per cent level, respectively
Sources: HILDA Release 12.0; authors' calculations

Does moving home affect consumption?

Moving home may raise spending, especially for young homeowners, when they trade up their housing, thus we check whether results described in Table 5.2 are robust to dropping homemovers. We estimate the effects of house prices on consumption using Panel 3 defined in section 4.1.1, then compare these results with Table 5.2.

Table 5.4 shows the results without homemovers. For young non-moving homeowners, the effect of the unexpected level of house prices on consumption is insignificant. For non-moving middle age homeowners, a 1% increase in the unexpected level of house prices is associated with a 0.11% increase in consumption. For non-moving old homeowners, a 1% increase in the unexpected level of house prices is associated with a 0.04% decrease in consumption. The difference between wealth effect for young homeowners and middle age homeowners is not significant. The wealth effect difference between young homeowners and old homeowners is significant. There is a significant wealth effect difference between middle age homeowners and old homeowners. The second column shows that when we restrict spending to non-durable consumption items, the age distribution of home-price wealth effects is similar to the case when we use total spending. Comparing Table 5.4 with Table 5.2, we find that moving home only have effects on young and middle age homeowners' consumption, because after dropping homemovers, only the house price effects for young and middle age homeowners change.

In Table 5.4, the results for home price growth are similar to that of table 5.2, for non-moving homeowners. The effects of level of house prices on consumption are qualitatively similar.

Comparing table 5.4 with table 5.2, we find only young homeowners have a stronger consumption response after dropping homemovers. Thus, moving home only affects young

homeowners' consumption.

Table 5.4 Coefficients on the different measures of house prices

	Total spending	Non-durable spending
Benchmark: unexpected level of house prices		
$HP^E_{it} \times Young$	0.10	0.09
$HP^E_{it} \times Middle$	0.11***	0.1***
$HP^E_{it} \times Old$	–0.04**	–0.03
$H^1_o : Young = Middle^{(a)}$	Don't reject	Don't reject
$H^2_o : Young = Old^{(b)}$	Reject**	Reject**
$H^3_o : Middle = Old^{(c)}$	Reject***	Reject***
House price growth		
$\triangle ln(HP_{it}) \times Young$	0.07**	0.07**
$\triangle ln(HP_{it}) \times Middle$	0.007	0.001
$\triangle ln(HP_{it}) \times Old$	–0.03**	–0.03***
$H^1_o : Young = Middle^{(a)}$	Reject***	Reject**
$H^2_o : Young = Old^{(b)}$	Reject***	Reject***
$H^3_o : Middle = Old^{(c)}$	Don't reject	Don't reject
Level of house prices		
$ln(HP_{it}) \times Young$	0.17***	0.15***
$ln(HP_{it}) \times Middle$	0.07***	0.07***
$ln(HP_{it}) \times Old$	–0.02	–0.01
$H^1_o : Young = Middle^{(a)}$	Don't reject	Don't reject
$H^2_o : Young = Old^{(b)}$	Reject***	Reject***
$H^3_o : Middle = Old^{(c)}$	Reject***	Reject***

Sources: HILDA Release 12.0; authors' calculations

Note: ***, ** and * indicate significance at the 1, 5 and 10 per cent level, respectively; we use F-test here.

(a) H^1_o is that home-price wealth effects for young and middle-aged homeowners are not statistically different from one another

(b)H^2_o is that home-price wealth effects for young and old homeowners are not statistically different from one another

(c)H^3_o is that home-price wealth effects for middle-aged and old homeowners are not statistically different FROM one another

5.2.2 Hypothesis 2: Credit constraint vs. common factors

As discussed in section 2.3, the credit constraint channel and the common factor channel may both potentially explain the co-movement between house prices and consumption. To distinguish these two channels, we compare the house price effects for renters and homeowners using Panel 1 defined in section 4.1.1. Because renters cannot report the house price value, we use regional aggregate house prices (ABS regional median house price) instead

of self reported house prices in our analysis. We find renters have negative consumption responses, while homeowners have positive consumption responses, thus credit constraint channel is more plausible in explaining the co-movement between house prices and consumption.[2]

Benchmark: unexpected house prices

We use the unexpected level of house prices, as Table 5.5 shows, the unexpected level of house prices seems not to affect both renters and owners' consumption.

House price growth

As shown in Table 5.5, an increase in house price growth leads to a decrease in renters' consumption; in contrast, an increase in house price growth leads to an increase in homeowners' consumption. This result is not consistent with the common factor channel.

Level of house prices

In Table 5.5, for homeowners, on average, a 1% increase in level of house prices is associated with a 0.17% increase in consumption. For renters, a 1% increase in level of house prices is associated with a 0.51% decrease in consumption. The difference between level of house price effects for homeowners and renters is significant. From column 2, the results are almost same, when we restrict spending to non-durable goods.

As Table 5.5 shows, homeowners have a significant positive consumption response when

[2]In Panel 1, dropping households who change their homeownership tenure may cause loss of efficiency and possibility of non-representative sample problem. The results do not change qualitatively when using panel without dropping households who change homeownership tenure.

the level of house prices change, while renters have a significant negative consumption response. These results are not consistent with the common factor channel, because under the common factor channel renters and homeowners should both increase their consumption when house prices increase.

Table 5.5 Coefficients on different measures of house prices (aggregate level)

	Total spending	Non-durable spending
Benchmark: unexpected house prices		
$HP^E_{it} \times renter$	0.15	0.12
$HP^E_{it} \times owner$	0.03	0.002
$H_o : renter = owner^{(a)}$	Don't reject	Don't reject
House price growth		
$\triangle ln(HP_{it}) \times renter$	-0.15***	-0.13***
$\triangle ln(HP_{it}) \times owner$	0.06***	0.05***
$H_o : renter = owner^{(a)}$	Reject***	Reject***
Level of house prices		
$ln(HP_{it}) \times renter$	-0.51***	-0.45***
$ln(HP_{it}) \times owner$	0.17***	0.12***
$H_o : renter = owner^{(a)}$	Reject***	Reject***

Note: ***, ** and * indicate significance at the 1, 5 and 10 per cent level, respectively; we use F-test here.
(a) H_o is that home-price wealth effects for Renters and owners are not statistically different from one another

5.2.3 Hypothesis 3: Credit constraints vs. Precautionary savings

As discussed in section 2.4, if the co-movement between consumption and house prices is driven by the credit constraints channel, then consumption should respond to either expected or unexpected house price changes. Alternatively, if precautionary saving channel is the explanation, consumption would only respond to unexpected house price changes. We therefore distinguish the precautionary saving channel from the credit constraint channel by comparing the coefficients on the expected level of self-reported house prices and the unexpected level of self-reported house prices by using Panel 2. The results in Table 5.6 im-

ply the credit constraint channel is more likely to explain the co-movement between house prices and consumption.

In Table 5.6, a 1% increase in expected house prices is associated with 0.39% increase in total spending; however, a 1% increase in unexpected house prices is only associated with 0.006% increase in total spending. Expected house prices' effects are much stronger than unexpected house price's effects and unexpected house prices do not significantly affect consumption. For non-durable spending, the pattern of wealth effects are similar. These results suggest that compared with the precautionary saving explanation, the credit constraint channel is more likely to explain the co-movement between house prices and consumption.

Table 5.6 Coefficients on the unexpected level of house prices and expected level of house prices

	Total spending	Non-durable spending
Expected house prices	0.39***	0.36***
Unexpected house prices	0.006	0.009

Note: ***, ** and * indicate significance at the 1, 5 and 10 per cent level, respectively

5.3 Is pseudo-panel a good substitute for true panel?

Due to the lack of adequate actual panel data sets, many studies use pseudo-panels introduced by Deaton (1985) to study the relation between house prices and consumption. Is the pseudo-panel a good substitute for an actual panel? This section tries to answer this question.

At the cohort level, we define twelve five-year cohorts based on the birth year of head of

household from before 1926 to 1980 (see Table 5.7). By adding these cohorts, yields:

$$ln(totalspending_{it}^{c}) = \alpha_c + B'W_{it} + A'Z_i + u_{it}^{c} + E_{it} \tag{5.3}$$

where α_c are the cohort dummies that capture unobserved cohort heterogeneity, and u_{it}^{c} is household i's deviation from the cohort average. This model assumes that the age profile of spending is the same within each cohort. This model also assumes that the composite error term $u_{it}^{c} + E_{it}$ is uncorrelated with the explanatory variables.

Table 5.7 Number of households per cohort

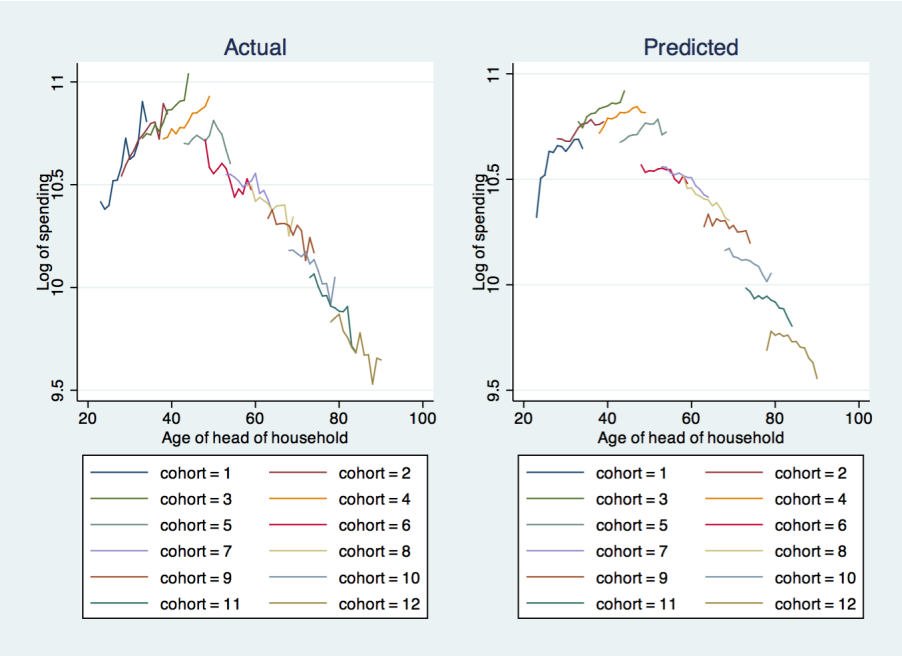
Cohort dummy	Birth year	Cohort size
Cohort 1	1976 to 1980	28
Cohort 2	1971 to 1975	89
Cohort 3	1966 to 1970	145
Cohort 4	1961 to 1965	197
Cohort 5	1956 to 1960	145
Cohort 6	1951 to 1955	132
Cohort 7	1946 to 1950	193
Cohort 8	1941 to 1945	190
Cohort 9	1936 to 1940	174
Cohort 10	1931 to 1935	152
Cohort 11	1926 to 1930	123
Cohort 12	Pre-1926	58

Sources: HILDA Release 12.0; authors' calculations

To obtain insights about the trend of the households' consumption over the life-cycle at cohort level and check whether equation 5.3 fits the data, we estimate equation 5.3 using the unexpected level of aggregate house prices with panel two and plot the predicted and actual spending by age within the birth cohort. In Figure 5.1, at cohort level, the life cycle model still follows a bell-shape and in Figure 5.2, we can see equation 5.3 fits the data well.

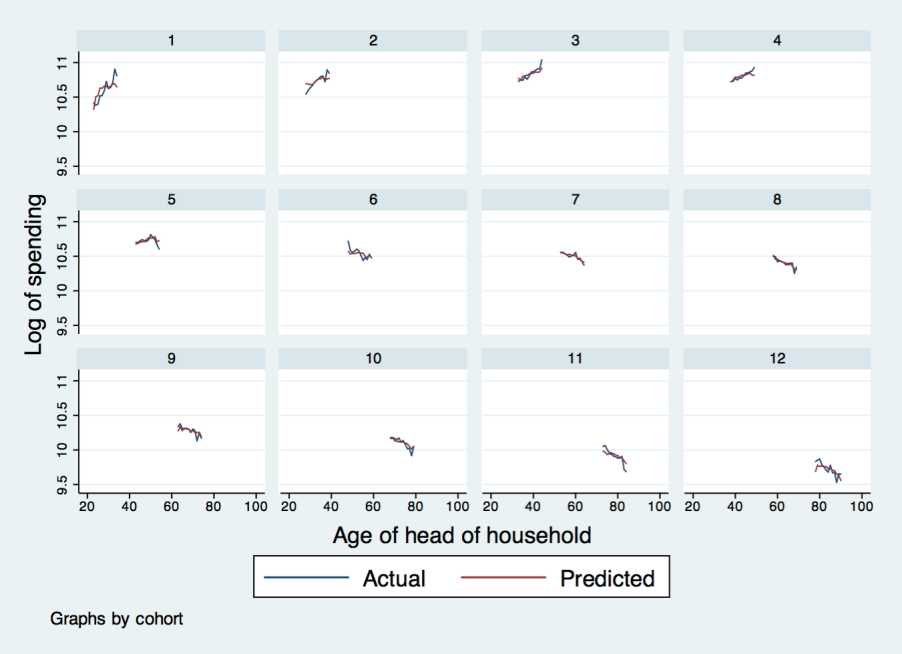
If we use the unexplained component of self-reported house prices in this model, the estimation results may be biased, because the cohort dummies α_c and household i's deviation from the cohort average u_{it}^{c} may be correlated with self-reported home prices. Considering

Fig. 5.1 Real household spending (by age within birth cohort)



*Soure:*HILDA Release 12.0; authors' calculations

Fig. 5.2 Real household spending(predicted vs actual spending)



*Soure:*HILDA Release 12.0; authors' calculations

this problem, we also use aggregate regional house prices, because using the unexplained component of aggregate house prices at the regional level can break the link between household's home prices and any unobserved household heterogeneity.

Pseudo panels are widely used in case where true panels are not available, while whether pseudo panels are good substitutes for actual panels still remains investigating. We expect that the housing wealth effects for pseudo panels and actual panels are similar, if pseudo panels are good substitutes for actual panels. The results in Table 5.8 show the age patterns of consumption responses at both cohort level and household level are similar, thus pseudo-panel can be a good substitute for true panel.

With homemovers

In Table 5.8, coefficients on self-reported home prices at cohort level are similar across ages. These results are different from those of Table 5.2, coefficients for all age groups increase and the consumption response of young homeowners become significant. However, these results are likely biased. In the second column of Table 5.8, we use aggregate regional house prices instead of self-reported house prices. Comparing results in the second column with results in third column, we find that the pattern of home-price wealth effects obtained from cohort level regression is similar to that obtained from household-level regression but weaker. Middle age homeowners have the largest consumption response and old homeowners have a negative consumption response. This suggests that pseudo panels may be a reasonably good substitute for actual panels. However, it should be noted that point estimates of home-price wealth effects for different age groups are less precise at the cohort level. For all three age groups, house price wealth effects are not significantly different. Compared with Table 5.2, the third column of Table 5.8 also shows that using aggregate home prices tends to inflate the house price wealth effects on consumption.

Without homemovers

In Table 5.8, at cohort level, we find after dropping homemovers, the wealth effects become stronger and again the pattern of house price wealth effects at cohort level is similar to the pattern of house price wealth effects at household level.

Table 5.8 Cohort-level wealth effects by age

		Cohort regression	Household-level regression
	Self-assessed home prices	Aggregate home prices	Aggregate home prices
With homemovers			
Young	0.14***	0.06	0.18**
Middle	0.14***	0.13	0.24***
Old	0.10***	-0.02	-0.08
$H_o^1 : Young = Middle^{(a)}$	Don't reject	Don't reject	Don't reject
$H_o^2 : Young = Old^{(b)}$	Don't reject	Don't reject	Reject***
$H_o^3 : Middle = Old^{(c)}$	Don't reject	Don't reject	Reject***
Without homemovers			
Young	0.06	0.25***	0.34**
Middle	0.12***	0.21	0.28***
Old	0.12***	0.04	-0.07
$H_o^1 : Young = Middle^{(a)}$	Don't reject	Don't reject	Don't reject
$H_o^2 : Young = Old^{(b)}$	Don't reject	Don't reject	Reject***
$H_o^3 : Middle = Old^{(c)}$	Don't reject	Reject***	Reject***

Note: ***, ** and * indicate significance at the 1, 5 and 10 per cent level, respectively; we use F-test here.
(a) H_o^1 is that home-price wealth effects for young and middle-aged homeowners are not statistically different from one another.
(b)H_o^2 is that home-price wealth effects for young and old homeowners are not statistically different from one another.
(c)H_o^3 is that home-price wealth effects for middle-aged and old homeowners are not statistically different from one another.
Sources: HILDA Release 12.0; authors' calculations

Chapter 6

Conclusion

We use the HILDA survey to investigate the relationship between home prices and households' consumption in Australia. We distinguish four alternative channels in the literature to explain this co-movement : (1) the wealth effect channel, (2) the credit constraints channel, (3) the common factor channel, and (4) precautionary saving channel.

Our analysis suggests that the credit constraint channel is the most likely explanation for the close co-movement between house prices and consumption among the four alternative channels. In particular, we find that the spending by young households, who are more credit constrained is more responsive to changes in home prices than that of old households. This finding is not consistent with the direct wealth effect channel which indicates house-price wealth effect should be stronger for old households, who likely own more housing and are more likely to trade down their housing. We also find that renters (homeowners) decrease (increase) their consumption in response to increases in house prices. This finding is against the explanation of a common factor, since renters and homeowners should both increase their consumption when expected future incomes increase. We find that households' consumption only respond to changes in expected house prices. This finding is not consis-

tent with precautionary saving channel, since the precautionary saving channel predict that consumption only responds to changes in unexpected house prices.

These findings have several implications: (1) the co-movements between house prices and consumption are mainly contributed by the the young households' strong consumption responses to changes in house prices, as the Australian population ages, the link between house prices and consumption may become weaker in the future; (2) Australian experienced rapid increases in house prices even after 2008, however, if Australian house prices drop sharply in the future, decreases in house prices will tighten the credit constraints of households, and therefore, reduce their consumption. This calls for careful government policies to maintain a stable growth in house prices, given a relatively high oversea demand; (3) Our findings support the credit constraint channel of monetary policy. If RBA increases (decreases) interest rate, we should expect consumption to fall (raise) due to tightening (loosening) credit constraints.

We not only distinguish the four main channels but also explore the relationship between house prices and consumption in other aspects. We find that the effects of housing wealth on consumption are much higher than that of financial assets wealth on consumption. We find moving home obviously affects young homeowners, but for the middle age and old homeowners, the effects of moving home are not obvious. To check whether pseudo-panels are reliable for analysing the relationship between house prices and consumption, we investigate this relationship at both cohort and household level. We find that household-level and cohort regressions imply similar patterns of spending reactions in response to a change in home prices. This suggests that pseudo-panels are a reasonably good substitute for actual panels. We also find that using aggregate home prices in pseudo-panels seem to inflate estimated wealth effects.

The HILDA survey does not record enough information about discretionary spending, bequest motive, whether households refinance their housing wealth; therefore, tests for distinguishing precautionary saving channel from credit constraint channel, such as comparing households' consumption responses between discretionary and non-discretionary spending, and comparing consumption responses between households with or without refinancing their housing wealth, cannot be implemented; Hence, we cannot explore how bequest motive affects the co-movement between house prices and consumption. The effects of precautionary saving and bequest motives on consumption due to changes in house prices remain to be further investigated.

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Appendix A

Regression output–home-price model

Table A1 Home-price model (Panel 2)

Parameters	Coefficient	Parameters	Coefficient
age	0.491***	8	0.133***
age^2	-0.016***	9	0.136***
age^3	0.000***	10	0.146***
age^4	-0.000**	11	0.173***
age^5	0.000**	12	0.151***
ur_t	-0.030***	13	0.200***
$\triangle ir$	-0.053***		
Dummy: log real financial asset vigintile:			
1	0.000	14	0.212***
2	0.057***	15	0.202***
3	0.035*	16	0.205***
4	0.043**	17	0.261***
5	0.080***	18	0.252***
6	0.143***	19	0.345***
7	0.120***	20	0.431***
Constants	7.684***		
Number of observation	16259		
Adjusted R^2	0.535		

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: HILDA 12.0

Appendix B

Regression output–wealth effects

Table B1 Household-level wealth effects (Panel 1)

(Continued next page)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
No of adults	0.143***	0.143***	0.143***	0.152***	0.151***	0.151***
No of children	0.155***	0.156***	0.156***	0.159***	0.160***	0.160***
(age 0-14)						
Dummy	0.097***	0.102***	0.103***	0.100***	0.104***	0.105***
(More than 2 adults)						
$ln(HP_{it}) \times Renter$	-0.508***			-0.454***		
$ln(HP_{it}) \times Owners$	0.170***			0.117***		
$\triangle ln(HP_{it}) \times Renters$		-0.145***			-0.130***	
$\triangle ln(HP_{it}) \times Owners$		0.059***			0.046**	
$HP^{E}_{it} \times renter$			0.160			0.126
$HP^{E}_{it} \times Owners$			0.033			0.000

Table B1 Household-level wealth effects (Panel 1)

(Continued)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
$ln(HHDY_{it})$	0.011**	0.011**	0.011**	0.006	0.006	0.006
$ln(FA_{it})$	0.015***	0.013***	0.013***	0.011***	0.010**	0.010**
Constants	8.952***	9.748***	9.748***	9.347***	9.686***	9.685***
Number of observation	19334	19333	19334	19335	19334	19335
Adjusted R^2	0.027	0.022	0.021	0.028	0.024	0.023

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Model 1: With self-reported home values by homeownership

Model 2: With house price growth by homeownership

Model 3: With unexplained self-reported home values by homeownership

Model 4:With self-reported home values by homeownership (non-durable spending)

Model 5: With house price growth by homeownership (non-durable spending)

Model 6: With unexplained self-reported home values by homeownership (non-durable spending)

Dummies for year and region omitted

Source: HILDA 12.0

Table B2 Household-level wealth effects (Panel 2)

(Continued next page)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
No of adults	0.127***	0.128***	0.125***	0.128***	0.128***	0.113***	0.128***
No of children (age 0-14)	0.141***	0.140***	0.137***	0.142***	0.140***	0.134***	0.143***
Dummy (more than 2 adults)	0.112***	0.110***	0.109***	0.114***	0.110***	0.111***	0.114***
$ln(HP_{it})$	0.042***						
$ln(HHDY_{it})$	0.013***	0.013***	0.013***	0.013***	0.013***	0.008*	0.013***
$ln(FA_{it})$	0.012**	0.010**	0.013**	0.013**	0.010**	0.002	0.013**
$ln(HP_{it}) \times Young$		0.041			0.041		
$ln(HP_{it}) \times Middle$		0.061***			0.061***		
$ln(HP_{it}) \times Old$		-0.014					
$HP^{E}_{it} \times Young$			0.143***				
$HP^{E}_{it} \times Middle$			0.052**				
$HP^{E}_{it} \times Old$			-0.036*				
$\triangle ln(HP_{it}) \times Young$				0.036**			
$\triangle ln(HP_{it}) \times Middle$				0.002			
$\triangle ln(HP_{it}) \times Old$				-0.015***			

Table B2 Household-level wealth effects (Panel 2)

(Continued)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
$ln(HP_{it}) \times Old$					-0.171		
(invested)							
$ln(HP_{it}) \times Old$					-0.163		
(non-invested)							
HP_{it}^{hat}						0.392***	
HP_{it}^{E}							0.006
Constants	9.346***	9.707***	9.871***	9.855***	9.707***	6.332***	9.855***
Number of observation	16258	16258	16258	16257	16258	16258	16258
Adjusted R^2	0.024	0.024	0.025	0.024	0.024	0.027	0.023

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Model 1: with self-reported home values and financial asset

Model 2: With self-reported home values by age

Model 3: With unexplained self-reported home values by age

Model 4: With house price growth by age

Model 5: With self-reported home values by old investors and non-investors

Model 6: With predicted self-reported home values

Model 7: With unexplained self-reported home values

Dummies for year and region omitted

Source: HILDA 12.0

Table B3 Household-level wealth effects with excluding durable spending (Panel 2)
(Continued next page)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
No of adults	0.140***	0.142***	0.139***	0.141***	0.128***	0.141***
No of children(age 0-14)	0.150***	0.149***	0.146***	0.151***	0.143***	0.151***
Dummy:more than 2 adults	0.113***	0.110***	0.110***	0.114***	0.112***	0.114***
$ln(HP_{it})$	0.042***					
$ln(HHDY_{it})$	0.008*	0.008*	0.008*	0.008*	0.003	0.008*
$ln(FA_{it})$	0.008	0.006	0.008*	0.008*	-0.001	0.009*
$ln(HP_{it}) \times Young$		0.036				
$ln(HP_{it}) \times Middle$		0.067***				
$ln(HP_{it}) \times Old$		-0.012				
$HP^{E}_{it} \times Young$			0.130***			
$HP^{E}_{it} \times Middle$			0.058**			
$HP^{E}_{it} \times Old$			-0.030*			
$\triangle ln(HP_{it}) \times Young$				0.055***		
$\triangle ln(HP_{it}) \times Middle$				0.004		
$\triangle ln(HP_{it}) \times Old$				-0.021**		

Table B3 Household-level wealth effects with excluding durable spending(Panel 2)

(Continued)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
HP_{it}^{hat}					0.364***	
HP_{it}^{E}						0.009
Constants	9.274***	9.603***	9.796***	9.783***	6.668***	9.781***
Number of observation	16259	16259	16259	16258	16259	16259
Adjusted R^2	0.026	0.026	0.026	0.026	0.029	0.025

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Model 1: with self-reported home values and financial asset

Model 2: With self-reported home values by age

Model 3: With unexplained self-reported home values by age

Model 4: With house price growth by age

Model 5: With predicted self-reported home values

Model 6: With unexplained self-reported home values

Dummies for year and region omitted

Source: HILDA 12.0

Table B4 Household-level wealth effects (Panel 3)

(Continued next page)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
No of adults	0.125***	0.128***	0.129***	0.139***	0.141***	0.143***
No of children	0.131***	0.138***	0.140***	0.141***	0.147***	0.149***
(age 0-14)						
Dummy	0.119***	0.120***	0.124***	0.117***	0.117***	0.122***
(more than 2 adults)						
$ln(HP_{it}) \times Young$	0.172**			0.150**		
$ln(HP_{it}) \times Middle$	0.071***			0.074***		
$ln(HP_{it}) \times Old$	-0.016			-0.013		
$HP^{E}_{it} \times Young$		0.100			0.087	
$HP^{E}_{it} \times Middle$		0.105***			0.108***	
$HP^{E}_{it} \times Old$		-0.038*			-0.033	
$\triangle ln(HP_{it}) \times Young$			0.074*			0.067*
$\triangle ln(HP_{it}) \times Middle$			-0.007			-0.001
$\triangle ln(HP_{it}) \times Old$			-0.028***			-0.028***

Table B4 Household-level wealth effects (Panel 3)

(Continued)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
$ln(HHDY_{it})$	0.017***	0.017***	0.017***	0.009**	0.010**	0.010**
$ln(FA_{it})$	0.011**	0.014**	0.015**	0.007	0.011	0.011*
Constants	9.519***	9.766***	9.755***	9.451***	9.715***	9.706***
Number of observation	11330	11330	11329	11331	11331	11330
Adjusted R^2	0.025	0.025	0.024	0.026	0.025	0.024

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Model 1: With self-reported home values by age

Model 2: With unexplained self-reported home values by age

Model 3: With house price growth by age

Model 4: With self-reported home values by age (non-durable spending)

Model 5: With unexplained self-reported home values by age (non-durable spending)

Model 6: With house price growth by age (non-durable spending)

Source: HILDA 12.0

Appendix C

Cohort-level wealth effects

Table C1 Cohort-level wealth effects

(Continued next page)

	Model 1	Model 2
Dummy:more than 2 adults	-0.170***	-0.169***
No of adults	0.257***	0.266***
No of children(age 0-14)	0.077***	0.086***
Cohort 1 (Dummy)	0.476***	0.334***
Cohort 2 (Dummy)	0.495***	0.404***
Cohort 3 (Dummy)	0.518***	0.487***
Cohort 4 (Dummy)	0.506***	0.493***
Cohort 5 (Dummy)	0.466***	0.425***
Cohort 6 (Dummy)	0.428***	0.408***
Cohort 7 (Dummy)	0.527***	0.501***
Cohort 8 (Dummy)	0.466***	0.433***
Cohort 9 (Dummy)	0.392***	0.374***
Cohort 10 (Dummy)	0.285***	0.239***
Cohort 11 (Dummy)	0.165***	0.138***
Postgraduate (Dummy)	0.200***	0.202***
Graduate (Dummy)	0.132***	0.134***
Bachelor (Dummy)	0.150***	0.160***
diploma (Dummy)	0.120***	0.136***

Table C1 Cohort-level wealth effects

(Continued)

	Model 1	Model 2
occ certificate (Dummy)	0.076***	0.059**
Year 12 (Dummy)	0.010	-0.027
$ln(FA_{it})$	0.053***	0.046***
$ln(HHDY_{it})$	0.051***	0.045***
$HP^E_{it} \times Young$	0.058	0.248***
$HP^E_{it} \times Middle$	0.126	0.213
$HP^E_{it} \times Old$	-0.019	0.035
Constants	8.212***	8.365***
Number of observation	13007	9071
Adjusted R^2	0.443	0.453

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Model 1: With homemovers

Model 2: Without homemovers

Source: HILDA 12.0