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Gianni La Cava, Helen Hughson and
Greg Kaplan

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Enquiries:

Phone: +61 2 9551 9830
Facsimile: +61 2 9551 8033
Email: rbainfo@rba.gov.au
Website: http://www.rba.gov.au

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Authors: lacavag at domain rba.gov.au and gkaplan at domain uchicago.edu

Media Office: rbainfo@rba.gov.au

Abstract

We explore whether changes in interest rates affect household consumption by changing the amount of cash that households have to spend – the household cash flow channel of monetary policy.

Based on a panel of Australian households, we find that, when interest rates decline, the cash flows and durable goods spending of households with variable-rate mortgage debt increases relative to comparable fixed-rate borrowers. This is consistent with a 'borrower' cash flow channel. We also find that lower interest rates reduce the cash flows available to households that receive interest on bank deposits and that this, in turn, is associated with lower spending by these households. This is consistent with a 'lender' cash flow channel.

Overall, the borrower channel is a stronger channel of monetary transmission than the lender channel, such that lower interest rates will typically increase household cash flows and lead to higher spending in aggregate. The central estimates imply that lowering interest rates by 100 basis points would be associated with an increase in aggregate household expenditure of about 0.1 to 0.2 per cent per annum. Overall, the household cash flow channel appears to be an important channel of monetary transmission in Australia.

JEL Classification Numbers: D31, E21, E52

Keywords: cash flow, consumption, liquidity constraints, monetary policy, mortgage debt

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1. Introduction

Changes in monetary policy directly affect the household sector through several channels. Lower interest rates can encourage households to save less and bring forward consumption from the future to the present (the intertemporal substitution channel). Lower interest rates can also lift asset prices, such as housing prices, and the resulting increase in household wealth may encourage households to spend more (the wealth channel). Additionally, lower interest rates reduce the interest payments of borrowing households with variable-rate debt, resulting in higher cash flows and potentially more spending, particularly for households that are constrained by the amount of cash they have available (the borrower cash flow channel). At the same time, lower interest rates can reduce the interest earnings of lending households, which may in turn lead to lower cash flows and less spending for these households (the lender cash flow channel). These last two channels together will be referred to as 'the household cash flow channel' in this paper.

This paper explores whether a household cash flow channel of monetary policy exists in Australia. The analysis focuses on a fairly narrow definition of the cash flow channel. It examines the direct effects of interest rates on interest income and expenses, but abstracts from monetary policy changes that have an indirect cash flow effect by influencing other sources of income, such as labour or business income. Auclert (2016) provides a theoretical framework for considering the indirect cash flow effects of interest rate changes.

Two important concepts that will be used throughout the paper are 'interest-earning liquid assets' and 'variable-rate debt'. Interest-earning liquid assets are defined as assets that have income streams that are directly tied to interest rates and which are easily convertible to cash. For households, this is mainly savings deposits. Variable-rate (or floating-rate) debt is debt that has a repayment stream that is directly linked to interest rates with these repayments effectively repricing with the cash rate. This is mainly variable-rate home mortgage debt. Using this classification, a net borrower (lender) is a household that holds more (less) variable-rate debt than interest-earning liquid assets. The income flows that are associated with both interest-earning liquid assets and variable-rate debt will be referred to as 'interest-sensitive cash flows'.

Broadly speaking, the household cash flow channel consists of three stages. First, changes in the cash rate are transmitted to changes in the lending and deposit rates faced by households. Second, changes in household lending and deposit rates flow through to changes in household cash flows by changing the required repayments of borrowing households and the net interest earnings of lending households. Third, changes in cash flows can affect household spending, particularly for households that are constrained by the amount of available cash ('liquidity constrained'). This paper focuses on the latter two stages; other recent publications discuss how changes in the cash rate are transmitted to the interest rates faced by households (e.g. Wilkins, Gardner and Chapman 2016).

The cash flow channel has been described in journal articles (e.g. Mishkin 1996), speeches (e.g. Kent 2015) and public commentary (e.g. Janda 2015; Mulligan 2015; Rolfe 2015). Despite its intuitive appeal, to date there has been little formal research into the existence of the household cash flow channel, either in Australia or overseas. We make four main contributions to this new literature.

First, our identification strategy deals with the difficult practical problem of separating the cash flow channel from the other monetary transmission channels, such as the intertemporal substitution and wealth channels. To isolate the cash flow channel for borrowers we adopt a quasi-experimental research design based on the sharp decline in interest rates at the onset of the global financial crisis. Specifically, we exploit the fact that short-term interest rate changes should have a more immediate (and larger) effect on the cash flows of households with variable-rate debt than on the cash flows for comparable households with fixed-rate debt. In effect, if the cash flow channel exists, a cut in interest rates should lead to lower interest repayments and a corresponding increase in cash flows and spending for variable-rate borrowers, relative to fixed-rate borrowers.

Cloyne, Ferreira and Surico (2015) take a similar approach in comparing the responses of mortgagor households in the United Kingdom and the United States following a monetary policy shock. Their identification strategy relies on the fact that most UK mortgages are at variable rates, while most US mortgages are at fixed rates. They argue that the consumption and cash flow response of mortgagor households should be stronger in the United Kingdom than the United States if there is a cash flow channel. However, differences in macroeconomic conditions between the United States and United Kingdom could drive any observed differences in the correlation between household cash flows and expenditure across the two countries. By exploiting variation between fixed-rate and variable-rate households *within the same mortgage market*, we are able to better control for unobserved characteristics that might drive a differential response to interest rate shocks for reasons other than the cash flow channel.[1]

Flodén *et al* (2016) study the cash flow channel in Sweden using administrative data. They show that interest rate shocks affect the cash flows of households with variable-rate mortgage debt and that this, in turn, has a strong effect on their spending. They find a marginal propensity to consume out of cash flows that is equal to (or greater than) unity. Despite having a very rich dataset, they do not exploit the differential responses of variable-rate and fixed-rate borrowers to interest rate changes. Arguably, the results are potentially driven by the other channels of monetary policy.

Second, we explore the quantitative importance of *both* the borrower and lender channels. There are a handful of studies that examine the borrower cash flow channel. For instance, Di Maggio, Kermani and Ramcharan (2014) and Keys *et al* (2014) exploit differences across mortgagor households in the timing of mortgage rate resets to identify the effect of anticipated interest rate changes on household spending and debt repayment in the United States. They find that households spend some of the extra income after a cut in mortgage rates (but also pay down more debt). This is evidence in favour of a borrower cash flow channel.

In contrast, there is virtually no research on the lender cash flow channel.[2] Previous research may provide a poor guide to the importance of the aggregate cash flow channel to the extent that the

1 Wong (2015) finds that young borrowers in the United States are more responsive to monetary policy shocks than older households, and that this consumption response is driven by home owners who refinance or take on new loans when interest rates fall.

2 For the United Kingdom, there is some survey-based research indicating that lenders are much less sensitive to changes in interest rates than borrowers (Anderson *et al* 2014). For Australia, previous research has shown that the marginal propensity to consume out of interest-earning assets is small or zero (Connolly, Fleming and Jääskelä 2012). However, this estimate is better attributed to the wealth channel than the cash flow channel *per se*.

lender channel is ignored. For instance, if there are more lenders than borrowers in the economy and/or lenders have a higher propensity to consume out of cash flows than borrowers, then lower interest rates may have a negative effect on household cash flows overall and lead to less spending in aggregate.[3]

Third, we highlight the role of mortgage prepayment behaviour in affecting the sensitivity of the economy to changes in monetary policy via the cash flow channel. Australia has a relatively high share of borrowers with variable-rate mortgage debt by international standards (at around 80 per cent of all mortgages). This suggests that it should be an important channel of monetary transmission (and may explain why it receives so much media attention).

However, there are institutional features of the Australian mortgage market that complicate the links between interest rates, mortgage repayments and cash flows. In Australia, variable-rate mortgage borrowers can prepay their mortgages without penalty. So when mortgage lending rates fall, some variable-rate mortgage borrowers may choose to maintain their existing level of repayments rather than make the lower required mortgage repayments. For these households, the cash flows available for spending on goods and services are unchanged despite lower interest rates. In effect, any interest rate-induced change in cash flows is absorbed by changes in saving in the form of excess repayments (the difference between what they are required to pay and actually pay). The ability of households to 'smooth' their cash flows in the face of interest rate fluctuations by adjusting excess repayments may reduce the potency of the cash flow channel of monetary policy.

This paper contributes to the literature that highlights the importance of the mortgage market for monetary policy. According to standard New Keynesian models, central banks can affect the real economy by changing nominal interest rates because prices are sticky in the short run (e.g. Woodford 2003; Galí 2008). But a recent strand of the literature has shown that changes in nominal interest rates can have real effects even when prices are not sticky because of the presence of nominal debt contracts in the economy (e.g. Doepke and Schneider 2006; Sheedy 2014; Garriga, Kydland and Šustek 2015; Sterk and Tenreyro 2016). Mortgage debt contracts specify cash flows between borrowers and lenders in nominal terms. To the extent that monetary policy affects inflation, it will affect the real value of these payments and, under incomplete asset markets, the disposable income of borrowers and lenders (Garriga, Kydland and Šustek 2016). This, in turn, will have aggregate effects to the extent that the marginal propensity to consume (MPC) out of disposable income differs for borrowers and lenders (Auclert 2016). We provide direct evidence for this in the context of Australia.

Along similar lines, this paper contributes to a new and growing literature on the distributional effects of monetary policy (e.g. Coibion *et al* 2012; Doepke, Schneider and Selezneva 2015; Auclert 2016; Broer *et al* 2016). The cash flow channel is a key channel through which changes in interest rates affect the income flows associated with assets and debt. To the extent that interest-

3 Our research is also related to a branch of the literature that examines the correlation between consumption and the *stock* of debt (or leverage). These studies are typically motivated by the observation that, following the global financial crisis, many households 'deleveraged' by increasing their saving and repairing their balance sheets rather than spending. These studies typically find that the households that were most indebted prior to the crisis were those that reduced consumption the most during the crisis (e.g. Mian and Sufi 2010; Dynan 2012; Andersen, Duus and Jensen 2014; Bunn and Rostom 2014). While we take a different approach, we find little evidence to suggest that leverage matters directly to household spending in Australia once we control for other factors.

earning assets and debt are not distributed equally across households, changes in monetary policy can directly affect the income distribution, at least in the short term, through this channel.

Finally, we also contribute to the existing literature by providing new estimates of liquidity-constrained households and assessing how the existence of such households affects the potency of monetary policy. A vast array of studies have examined how liquidity constraints affect the sensitivity of the economy to fiscal policy changes. By comparison, there has been very little research into the importance of liquidity constraints in affecting how the economy responds to monetary policy shocks.[4]

Kaplan, Violante and Weidner (2014) introduce a theoretical framework in which the consumption of some households may be very sensitive to shocks to current income despite relatively high levels of net wealth. The key insight is that some households hold wealth in the form of illiquid assets, such as housing, and still act as if they are constrained because their liquid asset holdings are low. As such, these households may adjust their spending even in response to transitory (and predictable) income changes. We apply this framework to the Australian data and examine whether the spending of households that are estimated to be liquidity constrained (or 'hand-to-mouth') is more sensitive to cash flows than other households.

To preview our key results – we find that:

- The expenditure of variable-rate mortgage borrowers is more responsive than that of fixed-rate borrowers to changes in interest-sensitive cash flows. This evidence suggests that some of the effect of interest rates on spending is due to a cash flow channel rather than an alternative channel of monetary transmission.

- We find evidence for both the borrower and lender channels but the borrower cash flow channel is a stronger channel of monetary transmission. This is because:

    - borrowers hold two to three times as much net debt as lenders hold in net interest-earning liquid assets, implying that the cash flow of borrowers is more sensitive to interest rates

    - the spending of borrowers is at least twice as sensitive as that of lenders to a given change in interest-sensitive cash flows.

- The household cash flow channel is reasonably strong at an aggregate level, with a 100 basis point reduction in interest rates being associated with a 0.1 to 0.2 per cent increase in household spending. This is within the range of estimates produced by a number of

4 More generally, we contribute to the literature documenting the significant heterogeneity in the sensitivity of household consumption to income shocks. Several studies have shown that the consumption response to income varies depending on the type of household and the type of income. For example, Jappelli and Pistaferri (2014) document significant heterogeneity in MPCs amongst Italian households, based on households' stated intention to spend unexpected bonuses. Estimated MPCs tended to be negatively correlated with cash-on-hand and credit constraints, and positively correlated with unemployment and retirement. Misra and Surico (2014) find that almost half of American households did not have a consumption response significantly different to zero following tax rebates intended to stimulate the economy, while a smaller number (generally low-income households) responded quite strongly. In a related area, Mian, Rao and Sufi (2013) and Mian and Sufi (2014) chronicle heterogeneity in marginal propensities to borrow and spend out of housing wealth across the income distribution.

macroeconomic models that assess the effect of an exogenous change in the cash rate on household consumption in Australia, including through other channels and second-round effects.[5]

2. Stylised Facts

This paper attempts to identify the household cash flow channel by focusing on a sample period around the global financial crisis. To set the scene, it is useful to briefly consider how interest rates, cash flows and household spending evolved in Australia through this period.

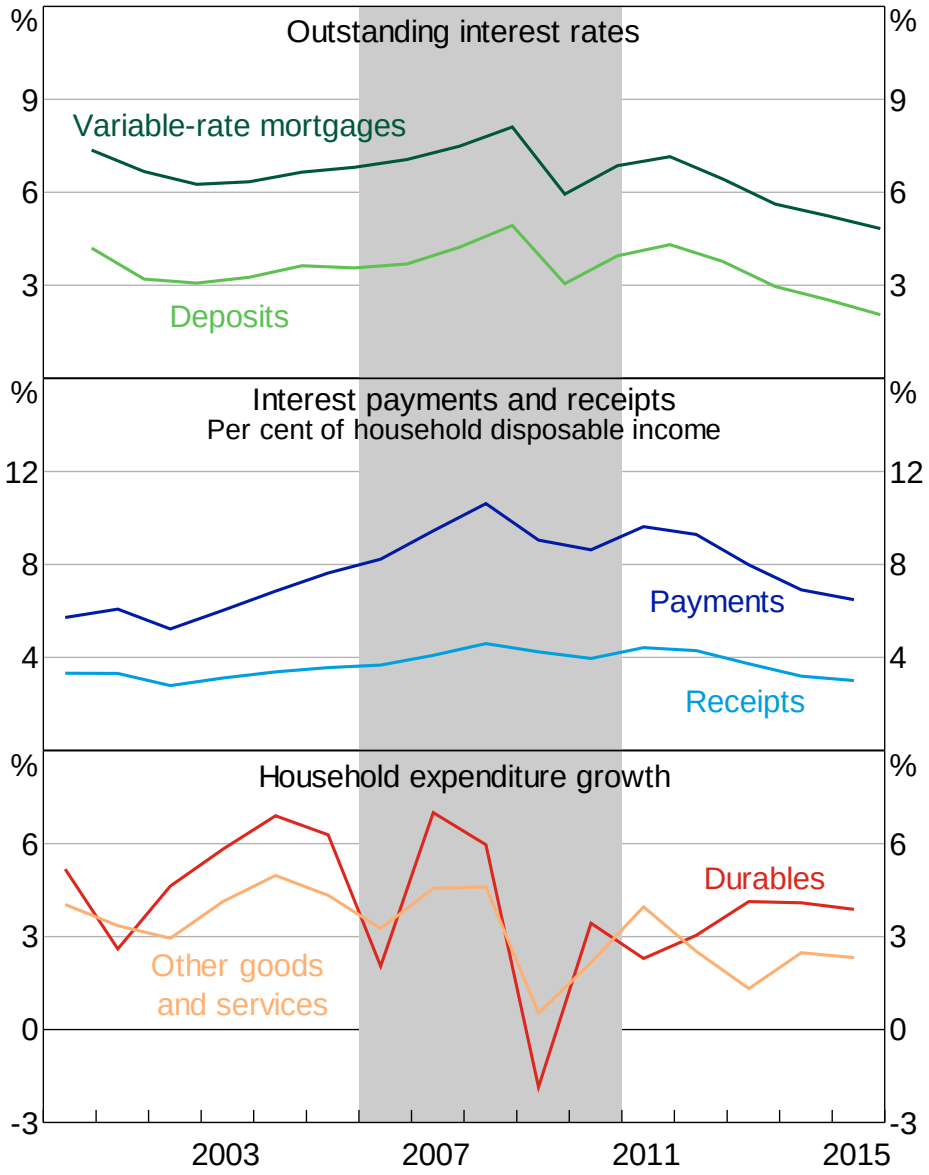
From the early 2000s until the global financial crisis in 2008–09, the Australian economy was growing at an above-trend pace and interest rates on both mortgages and deposits were rising (top panel of Figure 1). Consistent with this, household interest payments and receipts were rising as a share of household disposable income (middle panel of Figure 1). At the same time, expenditure on durable goods was growing relatively strongly (bottom panel of Figure 1).

With the onset of the crisis, monetary policy was eased and interest rates fell sharply, directly contributing to a decline in interest payments and, to a lesser extent, interest receipts (as a share of income). This should have resulted in higher cash flows for the average borrowing household and lower cash flows for the average lending household. As the crisis hit, the growth of household durable goods expenditure declined noticeably. However, within a couple of years, growth in expenditure on durable goods recovered to some extent and interest rates also began to rise again.

This cyclical variation in interest rates, cash flows and spending will be important in pinning down the household cash flow channel of monetary policy. But for this we need household-level data, which is discussed in the next section.

5 For example, see Lawson and Rees (2008), Jääskelä and Nimark (2011) and Rees, Smith and Hall (2016).

Figure 1: Interest Rates, Interest-sensitive Cash Flows and Spending



Notes: Household disposable income is before the deduction of interest payments, estimates from the annual national accounts (ABS Cat No 5204.0); shaded areas indicate the sample period from 2006 to 2010

Sources: ABS; Authors' calculations; RBA

3. Data

To identify the household cash flow channel, we need household-level information on consumption expenditure, cash flows, liquid assets and debt. We obtain this information from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. This is a nationally representative household-based longitudinal study undertaken annually since 2001. The survey tracks individuals over time and provides detailed information on various household characteristics.

A relative advantage of the HILDA Survey compared to most other international household surveys is the availability of detailed longitudinal data on each of spending, income and wealth. Most household surveys require at least one of these items to be imputed or estimated. Saying that, the

HILDA Survey data are only available at an annual frequency, which hinders our ability to identify the effect of monetary policy changes, which are likely to occur on a more regular (monthly) basis.

3.1 Household Consumption Expenditure

The HILDA Survey has been collecting detailed information on non-durable goods and services expenditure since at least 2006. For a shorter period of time (from 2006 to 2010), the survey also collected information on durable goods expenditure (e.g. cars, computers and audio visual equipment).[6] The classification of expenditures is shown in Table 1.

Table 1: Household Expenditures in the HILDA Survey

Non-durables expenditure	Durables expenditure
Groceries	Motor vehicle purchases
Alcohol and tobacco	Computers and related services
Meals eaten out	Audio visual equipment
Public transport and taxis	Household appliances
Clothing and footwear	Furniture
Motor vehicle fuel and maintenance	Holiday travel
Home repairs, renovation and maintenance	
Healthcare fees and products	
Utilities	
Telecommunications	
Education fees	
Insurance	

Source: HILDA Survey Release 14.0

The analysis in this paper focuses on durables expenditure. This is because the cash flow channel in Australia appears to mainly operate through expenditure on durable goods.[7] Expenditure on durables is typically more discretionary and sensitive to changes in interest rates than expenditure on non-durable goods and services. The period in which the durable spending data are available is relatively short in spanning five years. However, it covers the global financial crisis period and hence captures some important cyclical fluctuations in interest rates, income and spending.

In theory, the household cash flow channel links changes in *real* household spending to changes in *nominal* interest rates and cash flows. Ideally, we would have household-level information on real spending. However, this kind of information is very rare in household-level datasets. Like almost all micro data studies, we instead rely on nominal spending data to identify the cash flow channel.

This is unlikely to be a serious limitation for the analysis. The identification of the aggregate cash flow channel relies on differences in the MPC for borrowers and lenders. For the distinction between real and nominal spending to matter, the response of durable goods prices to interest rate changes needs to be very different for borrowers and lenders. Recent research has shown

6 These items could be described as 'discretionary' rather than durable, as some services, such as holiday expenditures, are included. However, these items make up a small share of overall expenditure in the HILDA Survey.

7 Unreported estimates indicate that there is basically no correlation between interest-sensitive cash flows and expenditure on non-durable goods and services.

that there is significant heterogeneity in the inflation rates faced by different households (Kaplan and Schulhofer-Wohl 2016). However, these cross-sectional differences are largely constant over time and unresponsive to macroeconomic shocks, such as a change in monetary policy.[8]

3.2 Household Cash Flows

The HILDA Survey provides a measure of total disposable (or after-tax) income (Y^D). This is equal to: 1) interest receipts (i.e. the income flows from holdings of interest-earning assets, such as deposits, (IR)) plus 2) other types of income, such as wages, business income, pensions (Y^O) less 3) taxes (T):

$$Y^D \equiv IR + Y^O - T$$

To construct the preferred estimate of household 'cash flows' (Y^{CF}), required mortgage repayments (M) are deducted from after-tax income:

$$Y^{CF} \equiv Y^D - M \equiv IR + Y^O - T - M$$

This measure of household cash flows is a measure of income after taxes *and* required mortgage repayments.[9] In the econometric analysis it will be helpful to separately identify the components of cash flows that are directly sensitive to interest rates. This will be referred to as 'interest-sensitive cash flows' (Y^{ICF}). For borrowers, this relates to required mortgage repayments (M). For lenders, it relates to interest receipts (IR). The remainder of household cash flows will be referred to as 'other cash flows'.

The preferred measure of household cash flows subtracts required mortgage repayments from after-tax income. This requires estimates of the mortgage repayments of each household in the HILDA Survey. Each year, the HILDA Survey collects data on the stock of mortgage debt and 'usual' mortgage repayments for each owner-occupier household. However, prior to 2014, there was no information on how much each household is *required* to pay each year. And it is the required repayments that presumably matter in measuring a household's sensitivity to interest rate changes via the cash flow channel.

We construct estimates of the required repayments separately for variable-rate and fixed-rate owner-occupier mortgage debt. The 2010 and 2014 HILDA Surveys provide information on whether the mortgage is fixed rate, variable rate or a combination of both types of loan product. We assume that the 'combination' loans are fixed-rate mortgages, as most fixed-rate mortgages in Australia have an initial 'teaser' period where the interest rate is fixed (usually for about one to

8 Also, the available durables expenditure data in the HILDA Survey indicate that the consumption baskets of borrowers and lenders are very similar (the only notable differences are that borrowers spend slightly more of their budget on cars while lenders spend more on holiday travel). The inflation outcomes for borrowers and lenders are likely to be very similar given they purchase similar durable items on average.

9 Ideally, the estimate of household cash flows would subtract *all* required debt repayments. The HILDA Survey only provides enough information to construct annual estimates of required payments for owner-occupier mortgage debt. This is unlikely to be a major issue though. Estimates from the Australian Bureau of Statistics' Household Expenditure Survey (HES) indicate that mortgage payments made up a very large fraction of total debt payments at around 86 per cent in 2009/10.

three years) and then become variable rate after that (we obtain similar results if we instead assume the combination mortgages are all variable-rate loans).

In the absence of similar household-level information for earlier surveys, we assume that the loan type in 2010 applies to all the years prior to 2010 for which the household reportedly still had the same mortgage loan. This might be considered a strong assumption. However, there are monetary costs and, perhaps more importantly, time costs involved in switching mortgage products, particularly if switching between lending institutions. Moreover, the econometric analysis will control for household characteristics that might be expected to be correlated with the decision to switch loan products (e.g. age, income and level of housing wealth).

The required mortgage repayments are estimated annually using a credit-foncier model. A credit-foncier loan requires a constant annual repayment (M) over the life of the loan which is calculated as:

$$M = \frac{Vr(1+r)^N}{(1+r)^N - 1} = \frac{Vr}{1-(1+r)^{-N}}$$

where V is the loan balance at origination, r is the (annual) nominal interest rate and N is the number of years remaining in the term of the loan. Every four years, indebted households provide estimates of both the loan size at origination and the year in which the loan was originated. For survey respondents that report having refinanced, the loan size and the year in which they last refinanced are also reported. Based on this information, we construct annual estimates of the loan balance at origination after adjusting for any refinancing. We assume a standard 30-year term for each mortgage.

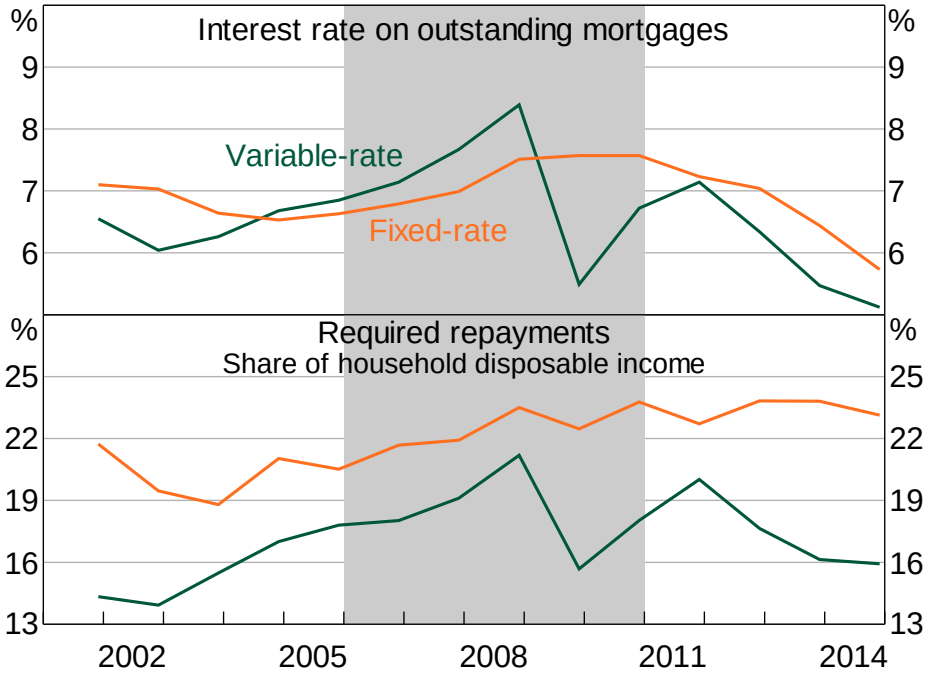
The credit-foncier model also requires estimates of the interest rate faced by borrowers. This information is not collected in the HILDA Survey so, instead, the interest rate is assumed to be equal to the average advertised interest rate on mortgage loans. The variable-rate mortgage borrower is assumed to face the average advertised interest rate on new mortgages in the year of origination (or the year of refinancing). For other years, the borrower is assumed to face the average rate on outstanding loans. The fixed-rate mortgage borrower is assumed to face the average advertised interest rate on new fixed-rate debt in the year of origination. This interest rate continues to apply for the remainder of the loan unless the borrower reports that they have refinanced (in which case, the interest rate in the year of refinancing is applied).

Under the credit-foncier model, required repayments are a positive function of the nominal interest rate. For variable-rate mortgages, the estimated required nominal repayments should change as interest rates change. For fixed-rate mortgages, the estimated nominal repayments will instead remain fixed at the level at origination (or refinancing). As interest rates fall, this should lead to lower required repayments and higher cash flow for households with variable-rate debt relative to those with fixed-rate debt.

Consistent with this, there are differences in the interest rate and repayment cycles faced by variable-rate and fixed-rate mortgage borrowers. For instance, in 2009, the average lending rate on outstanding debt declined by nearly 3 percentage points for variable-rate mortgages but was

basically unchanged for fixed-rate mortgages (top panel of Figure 2). Similarly, in 2009, the required repayments for the median variable-rate borrower are estimated to have declined by about 5.5 per cent of household disposable income, while the median fixed-rate borrower experienced a much smaller decrease of about 1 per cent of income (bottom panel of Figure 2).

Figure 2: Mortgage Lending Rates and Required Repayments



Notes: Required repayment estimates based on the credit-foncier model for the median indebted household using information on mortgage interest rates, current loan balance, loan balance at origination and age of the mortgage (adjusted for refinancing); household disposable income is equal to household gross income less taxes, estimates from the HILDA Survey; shaded areas show the estimation sample period from 2006 to 2010

Sources: Authors' calculations; HILDA Survey Release 14.0

However, there are institutional features of the Australian mortgage market which imply that the relationship between interest rates and borrower cash flows is not as straightforward as suggested by the theory. For instance, households with variable-rate mortgages have the opportunity to make larger repayments than required, allowing them to repay their loan ahead of schedule. This is known as 'mortgage prepayment'. A partial mortgage prepayment occurs when a borrower repays some, but not all, of the mortgage ahead of schedule. Such prepayments can be made on a regular basis, or as a one-off excess repayment.[10] We will examine how mortgage prepayments can affect the sensitivity of the economy to the cash flow channel in an extension to the main econometric analysis.[11]

10 Most prepayments of loan principal are paid by borrowers with variable-rate loans. There is generally a limit to how much Australian borrowers are able to prepay on fixed-rate mortgages before they incur some penalty. However, most fixed-rate loans are for one to three years, after which these loans are usually rolled over into variable-rate loans.

11 For more information on household mortgage prepayment behaviour and other institutional features which may affect the cash flow channel of monetary policy, see Ellis (2005, 2006) and Thurner and Dwyer (2013).

3.3 Household Net Interest-earning Liquid Assets

To identify the cash flow channel we also need household-level estimates of liquid assets and debt. The HILDA Survey provides detailed information on the wealth holdings of Australian households at four-year intervals (in 2002, 2006, 2010 and 2014).[12]

The decomposition of the average household balance sheet into interest-earning liquid assets and variable-rate debt is shown in Table 2. Estimates are shown for both the 'mean' and 'median' Australian household.

Table 2: Assets and Debt per Household

2014

	Assets		
	Mean $'000	Median[(a)] $'000	Share of mean assets
Bank deposits	51.0	11.0	5.6
Cash investments (e.g. bonds)	2.1	0.0	0.2
Total interest-earning liquid assets	*53.1*	*12.0*	*5.8*
Housing assets	530.0	393.8	58.0
Superannuation	185.7	65.0	20.3
Other assets (e.g. equities, vehicles)	145.6	25.5	15.9
Total assets	**914.3**	**579.0**	**100.0**
	Debt		
	Mean $'000	Median[(a)] $'000	Share of mean debt
Variable-rate housing debt	114.1	0.0	65.8
Variable-rate personal debt	8.4	0.0	4.9
Variable-rate business debt	6.0	0.0	3.5
Total variable-rate debt	*128.6*	*5.0*	*74.1*
Fixed-rate housing debt	28.5	0.0	16.4
Fixed-rate personal debt	6.9	0.0	4.0
Fixed-rate business debt	3.2	0.0	1.9
Credit cards	1.7	0.0	1.0
Other debt (e.g. student debt)	4.6	0.0	2.7
Total debt	**173.5**	**22.0**	**100.0**

Notes: The HILDA Survey provides direct estimates of the share of housing debt at fixed and variable interest rates but the shares for personal debt and business debt are approximated using banking data, which indicate that around 55 per cent of personal lending and 65 per cent of small business lending is at variable interest rates
(a) Median estimates do not sum to totals

Sources: Authors' calculations; HILDA Survey Release 14.0; RBA

12 We can also look at the wealth distribution in Australia using the Survey of Income and Housing (SIH) produced by the Australian Bureau of Statistics. The SIH has provided information about the wealth distribution at roughly two-year intervals since 2003/04. We focus on the HILDA Survey estimates due to the longitudinal nature of the household-level data.

In this framework, the *mean* household holds $53 100 in interest-earning liquid assets (7.2 per cent of total net wealth). The mean household also has $128 600 in interest-sensitive debt (17.4 per cent of total net wealth), with most of this consisting of variable-rate home mortgage debt. In net terms, the mean household has a negative net interest-earning liquid asset position. However, Table 2 also makes clear that the distribution of net interest-earning liquid assets is skewed and a different picture emerges if focusing on the *median* household; they hold more interest-earning liquid assets than debt. In other words, the median household has a positive net interest-earning liquid asset position. The differences in the balance sheet positions of the median and mean households highlights the importance of looking at the full distribution of assets and debt in the economy.

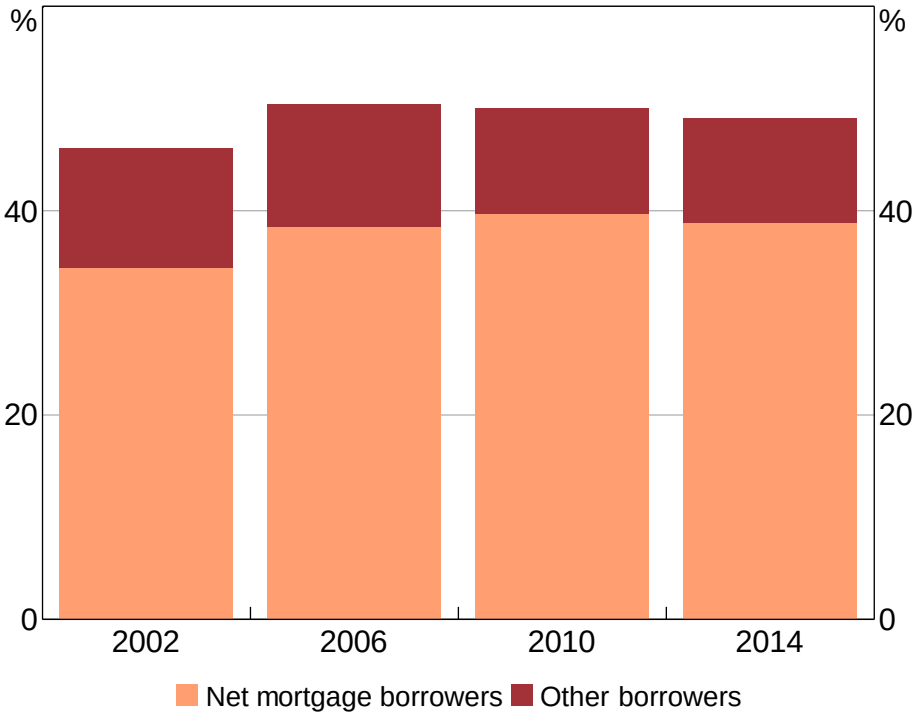
3.4 Borrowing and Lending Households

To disentangle the separate cash flow channels, the estimated level of net interest-earning liquid assets is used to split households into borrowers and lenders. Borrowers are defined as households with negative net interest-earning liquid assets (i.e. households for which variable-rate debt exceeds interest-earning liquid assets). Conversely, lenders are households with more interest-earning liquid assets than variable-rate debt). These labels are a convenient way to distinguish the two cash flow effects that depend on the net interest-earning liquid asset positions of households. In doing so we recognise that, technically speaking, households should be defined as lenders (borrowers) if their incomes are greater (less) than their spending in a given period.[13]

The HILDA Survey indicates that the population is split fairly evenly between borrowers and lenders. More than two-thirds of households hold some form of debt, but many hold only small amounts of debt (usually in the form of credit cards) and hence are still defined as 'lenders'. The HILDA Survey indicates that the share of borrowers in the economy was quite stable between 2002 and 2014, although there was a rise in the share of net borrowers between 2002 and 2006 (Figure 3). The increase in the share of net borrowers over this period was driven by an increase in the share of the population taking on (net) home mortgage debt.

13 Our measure of net interest-earning liquid assets is similar to the concept of 'unhedged interest rate exposure' (URE) used by Auclert (2016). The URE measures the net difference between all maturing assets and liabilities each period, including the difference between income and consumption (or current saving), whereas our measure excludes current saving.

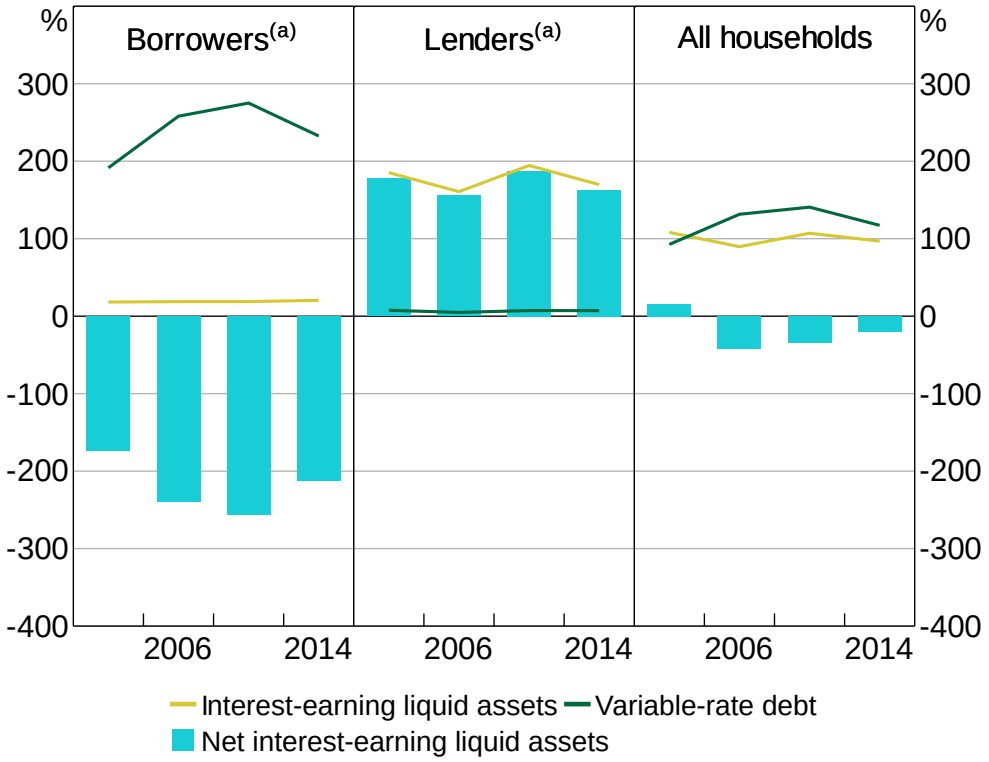
Figure 3: Net Borrowers
Share of all households



Notes: Net borrowers are households with negative net interest-earning liquid assets; net mortgage borrowers are households for which total home mortgage debt exceeds interest-earning liquid assets
Sources: Authors' calculations; HILDA Survey Release 14.0

While there are roughly the same number of borrowers and lenders in the economy, borrowers hold more net debt than lenders hold in net liquid assets, on average. In fact, the HILDA Survey suggests that, between 2002 and 2014, the average borrower held nearly three times as much net variable-rate debt as the average lender held in net interest-earning liquid assets (Figure 4). In real terms, the average borrower held about $230 000 in net variable-rate debt while the average lender held roughly $80 000 in net interest-earning liquid assets. This suggests that lower interest rates will boost interest-sensitive cash flows, on average.

Figure 4: Net Interest-earning Liquid Assets
Share of household disposable income



Notes: Household disposable income is equal to household gross income less taxes, estimates from the HILDA Survey
(a) Borrowers (lenders) are households with negative (positive) net interest-earning liquid assets
Sources: Authors' calculations; HILDA Survey Release 14.0

A notable feature of the net liquid wealth distribution is its bi-model nature – borrowers hold high levels of debt and low levels of liquid assets, while lenders hold high levels of liquid assets and low levels of debt. This suggests that we can focus on *gross* asset and debt positions in quantifying the relative importance of the two channels.

Table 3 compares the average characteristics of net borrowers and lenders. Borrowers and lenders mainly differ because of their positions in the life cycle. The average borrower is younger, earns more income and is almost twice as likely to be in the workforce as the average lender. The average borrowing household is also typically larger, less wealthy and more educated than the average lending household, on average.

Table 3: Summary Statistics
Annual average, 2002 to 2014

	Borrowers			Lenders		
	Mean	Median	Std dev	Mean	Median	Std dev
Durables consumption ($'000)	11.2	5.2	25.8	7.4	2.5	14.8
Total consumption ($'000)	45.6	39.1	34.5	33.5	26.9	26.6
Cash flows ($'000)	89.0	77.0	67.1	68.5	49.8	94.4
Interest-earning liquid assets ($'000)	17.6	5.5	37.9	68.7	17.3	192.8
Variable-rate debt ($'000)	214.7	140.8	324.4	4.7	0.0	31.5
Net interest-earning liquid assets ($'000)	–197.1	–123.8	314.6	64.1	15.0	185.6
Net total wealth ($'000)	673.9	382.5	1 534.6	721.6	382.6	1 270.4
Age of household head (years)	43.0	42.0	12.0	55.7	58.0	18.6
Household size (persons)	3.0	3.0	1.4	2.2	2.0	1.2
Share that are home owners (%)	75.9			57.8		
Share that are mortgagors (%)	66.3			4.5		
Share that are employed	81.3			45.2		
Share that are tertiary educated (%)	27.4			19.2		
Observations	15 066			15 806		

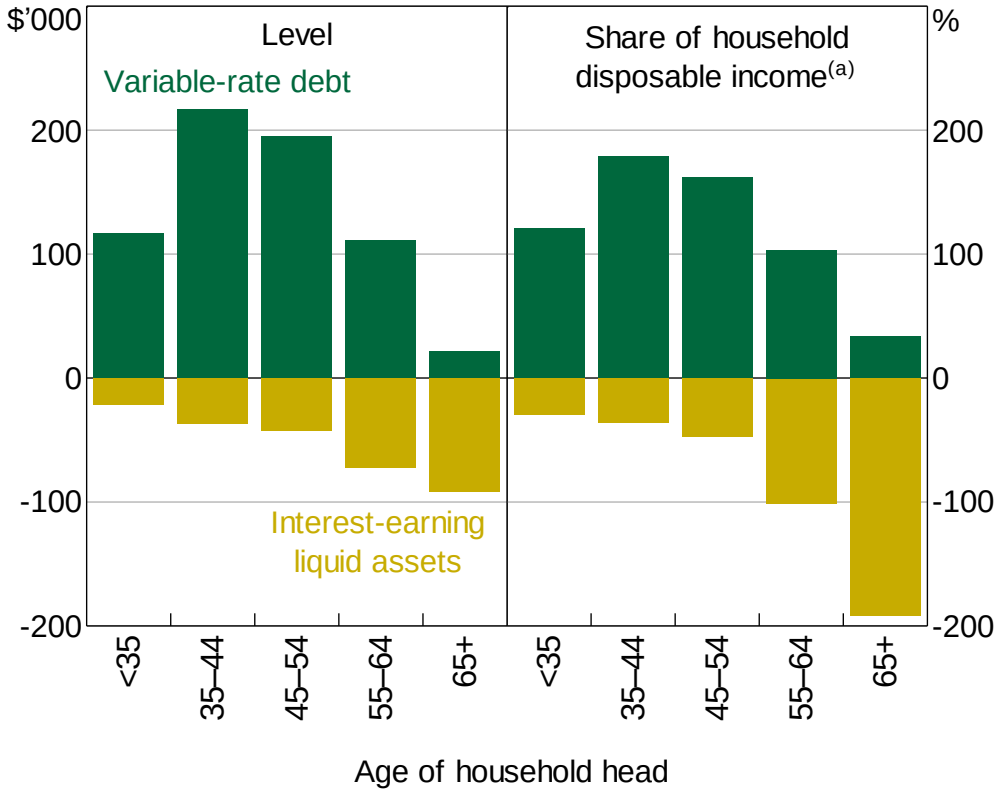
Notes: All variables in dollar amounts are deflated by the consumer price index and in 2014 dollars; all estimates are based on HILDA Survey wealth module years (i.e. 2002, 2006, 2010, 2014)
Sources: ABS; Authors' calculations; HILDA Survey Release 14.0

The influence of the life cycle for borrowers and lenders is also shown by the way in which the composition of wealth varies with the age of the household head (or 'reference person') (Figure 5).[14] Interest-earning liquid assets make up a greater share of net wealth for older households (aged 55 years and above), while middle-aged households hold higher levels of variable-rate debt.

In summary, the household-level evidence suggests that lower interest rates are likely to have a net positive effect on household cash flows (i.e. the borrower channel will be stronger than the lender channel). While there are roughly similar shares of lenders and borrowers in the population, average debt holdings exceed average liquid asset holdings. At least on the surface, this suggests that changes in interest rates will have a larger dollar effect on the cash flows of the average borrower than on the cash flows of the average lender. On top of this, we might expect that changes in cash flows will have a greater impact on spending of borrowers than lenders to the extent they are more likely to be liquidity constrained.

14 The head of each surveyed household is determined by applying certain criteria, in order, until a unique person is selected. These criteria are: in a registered marriage or defacto relationship (and still living together); a lone parent; the person with the highest income; the eldest person.

Figure 5: Net Interest-earning Liquid Assets by Age of Household Head
Mean estimates, 2014



Note: (a) Household disposable income is equal to household gross income less taxes, estimates from the HILDA Survey
Sources: Authors' calculations; HILDA Survey Release 14.0

3.5 Hand-to-mouth Households

The strength of the aggregate cash flow channel relies on some households being liquidity constrained and hence very sensitive to changes in cash flows. We follow Kaplan *et al* (2014) in identifying liquidity-constrained or 'hand-to-mouth' households. They draw a distinction between liquid assets (such as cash and shares) and illiquid assets (such as housing and superannuation). They postulate that only liquid assets are used by households to smooth through small, transient changes in income.

Underlying Kaplan *et al*'s (2014) empirical work is a two-period intertemporal consumption model in which households can choose to save in the form of liquid or illiquid assets. The latter provides a higher return but is only available at a transaction cost. Under certain parameters, some households will choose to save entirely through illiquid assets and optimally choose to consume at the kink in their budget constraint. These households have an MPC out of income that is equal to unity.

In practice, identifying these constrained households is challenging using annual (point-in-time) survey data. Like most household surveys, the HILDA Survey measures income as an annual flow but only measures the balance of liquid assets at the time of the interview. Even constrained households who spend all of their income each pay period are likely to spend it only gradually. Therefore, unless the interview date perfectly coincides with the end of the pay period, the balance of liquid wealth is likely to exceed zero and liquidity constraints will be measured with

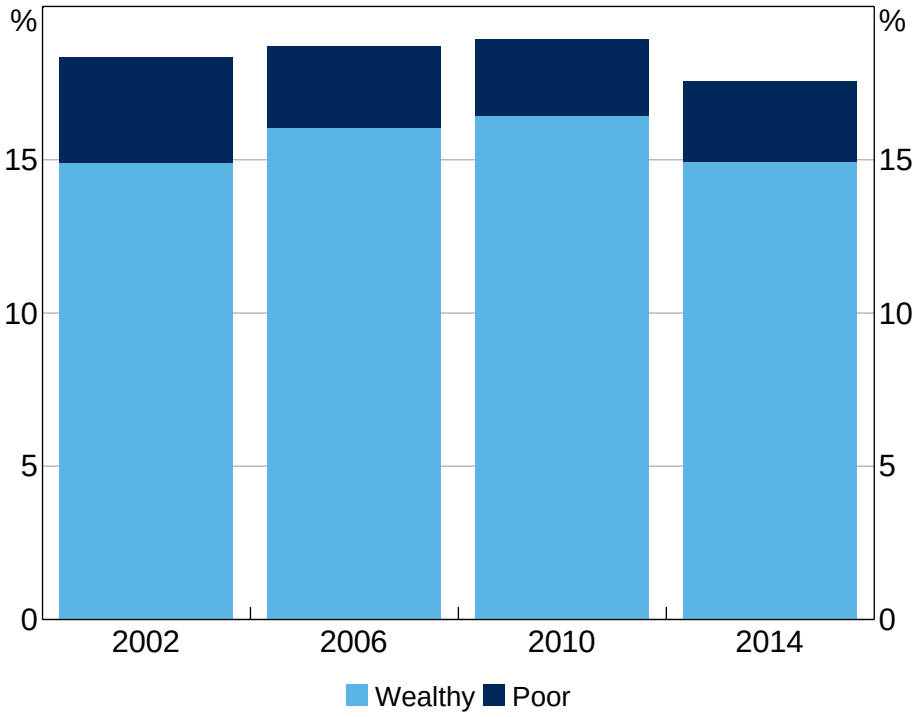
error. We follow Kaplan *et al* (2014) in assuming that households consume their liquid assets at a constant rate, and identify households as hand-to-mouth (HtM) if:

- their liquid wealth balance is positive, but less than half their income each pay period; or
- their liquid wealth balance is negative, and is less than the difference between half their income each pay period and a credit limit.

In effect, we identify HtM households as those households whose liquid wealth is low relative to their income (rather than the stricter requirement that liquid wealth is zero).

The allocation of households into HtM or non-HtM categories relies on detailed information on household wealth. We estimate that around 18 per cent of Australian households are HtM, with this share declining slightly between 2002 and 2014 (Figure 6). Notably, most of these households would be considered wealthy in that they own substantial (though illiquid) wealth, such as housing and superannuation.

Figure 6: Hand-to-mouth Households
Share of all households



Note: Wealthy hand-to-mouth households are those that have positive illiquid wealth; poor hand-to-mouth households are those with negative illiquid wealth
Sources: Authors' calculations; HILDA Survey Release 14.0

Who are the HtM households? By our estimates, HtM households are typically younger and have lower incomes than other households, on average. Notably, our estimates are highly correlated with other potential measures of financial constraints in the HILDA Survey: HtM households are more likely than non-HtM households to report that they have experienced financial stress, that they do not save money and that they are more likely to have difficulty raising emergency funds.

4. The Sensitivity of Household Spending to Cash Flows

4.1 Modelling Framework

To identify the cash flow channel, we estimate how the sensitivity of consumption to cash flows varies between net borrowers and lenders and between the components of cash flow that are interest-sensitive and those that are not. We estimate a household-level consumption model that is similar to models used extensively in the consumption literature (e.g. Jappelli and Pistaferri 2010). The model relates the level of household consumption to current cash flows, as well as other household characteristics that are assumed to determine permanent income (e.g. age, education and household size). The model is estimated separately for lenders and borrowers to explore any differences in the propensity to consume out of household cash flows:

$$\ln\left(C_{ijt}^{D}\right) = \beta^{j} \ln\left(Y_{ijt}^{CF}\right) + \gamma^{j} CONTROLS_{ijt} + \theta_{ij} + \varepsilon_{ijt}$$

where the dependent variable is (the log level of) household durables consumption for household i of type j in year t ($\ln(C^{D})$). The type of the household is either a lender ($j = L$) or a borrower ($j = B$). The key explanatory variable is the log level of cash flows (that is, income less taxes and required mortgage repayments, $\ln(Y^{CF})$).

The specification includes a vector of control variables ($CONTROLS$). These control variables include demographics (e.g. age of the household head) and labour market characteristics (e.g. the employment status of the household head). The specification also includes a range of housing market characteristics. These include each household's subjective estimate of the value of their home equity (i.e. the difference between the value of the home and the outstanding stock of mortgage debt), as well as indicators for whether the household has moved home or refinanced debt that year. The full list of controls is included in the regression output in Appendix A.

The specification also includes a household fixed effect (θ) that captures unobserved household characteristics that do not vary with time but are potentially correlated with the level of household consumption, such as risk aversion or time discounting.

The existence of a cash flow channel requires that there is a positive association between current spending and cash flows. But, more importantly, the cash flow channel requires that the effect of interest rate changes on spending should come through the income flows on interest-earning liquid assets and variable-rate debt (i.e. interest-sensitive cash flows). Hence, if there is a true causal effect of monetary policy via household cash flows, we should observe correlations between consumption and the interest-sensitive components of cash flows – namely, interest receipts and required mortgage repayments.

To investigate these relationships we separate cash flows (Y^{CF}) into interest-sensitive cash flows (Y^{ICF}) and other cash flows (Y^{OCF}). For borrowers, interest-sensitive cash flows are equal to required mortgage repayments (M). For lenders, interest-sensitive cash flows are equal to interest

receipts (IR). We then look at how consumption correlates with each variable in the same regression framework.[15] For borrowers, the regression is specified as:

$$\ln\left(C_{it}^{D}\right) = \beta_{M} \ln\left(M_{it}\right) + \gamma \ln\left(Y_{it}^{OCF}\right) + \delta CONTROLS_{it} + \theta_{i} + \varepsilon_{it} \quad (1)$$

For lenders, the regression is specified as:

$$\ln\left(C_{it}^{D}\right) = \beta_{IR} \ln\left(IR_{it}\right) + \gamma \ln\left(Y_{it}^{OCF}\right) + \delta CONTROLS_{it} + \theta_{i} + \varepsilon_{it} \quad (2)$$

If there is a borrower cash flow channel, borrower households should consume more in response to a decrease in required repayments ($\beta_{M} < 0$). If there is a lender cash flow channel, lender households should consume more in response to an increase in interest income ($\beta_{IR} > 0$).[16]

As the models are specified in logarithms, the estimated coefficients on cash flows (β) represent the elasticity of consumption with respect to cash flows. Ultimately though, we are interested in the MPC out of interest-sensitive cash flows (i.e. the dollar change in spending as a result of a dollar change in cash flows). Estimates of the MPC are constructed by multiplying the estimated elasticity by the mean ratio of spending to cash flows. This is done separately for lenders and borrowers:

$$\text{MPC} = \frac{\partial C}{\partial Y^{CF}} = \left(\frac{\Delta C}{\Delta Y^{CF}} \times \frac{\bar{Y}^{CF}}{\bar{C}}\right) \times \frac{\bar{C}}{\bar{Y}^{CF}} = \beta \times \frac{\bar{C}}{\bar{Y}^{CF}}$$

We impose some sample restrictions prior to estimation. As the dependent variable is expenditure on durable goods, the sample period is restricted to the period from 2006 to 2010. As the model is estimated in natural logarithms, we implictly drop observations that have non-positive values for durable goods spending, required mortgage repayments, cash flows and home equity. We adopt a common work-around for this problem and add a value of one to each observation before log transforming the data (so that ultimately only observations with negative values are excluded).[17] We restrict the age range of the household head to be between 18 and 80 years. Finally, we trim outliers based on the top and bottom 1 per cent of the distributions for: 1) the growth rate of durable goods expenditure; 2) the growth rate of cash flows; and 3) the growth rate of required mortgage repayments.

15 The specification implicitly assumes that the log level of total cash flows can be separated into the sum of the log levels of each type of cash flow. In doing so, we implicitly violate Jensen's inequality.

16 These models have also been estimated using first differences rather than fixed effects. The fixed effects specification is preferred for theoretical and practical reasons. First, a fixed effects model is typically preferred when the residuals are negatively serially correlated in first differences. The estimated residuals show clear evidence of this. Second, a year of data is 'lost' when estimating the model in first differences, which shrinks the sample size and could be problematic when the model is estimated over a short time window.

17 Following Pence (2006), we tried an alternative approach and estimated the model using the inverse sine transformation rather than the log transformation. The advantage of this approach is that it retains non-positive values in the estimation sample. The results were very similar to those presented, suggesting that the sample restriction due to the log transformation is not particularly important.

4.2 Results

Table 4 presents the results of estimating Equations (1) and (2).[18] The results are consistent with the presence of both borrower and lender cash flow channels.

The estimated MPCs indicate that lowering required mortgage repayments by 1 dollar is associated with durables spending rising by about 16 cents, on average (column 1). For lenders, the MPCs indicate that an extra dollar of interest income is associated with durables spending rising by around 5 cents, on average (column 2). The estimated MPC is more than three times larger for borrowers than for lenders, indicating that, for a given dollar change in cash flows, the borrower cash flow channel is a stronger channel of monetary transmission.

Table 4: The Sensitivity of Durables Expenditure to Cash Flows

	All households		HtM households		Non-HtM households	
	Borrowers	Lenders	Borrowers	Lenders	Borrowers	Lenders
Interest-sensitive cash flow elasticity (Y^{ICF})	–0.27***	0.02**	–0.36*	0.04*	–0.23*	0.02*
	(–2.62)	(2.35)	(–1.66)	(1.76)	(–1.94)	(1.82)
MPC	**–0.16**	**0.05**	**–0.18**	**0.31**	**–0.15**	**0.04**
Other cash flow elasticity (Y^{OCF})	0.44***	0.18***	0.68***	0.28**	0.24	0.16***
	(3.20)	(3.71)	(3.46)	(2.11)	(1.25)	(3.11)
MPC	**0.05**	**0.02**	**0.07**	**0.03**	**0.03**	**0.02**
R^2	0.51	0.64	0.53	0.59	0.48	0.63
Within R^2	0.01	0.01	0.02	0.01	0.01	0.01
Observations	5 185	12 163	2 191	3 284	2 994	8 879

Notes: ***, ** and * denote statistical significance at the 1, 5 and 10 per cent levels, respectively; t statistics shown in parentheses; standard errors are clustered by household; estimated coefficients on control variables are omitted

Sources: Authors' calculations; HILDA Survey Release 14.0

To investigate whether liquidity-constrained households are driving the aggregate results, Equations (1) and (2) are re-estimated on the sub-samples of HtM and non-HtM households. The results are presented in columns 3 to 6. As expected, HtM households show a stronger propensity to consume out of cash flows than non-HtM households. This is true for both borrowers and lenders and for both interest-sensitive cash flows and other cash flows. And it is particularly notable when comparing the estimated elasticities between HtM and non-HtM households (rather than the MPCs). This is consistent with the theory that the spending of liquidity-constrained households is most sensitive to interest rate changes. Somewhat surprisingly, within the HtM sub-sample, we estimate a slightly larger MPC out of interest-sensitive cash flows for lender households (0.31) than for borrower households (−0.18), although this is not true for the estimated elasticities.

18 The full regression output is shown in Appendix A.

5. Quantifying the Aggregate Cash Flow Channel

Next, we combine the MPC estimates with the average net liquid wealth holdings of both borrowers and lenders to construct estimates of the cash flow channel for the overall economy. The necessary information is combined in Table 5.

Table 5: Aggregate Cash Flow Channel

	All households		HtM households	
	Borrowers	Lenders	Borrowers	Lenders
Mean net interest-earning liquid assets ($) $\left(\bar{W}_j\right)$	–194 600	39 600	–185 100	4 500
Interest rate change (bps) (Δr)	–100	–100	–100	–100
Change in cash flows ($) $\left(\Delta Y_j^{CF} = \Delta r * \bar{W}_j\right)$	1 946	–396	1 850	–45
MPC_j	0.16	0.05	0.18	0.31
Change in durables spending ($) $\left(\Delta C_j = \text{MPC}_j * \Delta Y_j^{CF}\right)$	310	–20	338	–14
Growth in durables spending (%) $\left(\Delta C_j / \bar{C}_j\right)$	3.2	–0.3	4.1	–0.4
Share of households (%) (w_j)	50.0	50.0	12.2	7.0
Aggregate growth in spending per household (%) $\left(\sum_j w_j * \Delta C_j / \bar{C}_j\right)$	**0.2**		**0.1**	

Note: Estimates relate to the data underlying the regression analysis and hence to the sample period from 2006 to 2010
Sources: Authors' calculations; HILDA Survey Release 14.0

A 100 basis point reduction in interest rates would be associated with an average increase in interest-sensitive cash flows per annum of about $1 950 for borrowers and an average decrease of about $400 for lenders (i.e. the interest rate change multiplied by the mean net interest-earning liquid assets of each group). Given the MPCs of borrowers and lenders, this would correspond to an increase in durables spending of about $310 per annum for borrowers and a fall of around $20 per annum for lenders. (Alternatively, at the mean of durables spending for each group, this would be equivalent to a 3.2 per cent increase in durables expenditure for the average borrower and a decrease of about 0.3 per cent in durables spending for the average lender.)

Given that the household population is evenly split between net borrowers and lenders, this implies that, across all households, durables consumption per household would rise by about 1.5 per cent. The HILDA Survey indicates that durables expenditure makes up approximately 17 per cent of total (nominal) household expenditure. So, assuming no change in spending on non-durable goods or services, the results indicate that a 100 basis point cut in lending rates is consistent with an increase of about 0.25 per cent in aggregate nominal consumption per annum.

Applying the same rule-of-thumb calculations to the HtM household sample, lowering interest rates by 100 basis points would be associated with aggregate household spending rising by about 0.1 per cent per annum. The lower estimate is due to the fact that, while HtM households have relatively high propensities to consume, they account for less than 20 per cent of the household population and they hold lower levels of debt than non-HtM households, on average. However, in aggregate, the borrower cash flow channel is still a lot stronger than the lender channel. This is because the average HtM borrower holds over 20 times more net debt than the average HtM lender holds in net interest-earning liquid assets.

In summary, these back-of-the-envelope calculations suggest that the cash flow channel is a fairly important channel of monetary transmission. However, as this exercise demonstrates, there are a number of assumptions underpinning these calculations, so they should be treated with some caution.

6. A Closer Look at the Borrower Cash Flow Channel

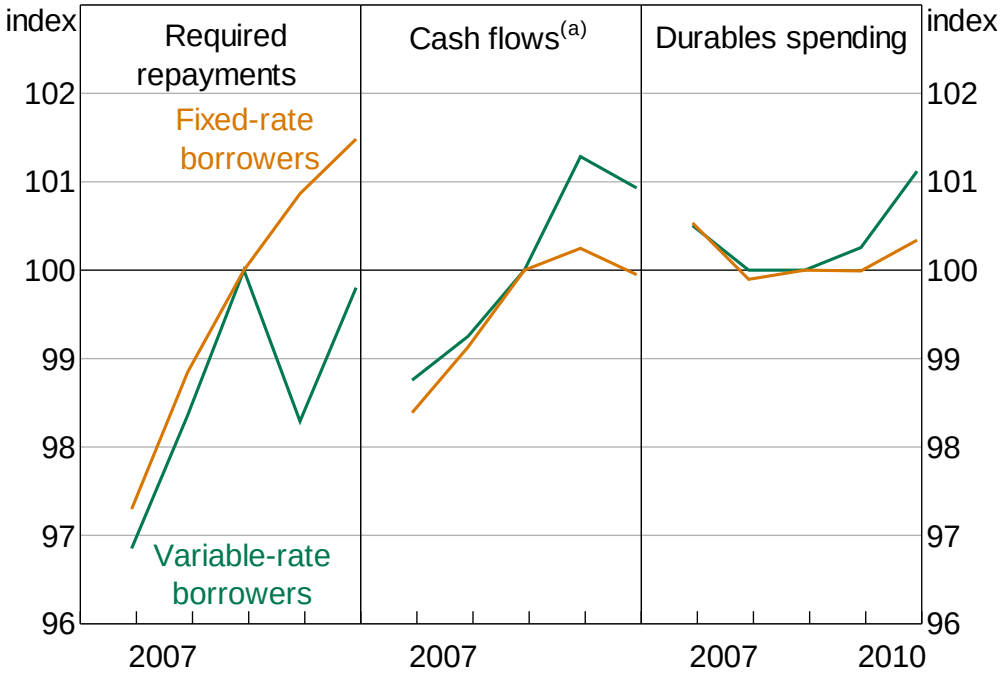
6.1 Variable-rate and Fixed-rate Mortgage Debt

Next, we take a closer look at the borrower cash flow channel by exploiting variation between variable-rate and fixed-rate borrowers in their response to changes in required mortgage repayments. The key difference between these two groups of borrowers is arguably the cash flow effect of an interest rate change; the other channels, such as the wealth and substitution channels, should operate in a similar fashion for both types of households.

To examine this, a regression model is estimated based on an experimental research design in which the variable-rate borrowers are the 'treatment' group, the fixed-rate borrowers are the 'control' group and we can think of an unexpected change in required mortgage repayments (due to interest rate changes) as the 'treatment'. If the borrower cash flow channel exists, the cash flows and spending of variable-rate borrowers should increase (decrease) relative to fixed-rate borrowers when interest rates fall (rise).

The graphical evidence indicates that interest rate changes have a larger effect on the cash flows and spending of variable-rate borrowers than on fixed-rate borrowers (Figure 7). Focusing on the sample period of 2006–10, the comparatively large decline in nominal lending rates on variable-rate mortgages in 2009 contributed to a much larger decline in required repayments (left-hand panel of Figure 7) and a larger increase in cash flows for the median variable-rate borrower compared to the median fixed-rate borrower (middle panel of Figure 7). At least some of this appears to have translated into higher spending by the median variable-rate borrower compared to the median fixed-rate borrower (right-hand panel of Figure 7). Taken together, these results are consistent with a borrower cash flow channel.

Figure 7: Cash Flows and Spending of Borrowers
Log level, 2008 = 100



Note: (a) Cash flows are equal to gross household income less taxes and required mortgage payments
Sources: Authors' calculations; HILDA Survey Release 14.0

To confirm the graphical evidence, we estimate the following regression model on the sample of households that have owner-occupier debt:

$$\ln\left(C_{it}\right) = \beta_{VR} \ln\left(M_{it}^{VR}\right) + \beta_{FR} \ln\left(M_{it}^{FR}\right) + \gamma CONTROLS_{it} + \mu_i + \xi_{it} \quad (3)$$

where each indebted household makes required repayments on either variable-rate mortgage debt (M^{VR}) or fixed-rate mortgage debt (M^{FR}). These two variables are constructed by multiplying the required repayments of each indebted household by a dummy variable indicating whether the household holds variable-rate or fixed-rate mortgage debt. If the cash flow channel exists, there should be a negative correlation between the change in required repayments and consumption for variable-rate borrowers ($\beta_{VR} < 0$), and this effect should be larger for variable-rate borrowers than for fixed-rate borrowers ($\beta_{VR} < \beta_{FR}$).

To interpret our estimates as the causal effect of changes in required repayments on spending, the households would be ideally 'randomly assigned' to the treatment and control groups. In other words, there should be no systematic differences between fixed-rate and variable-rate mortgage holders that might determine the sensitivity of their spending to changes in cash flows.

According to the HILDA Survey, fixed- and variable-rate mortgage borrowers are very similar in terms of their observed characteristics (Table 6). This suggests that selection effects are unlikely to be significant. While about 75–80 per cent of Australian mortgagors have variable-rate mortgage debt, the only really notable differences are that variable-rate borrowers are required to make slightly larger repayments and have higher total net wealth than fixed-rate borrowers, on average.

Table 6: Characteristics of Borrowers

Annual average, 2002 to 2014

	Variable-rate			Fixed-rate		
	Mean	Median	Std dev	Mean	Median	Std dev
Durables expenditure ($'000)	12.1	6.4	17.3	11.2	5.1	15.5
Total expenditure ($'000)	49.2	42.9	29.2	45.3	38.9	26.2
Cash flows ($'000)	92.5	82.0	60.2	86.1	73.1	90.6
Required mortgage repayments ($'000)	18.4	16.0	14.0	24.7	21.4	19.5
Usual mortgage repayments ($'000)	23.0	20.7	14.8	25.3	22.2	27.1
Interest-earning liquid assets ($'000)	25.5	7.5	70.1	23.8	8.2	56.7
Interest-earning debt ($'000)	261.3	186.4	316.7	275.8	208.4	335.0
Net interest-earning liquid assets ($'000)	–235.7	–169.5	315.0	–252.0	–194.8	333.6
Net total wealth ($'000)	724.2	502.5	936.4	651.6	393.8	948.1
Age of household head (years)	43.8	43.0	10.5	42.6	41.0	11.2
Age of mortgage (years)	7.2	5.0	6.8	6.2	3.9	7.0
Share that are tertiary educated (%)	32.1			30.4		
Share that are liquidity constrained (%)	17.8			16.4		
Observations		6 097			1 495	

Notes: All variables in dollar amounts are deflated by the consumer price index and in 2014 dollars; all estimates are based on HILDA Survey wealth module years (i.e. 2002, 2006, 2010, 2014)

Sources: ABS; Authors' calculations; HILDA Survey Release 14.0

To further alleviate selection concerns, the regression model includes a wide range of household-level variables to control for some of the observable differences between the two groups. On top of this, there are unobserved characteristics, such as the household's risk aversion or uncertainty about future income, that might also determine consumption and be correlated with the decision to hold a fixed-rate or variable-rate loan, which would confound any causal effect. We do not explicitly model the household choice between fixed- and variable-rate loans. But, if the characteristics that determine this choice do not change over time, they are controlled for because the model includes household fixed effects.

For causal inference, it is also important that an interest rate change does not cause some households to move from one treatment group to the other. For example, a sharp fall in interest rates may encourage some households to refinance from a variable-rate loan to a fixed-rate loan if they expect interest rates to revert back later in the cycle. Conversely, some households may respond by switching from a fixed-rate to variable-rate loan if they expect interest rates to continue falling.

We do not observe the loan type of mortgagor households prior to 2010 so we do not observe the extent to which households switched between the two borrower groups over the sample period. However, the sample window is quite short (at five years), which should limit the number of households switching treatment status.

Furthermore, we would expect that most borrowers will transition from fixed-rate to variable-rate mortgages rather than vice versa. This is due to a structural feature of the Australian mortgage market – that most fixed-rate mortgage contracts are only fixed for three years before they

become a variable-rate contract. The research design would wrongly classify these borrowers as being in the 'control group' when, in reality, their spending was potentially sensitive to changes in interest rates via the cash flow channel. This would cause us to underestimate the effect of cash flows on spending as we rely on the differential spending response of the variable-rate and fixed-rate borrowers. In other words, it suggests that such selection issues will impart a negative bias to our borrower cash flow channel estimates.

In support of this, we observe the loan type in both the 2010 and 2014 Surveys, which provides some guide as to the shares of borrowers that switch between types of mortgages. Between 2010 and 2014, outstanding mortgage lending rates declined by between 150 and 200 basis points. The HILDA Survey indicates that around half of the households that had a fixed-rate mortgage in 2010 switched to a variable-rate mortgage by 2014. In contrast, about 19 per cent of borrowers switched from having a variable-rate mortgage to a fixed-rate mortgage over the same period. This implies that most borrowers transitioned from a fixed-rate to variable-rate mortgage between 2010 and 2014.

In a similar vein, some mortgage borrowers may choose to switch between a fixed-rate mortgage with a high interest rate to one with a low interest rate. This again would imply that the cash flows of the control group are affected by changes in interest rates and again will cause us to underestimate the borrower cash flow channel.

The regression results support the graphical evidence and suggest that there is a negative correlation between required payments and durables consumption for only variable-rate borrowers (Table 7). The implied MPCs indicate that an additional dollar of cash flows due to lower mortgage payments is associated with around 17 cents being spent on durable goods for the variable-rate borrowers. For fixed-rate borrowers, the estimated coefficient is not statistically different to zero. These results are upheld in the same regressions on the sub-samples of HtM and non-HtM borrowers. The estimated elasticities and implied MPCs are stronger for HtM borrowers than for non-HtM borrowers. Together, the results point to the observed negative relationship between spending and required repayments being due to a cash flow effect rather than a wealth effect or intertemporal substitution effect.

Table 7: Sensitivity of Durables Spending to Required Mortgage Repayments

	All borrowers	HtM borrowers	Non-HtM borrowers
Fixed-rate repayments (β_{FR})	0.30	–0.01	0.53
	(1.03)	(–0.02)	(1.04)
MPC	**0.92**	**–0.02**	**1.78**
Variable-rate repayments (β_{VR})	–0.25***	–0.37*	–0.19**
	(–2.83)	(–1.88)	(–2.06)
MPC	**–0.17**	**–0.22**	**–0.15**
R^2	0.55	0.56	0.56
Within R^2	0.01	0.02	0.01
Observations	7 016	2 760	4 256

Notes: ***, ** and * denote statistical significance at the 1, 5 and 10 per cent levels, respectively; t statistics shown in parentheses; standard errors are clustered by household; coefficient estimates on control variables are omitted; samples exclude the top and bottom 1 per cent of the household distribution for growth in durable goods spending and growth in cash flows

Sources: Authors' calculations; HILDA Survey Release 14.0

6.2 Mortgage Prepayments and Household Deleveraging

Next, we examine the extent to which mortgage prepayment behaviour affects the sensitivity of the economy to changes in interest rates via the borrower cash flow channel. A household making excess repayments can smooth their total mortgage repayments through interest rate cycles, reducing the sensitivity of household spending to interest rate changes. Moreover, over time, a household that consistently makes excess repayments will lower the outstanding balance on their mortgage below the scheduled balance and potentially build up a large pool of savings that are available for redraw.

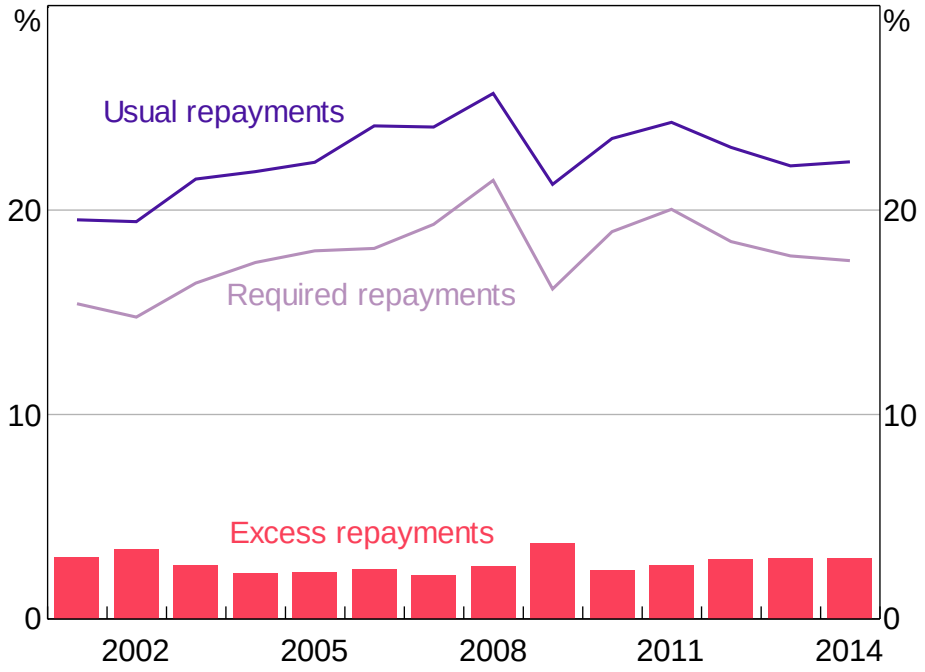
When mortgage lending rates fall, borrowers with variable-rate mortgages have two options: 1) they can choose to reduce their repayments to the lower minimum scheduled repayment (i.e. cash flow increases) or 2) they can maintain their existing repayments and make larger prepayments (i.e. cash flows are unchanged). The extent to which borrowers adjust their repayments depends on a number of factors, including lender processes, the level of mortgage lending rates, and the level of mortgage debt.

Interestingly, institutional factors could also introduce asymmetries in the cash flow channel of monetary policy. In particular, interest rate increases should have a larger effect on cash flows for borrowers than interest rate decreases. This is because, when interest rates fall, both the bank and borrower may choose to not adjust the repayment schedule, so cash flows will be unchanged, and the loan will just be repaid faster. But, when interest rates rise, the bank will not allow the borrower to extend the life of the mortgage beyond the original schedule – the bank will definitely raise the required repayments and reduce the cash flows of the borrower (assuming the borrower does not refinance the mortgage).

A unique feature of the HILDA Survey is the availability of survey information that can be used to construct household-level estimates of both usual and required mortgage repayments. We can therefore estimate excess repayments (the difference between usual and required repayments) and gauge how mortgage prepayment behaviour varies with factors such as interest rates.

According to the HILDA Survey, the median mortgage borrower typically makes excess repayments of close to 3 per cent of disposable income (Figure 8). Moreover, the size of these excess repayments varies within the interest rate cycle. In general, the excess repayments were declining over the early to mid 2000s when lending rates were rising and have been rising gradually since the global financial crisis when lending rates have typically fallen.

Figure 8: Mortgage Repayments
Share of household disposable income



Notes: Required repayments are estimated based on a credit-foncier model for the median indebted household using information on mortgage interest rates, current loan balance, loan balance at origination and age of the mortgage (adjusted for refinancing); excess repayments are equal to the difference between usual repayments (reported by survey respondents) and required repayments

Sources: Authors' calculations; HILDA Survey Release 14.0

The consumption response to an interest rate change through the borrower cash flow channel can be dampened by an increase in precautionary saving through mortgage prepayment. To see this, suppose lower interest rates reduced the current required repayments of a variable-rate mortgage borrower by a dollar. In Australia, a variable-rate mortgage borrower has the option to pay down the mortgage principal by an extra dollar. By making a dollar of prepayment, the household effectively 'saves' the additional money, and there are no additional cash flows to spend on goods and services in the current period.

To understand how this relates to the earlier MPC estimates, consider a simple flow of funds constraint for a household with mortgage debt:

$$C + M^U + S = Y^D + B$$

where the total use of funds on the left-hand side of the equation includes expenditure on goods and services (C), usual mortgage payments (M^U) and saving in liquid assets, such as bank deposits and mortgage offset accounts, as well as illiquid assets, such as superannuation (S). The

total availability of funds on the right-hand side of the equation includes disposable income (Y^D) and borrowing (B). Usual mortgage repayments (M^U) can be decomposed into required repayments (M) and excess repayments (X):

$$M^U = M + X$$

In this setting, holding constant the availability of funds, an additional dollar of cash flows due to lower required mortgage repayments (M) can be either: 1) spent on goods and services (C); 2) saved in excess repayments by paying down mortgage principal (X); or 3) saved in other assets (S).

The marginal propensity to save in excess repayments (or the 'marginal propensity to prepay') can be estimated by examining how excess repayments (X) respond to a change in required repayments (M). The estimated propensity to prepay is useful for a few reasons. First, it provides an effective upper bound estimate of the MPC out of interest-sensitive cash flows (more specifically, it provides an estimate of 1 – MPC, assuming that the household does not save in other assets). Second, unlike the consumption data, information on usual, required and excess repayments is available for the full sample period of 2001 to 2014. This allows for an examination of how the propensity to prepay varies over interest rate cycles.

The following regression model is estimated:

$$X_{it} = \beta_X M_{it} + \gamma CONTROLS_{it} + \mu_i + \lambda_t + \nu_{it} \quad (4)$$

This regression specification is essentially the same as the consumption model estimated earlier (Equation (1)), except that the dependent variable is now the level of excess mortgage repayments and the model is specified in levels rather than log levels.[19] The coefficient estimate is expected to be negative if borrowers increase their excess repayments in response to lower required repayments ($\beta_X < 0$). This coefficient provides a direct estimate of the marginal propensity to prepay.

This framework can be extended to examine whether the sensitivity of prepayment to cash flows varies over time. For instance, households may have become more likely to deleverage (and hence prepay their mortgage) in the period since the global financial crisis. To examine this, we split the sample into two periods before and after 2010. A dummy variable ($POST$) is included that is equal to one for the period after 2010 (and is equal to zero otherwise). This dummy variable is interacted with the required repayments variable to examine whether the sensitivity of excess repayments to required repayments has changed since the crisis:

$$X_{it} = \beta_{X1} M_{it} + \beta_{X2} POST_t * M_{it} + \gamma CONTROLS_{it} + \mu_i + \lambda_t + \nu_{it} \quad (5)$$

The results of estimating Equations (4) and (5) are presented in Table 8.

19 This is due to the fact that excess repayments can be negative and these observations would be excluded by using logarithms.

Table 8: Response of Mortgage Prepayments to Cash Flows

	Equation (4)	Equation (5)
Required repayments	–0.70***	
	(–8.73)	
Required repayments (pre-2010)		–0.60***
		(–11.98)
Required repayments (post-2010)		–0.14***
		(–3.72)
Other cash flows	0.02***	0.02***
	(2.86)	(2.98)
R^2	0.69	0.70
Within R^2	0.32	0.33
Observations	18 627	18 627

Notes: ***, ** and * denote statistical significance at the 1, 5 and 10 per cent levels, respectively; *t* statistics shown in parentheses; standard errors are clustered by household; coefficient estimates on control variables, household fixed effects and time fixed effects are omitted

Sources: Authors' calculations; HILDA Survey Release 14.0

The results indicate that the marginal propensity to prepay is about 70 cents in the dollar, on average, over the 2001 to 2014 period. Taken at face value, and recalling the earlier MPC estimates, this suggests that, for the average mortgagor household, a given change in required repayments is roughly divided amongst mortgage prepayment, durable goods spending and other saving by about 70 cents, 16 cents and 14 cents respectively. However, these estimates should be treated with some caution as they rely on different model specifications and sample periods.[20]

The results also show that the marginal propensity to prepay has increased from around 60 per cent in the period from 2001 to 2010 to around 74 cents in the period after 2010. This provides some evidence that mortgagor households have become more inclined in recent years to use any additional cash flows from lower interest rates to deleverage rather than spend. This is also consistent with the idea that, in a low interest rate environment, mortgagor households are more likely to save for precautionary reasons in expectation of higher interest rates in the future.

Notably, this deleveraging process provides a mechanism through which a temporary disposable income shock (due to a cyclical change in monetary policy) can reduce the expected remaining life of the mortgage. By promoting the speed of deleveraging, lower interest rates may 'bring forward' the time at which households feel comfortable with spending out of interest-sensitive cash flows.

20 The results are robust to other sampling changes, including excluding outliers and focusing solely on variable-rate mortgage borrowers. For instance, we find slightly stronger estimates of the propensity to prepay for variable-rate borrowers. This makes sense given that fixed-rate mortgage borrowers typically have to pay an additional cost to prepay their mortgages. However, for this exercise, the sample is restricted to the period from 2010 onwards so it is possible that the stronger propensity to prepay is due to the low interest rate environment.

7. Conclusion

We find evidence for the existence of a 'borrower' cash flow channel. In accordance with intuition, it appears to work mainly through households with variable-rate mortgage debt, and there is evidence that the effect of interest-sensitive cash flows on spending is particularly strong for liquidity-constrained households. We find some evidence for the existence of a lender cash flow channel, but the estimated effect is not strong enough to offset the borrower cash flow channel at an aggregate level. Importantly, changes in monetary policy have distributional effects that do not 'wash out' in the aggregate because of differences between borrowers and lenders in propensities to consume and in average holdings of net interest-earning assets. Borrowers have a higher propensity to consume than lenders, and borrowers have more net debt than lenders have net interest-earning liquid assets, on average. This implies that lower interest rates increase household cash flows, and spending in aggregate, via the cash flow channel.

The central estimates indicate that a 100 basis point cut in interest rates is associated with a 0.1 to 0.2 per cent increase in household spending in aggregate. This is within the range of estimates produced by macroeconomic models that examine how changes in the cash rate affect household consumption in Australia.

We also find some evidence that mortgage borrowers have used some of the cash flows generated by lower interest rates to prepay their mortgages rather than spend. This process can reduce the expected life of household debt and hence bring forward the day when households feel comfortable about increasing their consumption. Overall, our results suggest that the cash flow channel is an important channel of monetary policy transmission to household spending in Australia.

Appendix A: Full Regression Output

The results of estimating Equation (1) for the whole sample, the hand-to-mouth household sample and the non-hand-to-mouth household sample are shown in Table A1. The measurement and definitions for each of the control variables is shown below (with associated HILDA Survey mnemonics shown where relevant):

- **Interest-sensitive cash flows:** For borrowers, this is equal to required mortgage repayments (calculated from a credit-foncier model). For lenders, this is equal to interest income on deposit accounts as reported by each surveyed individual (*OIFINTA*) and aggregated across all individuals within each household.

- **Other cash flows:** For borrowers, this is equal to disposable income (*HIFDITP* – *HIFDITN*). For lenders, this is equal to disposable income less required mortgage repayments and interest income (as calculated above).

- **Home debt:** Each household's estimate of their current holdings of owner-occupier housing debt (*HSMGOWE* + *HSSLOWE*)

- **Home equity:** Each household's subjective estimate of the current value of their home (*HSVALUI*) less their estimate of their current holdings of owner-occupier housing debt (*HSMGOWE* + *HSSLOWE*)

- **Age:** The age of the household head (where the age is restricted to be between 18 and 80 years of age) (*HGAGE*)

- **Home owner:** A dummy variable equal to one if the household reportedly owns their home and equal to zero otherwise (*HSTEW* = 1)

- **Mortgagor:** A dummy variable equal to one if the household owns their home and has outstanding owner-occupier housing debt and equal to zero otherwise (*HSMGOWE* + *HSSLOWE* > 0)

- **Refinanced:** A dummy variable equal to one if the household reports to have refinanced their mortgage in that survey year and equal to zero otherwise (*HSEVREF* = 1)

- **Moved home:** A dummy variable equal to one if the household reports to have moved home since the last survey and equal to zero otherwise (*HHMOVE* = 1)

- **Employed:** A dummy variable equal to one if the household head's employment status is employed and equal to zero otherwise (the baseline is being unemployed) (*ESBRD* = 1)

- **Not in the labour force:** A dummy variable equal to one if the household head's employment status is not in the labour force and equal to zero otherwise (the baseline is being unemployed) (*ESBRD* = 3)

Table A1: Consumption Response to Interest-sensitive Cash Flows

	All households		HtM households		Non-HtM households	
	Borrowers	Lenders	Borrowers	Lenders	Borrowers	Lenders
Interest-sensitive cash flows	–0.27***	0.02**	–0.36*	0.04*	–0.23*	0.02*
	(–2.62)	(2.35)	(–1.66)	(1.76)	(–1.94)	(1.82)
Other cash flows	0.44***	0.18***	0.68***	0.30**	0.24	0.16***
	(3.20)	(3.71)	(3.46)	(2.11)	(1.25)	(3.11)
Log of home debt	0.13	–0.11**	0.16	–0.24*	0.13	–0.07
	(1.30)	(–2.39)	(0.76)	(–1.67)	(1.20)	(–1.52)
Log of home equity	0.02	–0.02	–0.05*	–0.05	0.09	–0.01
	(0.47)	(–0.50)	(–1.69)	(–0.63)	(1.42)	(–0.35)
Age	–0.17*	0.24***	–0.31*	0.17	–0.08	0.25***
	(–1.67)	(3.53)	(–1.66)	(1.35)	(–0.64)	(3.10)
Age squared	0.00	–0.00***	0.00	–0.00	0.00	–0.00***
	(1.64)	(–3.23)	(1.43)	(–0.79)	(0.85)	(–3.05)
Home owner		0.48		0.76		0.45
		(0.92)		(0.72)		(0.85)
Mortgagor	2.39***	1.23**		2.50	2.05**	0.86
	(3.16)	(2.32)		(1.60)	(2.15)	(1.53)
Refinanced	0.15	0.54	–0.00	–0.82	0.33	1.05**
	(0.72)	(1.02)	(–0.01)	(–0.82)	(1.03)	(2.00)
Moved home	0.35***	0.27***	0.41**	0.25	0.31**	0.28***
	(3.15)	(3.15)	(2.25)	(1.50)	(2.16)	(2.95)
Employed	0.66*	0.50***	0.71	0.41	0.53	0.61***
	(1.88)	(2.66)	(1.58)	(1.26)	(0.95)	(2.69)
Not in the labour force	0.19	0.38*	0.46	0.13	–0.26	0.56**
	(0.43)	(1.82)	(0.85)	(0.36)	(–0.35)	(2.23)
Constant	4.48*	–2.71	8.73**	–3.88	3.41	–2.24
	(1.75)	(–1.43)	(2.14)	(–1.16)	(1.04)	(–0.97)
R^2	0.010	0.008	0.017	0.009	0.011	0.010
Observations	5 185	12 163	2 161	3 284	2 994	8 879

Notes: ***, ** and * denote statistical significance at the 1, 5 and 10 per cent levels, respectively; t statistics shown in parentheses; standard errors are clustered by household; coefficient estimates on control variables are omitted

Sources: Authors' calculations; HILDA Survey Release 14.0

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