Research Discussion Paper

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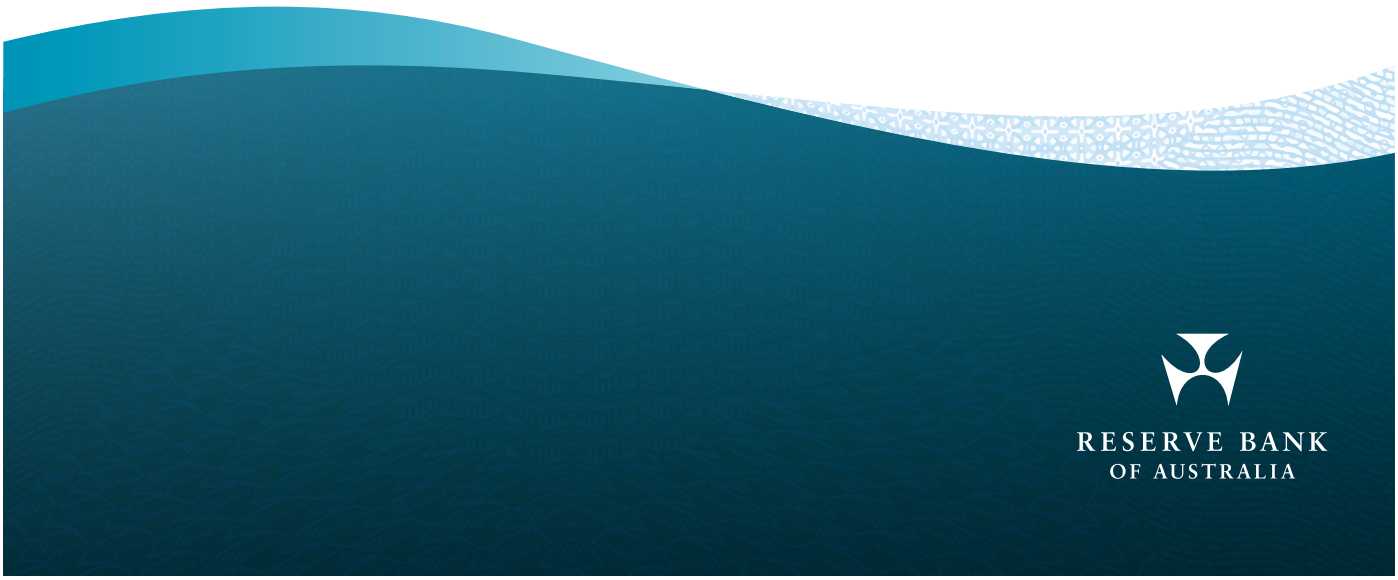

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Abstract

We explore the relationship between owner-occupier mortgage debt and spending using detailed panel data on Australian households. We find evidence consistent with a 'debt overhang effect' – households cut back on their spending when they have higher levels of outstanding mortgage debt. This overhang effect holds even when households' net housing wealth remains constant, implying that households reduce their spending when the gross value of both their debt and assets increases. This suggests that changes in the composition of household balance sheets affect spending, which runs counter to macroeconomic models that combine assets and liabilities into a single measure of net wealth. We find the overhang effect to be pervasive across owner-occupier households and not exclusively driven by households that are financially constrained or that have strong precautionary saving motives. We find evidence that indebted households reduce their spending by more than other households during adverse macroeconomic shocks, such as the global financial crisis, but the negative effect of debt is also pervasive at other times.

JEL Classification Numbers: D12, D14, E21

Keywords: household debt, consumption, borrowing constraints, liquidity constraints, precautionary saving, household survey data

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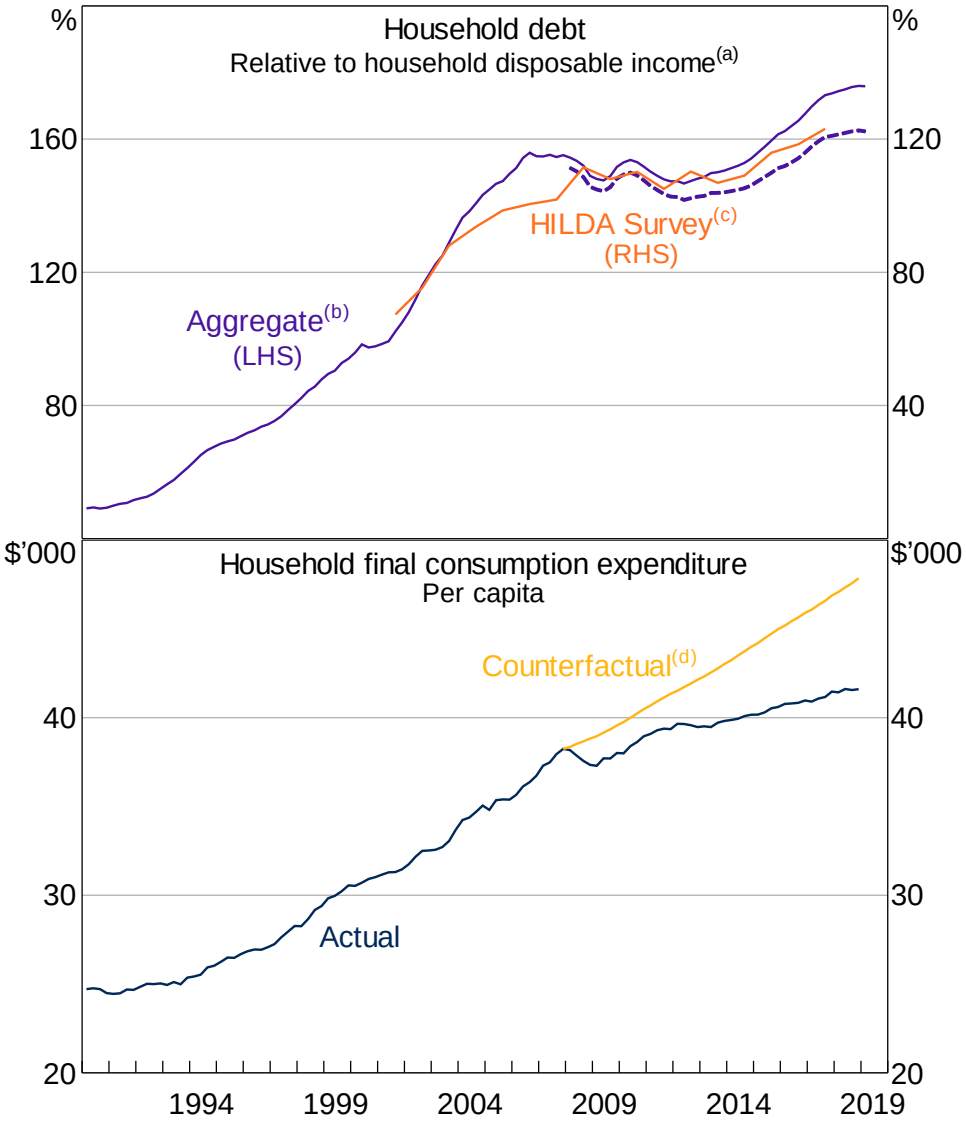
1. Introduction

The household debt-to-income ratio has risen to record levels in Australia in recent years, while household spending has been relatively weak (Figure 1). This follows a period of stagnation in household debt relative to income, which included the global financial crisis (GFC). A similar pattern of high household debt and weak spending has been observed across a range of other countries (Bunn and Rostom 2015; Pistaferri 2016; Lombardi, Mohanty and Shim 2017). This has led to concerns amongst policymakers that elevated levels of household debt are holding back the economic recovery and pose risks to future growth (Hunt 2015; Brazier 2017; Lowe 2017).

Figure 1: Household Debt and Consumption



Notes: (a) Excludes unincorporated enterprises and income is before interest payments
(b) Dashed line excludes offset account balances
(c) Owner-occupier housing debt
(d) Assumes household consumption grows at the 1960–2007 average of 0.9 per cent per quarter from March 2008 onwards

Sources: ABS; Authors' calculations; HILDA Survey Release 17.0; RBA

Supporting these concerns, international research indicates that expansions in household debt (relative to GDP) can increase the risk of financial crises and subsequently lower household spending (Schularick and Taylor 2012; Jordà, Schularick and Taylor 2013; Mian, Sufi and Verner 2017; Mian and Sufi 2018). This research has typically linked the decline in household spending to the balance sheet adjustments that tend to follow either widespread debt defaults or a tightening in bank lending standards that lowers the ability of households to borrow (e.g. Mian and Sufi 2010, 2018). Either way, the decline in spending is related to disruptions of the financial system and lower credit availability for households.

This makes Australia an interesting case study. Australia has seen a strong increase in household debt and weak spending over recent years despite a persistently stable banking system and reasonable economic growth even during the GFC. This suggests that a high level of household debt may weigh on spending even when the economy is in a more 'normal' phase of the business cycle.

So do high levels of household debt cause weaker spending? And does such a relationship exist in both an economic downturn and in more 'normal' times? We use a rich source of longitudinal household-level data to test whether higher mortgage debt causes lower household spending (which we refer to as the 'debt overhang effect'). Our unique data allow us to explore the underlying mechanisms of any debt overhang effect by looking at whether financially constrained households or households with strong precautionary saving motives are particularly sensitive to debt in their spending decisions. Relatedly, we also test for the presence of financing constraints and precautionary saving behaviour by examining whether debt matters for households at all times or only when households experience adverse income or wealth shocks (which we label the 'debt amplifier effect').

Identifying the causal effect of mortgage debt on household spending is difficult. First, an increase in spending intentions can lead to higher mortgage debt if households withdraw home equity to support consumption (reverse causality). Second, some unobserved factors, such as an increase in income expectations, may lead to higher debt and spending (omitted variables bias). In both cases, it will be more difficult to identify a negative relationship between mortgage debt and household spending. However, there are other non-causal explanations that may lead to a negative relationship between debt and spending. For instance, higher mortgage debt and lower spending on non-housing goods and services could be due to an unobserved shift in preferences towards owner-occupier housing. Alternatively, weak spending and high levels of debt may reflect the return of spending to its normal level after previously high levels of debt-financed spending (Anderson, Duus and Jensen 2016).

From a policy perspective, it is important to understand and distinguish between these mechanisms. If high levels of debt cause households to reduce their spending, providing debt relief or easing financing constraints through lower interest rates or tax incentives may lift spending. In contrast, if weak household spending is instead due to strong debt-financed spending in the past or a shift in preferences towards owner-occupier housing, such policies may merely postpone a downturn. Moreover, for a policymaker, the distinction between the debt overhang and amplifier effects is important. If debt has no direct effect on spending but affects spending only when there are shocks to income or wealth, the main concern is about the resilience of the economy to such shocks. In contrast, a direct debt overhang effect may explain why household spending in Australia has been relatively weak in recent years despite a strong labour market and rising house prices.

We address the three identification challenges outlined above using longitudinal household-level information from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. This survey is rare by international standards. It not only contains detailed annual information on consumption, income, housing assets and debt of a representative group of households over time, but also provides information on their expectations for future employment and debt, their liquidity holdings and their risk preferences. Moreover, since households are directly asked how much they spend each year, we do not need to impute expenditure like other papers in the literature.

Household-level data is imperative to deal with the challenges posed by externalities that mask any household-level effect of debt when using aggregate or regional-level data.[1] Moreover, the richness of our data allows us to control for a wide range of observable factors in estimating the effect of mortgage debt on spending. By tracking households over time, we are also able to fully control for unobserved household characteristics that likely do not vary over time but may affect the relationship between debt and spending, such as the household's level of patience. In addition, the longitudinal nature of the data allows us to explore the link between debt and spending during the GFC and in more normal times. This is in contrast to the existing research which often focuses on the linkage between debt and spending during rare episodes such as the GFC.

To further alleviate concerns about endogeneity, we adopt an instrumental variables approach using detailed survey information on each household's home purchase history. This allows us to exploit cross-sectional differences between households in the timing and location of their home purchases. We then use this information as an instrument for the level of outstanding mortgage debt today. In this empirical strategy, households that live in the same area are exposed to identical local demand shocks, but differ in the amount of debt they hold based on when they bought their home.

Based on these identification strategies, we find strong evidence for the debt overhang effect. Estimates from our preferred specification suggest that a 10 per cent increase in debt reduces household expenditure by 0.3 per cent. Notably, we find evidence for this overhang effect when we control for either a household's *gross* or *net* housing wealth. The latter implies that households lower their spending even when the *gross* value of *both* their debt and assets increases by the same amount (that is, when net wealth remains constant). In other words, a deepening of household balance sheets is associated with less household spending, even if it is not associated with rising *net* indebtedness. This directly violates conventional consumption theories such as the permanent income hypothesis (PIH), which assumes that the composition of household balance sheets does not affect consumption (Garriga and Hedlund 2017).

We do not find that any specific mechanism, such as financing constraints or precautionary saving, is driving the effect; instead, it appears to be pervasive across all mortgage borrowers, even households that are unlikely to face financing constraints or have strong precautionary saving motives. The effect is also pervasive over time and across regions and persists when allowing highly indebted households to respond more strongly to individual or local unemployment or house price shocks than less indebted households. This suggests that our results are not exclusively driven by financing constraints or precautionary saving motives or reflect the presence of a 'debt amplifier effect'. However, we do find that households are more sensitive to debt during the GFC and local

1 Estimates using aggregate data are likely to underestimate the negative effects of debt on spending. When one household takes out a mortgage to buy an existing home, the seller of the home receives the proceeds as cash and capital gains, which can increase their consumption.

house price shocks, which could suggest that financing constraints or precautionary saving motives play some role. Furthermore, we rule out some of the non-causal explanations. In particular, the debt overhang effect is evident when controlling for past spending, and also when total spending includes the consumption of (owner-occupier) housing services. This suggests that the debt overhang effect is not driven by spending normalisation or a shift in household preferences towards consuming more housing.

Finally, we use our household-level estimates to consider the potential implications of higher debt levels for aggregate consumption. Simple calculations suggest that the observed increase in aggregate mortgage debt since the GFC weighed on aggregate spending, and this debt overhang effect may explain some of the weakness in aggregate household spending since then. Specifically, we estimate that annual aggregate consumption growth would have been around 0.2 to 0.4 percentage points higher had mortgage debt remained at its 2006 level. However, these estimates abstract from other stimulatory effects of debt. The increase in mortgage debt has likely lifted house prices and by this also supported consumption over this period. Our estimates are thus best interpreted as the loss in consumption had all other trends, such as the growth in house prices, occurred even though debt remained constant. As a result, the net effect of the increase in debt since the mid 2000s is unclear.

The remainder of this paper is organised as follows. In Section 2, we discuss our contribution to the related literature. Section 3 provides an overview of the dataset used in our analysis. Section 4 presents the methodology and results for the debt overhang effect, while Section 5 aims to identify the mechanism behind this effect. Section 6 presents the results for the debt amplifier effect. In Section 7, we assess the potential effect of higher debt levels on aggregate consumption. Section 8 concludes.

2. Literature Survey and Our Contribution

The study of the effects of debt has a long history in both public and corporate finance. Since the GFC, there has also been growing interest in studying the effects of household debt. In a standard life-cycle model, households borrow and save to smooth their consumption over time and the outstanding stock of debt has no causal effect on spending decisions. Household spending depends on current net wealth, as well as current and expected future income. While debt is a component of net wealth, a change in debt can only have a wealth effect on spending if that change in debt is unanticipated and exogenous (Paiella and Pistaferri 2017).

But the assumptions of the standard life-cycle model may not hold. Most obviously, households may be restricted in their ability to borrow, have limited liquid wealth or face uncertainty about their lifetime income. The importance of borrowing and liquidity constraints as well as uncertainty for consumption has been brought to the fore during the GFC (Pistaferri 2016). To the extent that debt exacerbates borrowing or liquidity constraints or increases uncertainty about future repayment obligations, the composition of household balance sheets and, in particular, the level of debt can matter for spending. In Appendix A, we set out a simple model to illustrate the channels through which higher debt levels might affect spending, and hence explain the debt overhang mechanism.

Previous empirical cross-country evidence shows that expansions in household debt (relative to GDP) driven by (excessive) credit supply can increase the risk of financial crises and subsequently lead to

lower spending and economic growth (Schularick and Taylor 2012; Jordà *et al* 2013; Mian *et al* 2017; Mian and Sufi 2018). While this research establishes a link between debt and spending at the aggregate level, research at a more disaggregated level can provide important insights into why debt matters for spending. Exploiting regional variation in the United States, Mian and Sufi (2010) find evidence for a debt overhang effect – the regions that experienced stronger pre-crisis increases in household leverage also experienced stronger post-crisis declines in household spending. Mian, Rao and Sufi (2013), on the other hand, provide evidence for the debt amplifier effect by showing that falling housing prices exacerbated the reduction in spending in regions with relatively high levels of leverage. Household-level data is key to further unpacking these effects and identifying the underlying mechanisms.

Our results complement and extend these findings along several dimensions. First, by exploiting rich longitudinal data at the household level, we are able to better identify the causal effect of mortgage debt than studies that use aggregate or regional data. By aggregating across indebted households, region-level data implicitly put more weight on the richer households that spend more and hold more debt. If the debt overhang is less prevalent amongst rich households, this will attenuate any debt overhang effect – a mechanism that applies at the household rather than at the region level.

Second, by studying the Australian case, we generalise the results to show that debt matters even during periods of financial and economic stability. Almost all of the existing debt overhang research at the household level focuses on the GFC period in countries that experienced strong falls in house prices and large increases in unemployment, including the United States (Dynan 2012), the United Kingdom (Bunn and Rostom 2015), Denmark (Andersen *et al* 2016), and New Zealand (de Roiste *et al* 2019).[2] Evidence for the debt amplifier effect at the household level is also typically limited to periods of financial crises or recessions (Yao *et al* 2015; Atalay, Whelan and Yates 2017; Garriga and Hedlund 2017; Baker 2018). Cho, Morley and Singh (2019) provide further evidence that amplifier effects matter most during episodes of crises by showing that indebted households in the United States exhibited a considerably greater sensitivity to transitory income shocks during the GFC. While we find a similar pattern of stronger effects of debt during the GFC, we show that our results are not driven by this episode alone and that debt weighs on spending even in more 'normal' times.

Third, our rich household-level data allow us to inspect the causal mechanisms that link debt to spending. Only a handful of studies have done this. In contrast to these studies, we find the debt overhang effect to be pervasive across indebted households and find only indirect evidence for borrowing or liquidity constraints (Bunn and Rostom 2015; Baker 2018; de Roiste *et al* 2019; Cho *et al* 2019) and precautionary saving motives (Bunn and Rostom 2015; Fagereng and Halvorsen 2016) to be possible drivers. However, we can rule out non-causal explanations proposed by the literature. Specifically, our results contradict the finding of Anderson *et al* (2016) for Denmark that weak current spending can be explained by high levels of past (debt-financed) spending. Instead, we find that higher debt lowers spending even after controlling for past spending and borrowing. In contrast to other studies, we also assess the extent to which a shift in preferences towards housing services can explain the decline in spending, and find little evidence that it does.

2 Our work complements research on the role of debt for spending by Norwegian households. Similar to Australia, Norway saw little real economic impacts during the GFC and house prices fell only by 1.4 per cent in 2008 (Yao, Fagereng and Natvik 2015; Fagereng and Halvorsen 2016).

Finally, we emphasise that the debt overhang effect persists irrespective of whether we control for *gross* or *net* wealth. The latter implies that households that experience an increase in both the asset and liability sides of their balance sheet reduce their spending. This then suggests that any housing wealth effects on spending are reduced if the increase in housing prices is driven by an increase in the supply of mortgage debt. Using household-level data is crucial to isolate this channel, as the net wealth effect of rising housing prices dominates at higher levels of geographic aggregation. We also extend the findings in Mian and Sufi (2015) by showing that higher levels of mortgage debt can have real effects on the economy even if the credit expansion is just a passive response to higher housing prices.

3. Data

3.1 The Household, Income and Labour Dynamics in Australia (HILDA) Survey

We use household-level panel data from Wave 17 of the HILDA Survey to pin down the causal relationship between debt and spending (DSS and Melbourne Institute 2018). These data allow us to exploit the heterogeneity in debt holdings and spending patterns across and within households over time. The unique scope and depth of the information in the survey also allows us to examine the underlying mechanisms.

The HILDA Survey is an annual Australian survey that has tracked the same representative group of individuals (roughly 17,000 persons from 9,000 households) since 2001. We use data up to 2017. Through personal interviews and self-completed questionnaires, the survey collects detailed information on household economic behaviour, including their spending, income, debt and assets.[3] The wide range of information collected as well as the panel nature of this dataset makes it well-suited to answering our research questions.

There are a few features of the dataset that are worth highlighting. First, the survey collects information on both non-durables spending (between 2006 and 2017) and durables spending (between 2006 and 2010). Non-durables spending, as defined in this paper, covers frequently purchased items, such as groceries, fuel and utilities, while durables spending covers infrequently purchased items, such as whitegoods, motor vehicles and computers.[4] While the time series for durables spending is more limited than that for non-durables, it does cover the GFC period. Our model estimates mainly focus on total spending, though in some cases we provide separate model estimates for durables and non-durables spending.

Second, information on owner-occupier housing debt and assets are available each year, while the other components of the household balance sheet (e.g. financial assets, investor housing debt, and non-housing debt) are only available every four years. The model is estimated on an annual basis to capture relatively high-frequency changes in debt and spending. This means that we limit ourselves to studying the effect of owner-occupier housing debt rather than total household debt.

3 Expenditure items are collected through the self-completed questionnaire, which has a lower response rate than the interview (85 to 95 per cent response rate, depending on the wave).

4 Non-durable items collected are: groceries; meals out; leisure activities; child care; alcohol; cigarettes and tobacco; public transport and taxis; clothing and footwear; motor vehicle fuel, maintenance and repairs; health care (e.g. medical fees, private health insurance); telephone and internet charges; home maintenance and repairs; and education. Durable items collected are: holidays; motor vehicles; computers and related services; audio visual equipment; household appliances; and furniture.

In Australia, owner-occupier housing debt is by far the largest component of total household debt (at more than 60 per cent of the aggregate), so our results for its effect on spending at the household level should also matter for consumption at the aggregate level.[5]

Third, we use the level of owner-occupier housing debt as our measure of debt whilst controlling for income and housing wealth, as this is most closely tied with the model outlined in Appendix A and allows us to test whether the depth of household balance sheets (the level of both debt and assets) matters. This is in contrast to most of the existing literature, which uses debt *relative* to income or assets, or mortgage repayments relative to income. In Appendix E we provide results for these alternative debt indicators.

To limit the influence of large outliers on the results and ensure that households with non-positive debt, assets, housing equity or income are not excluded from the sample by default, we follow Dynan (2012) and apply the inverse hyperbolic sine (IHS) transformation to our main variables of interest. This is likely to be a serious problem in household-level studies that use the natural logarithm transformation, as a reasonable share of households have no debt or assets, or negative incomes and housing equity in some years. Also, some households report no durables spending in a given year. The IHS transformation allows us to keep these observations.

We need to place a couple of restrictions on the sample used in our estimations. Importantly, we use the sample of households that held owner-occupier debt in the previous year.[6] We drop all household-year observations with zero mortgage debt in the previous year for two reasons: first, we want to abstract from any short-term increase in spending due to taking on new debt (e.g. first home buyers furnishing their new home); and second, we observe that some previously indebted households are likely to have misreported having zero debt given that they return to a similar debt level the following year. We also remove some outlier observations since reporting error is an issue, particularly with the spending measures in the HILDA Survey.[7] Specifically, we remove household-year observations in the top or bottom 1 per cent of income, house prices, and spending growth from the sample.[8] Table C1 provides some descriptive statistics for the remaining sample as well as for the non-indebted households excluded from the sample.

The data suggest that there are some differences in spending across households with different levels of debt. Figure 2 shows the median level of durables and non-durables spending between 2006 and 2010 for highly indebted households (i.e. those in the top quartile of the debt distribution) compared with less-indebted and non-indebted households. First, highly indebted households tend to have higher levels of spending than other households since they are also more likely to be asset-rich and in the peak spending years of the life cycle (Carroll and Summers 1991; Deaton 1992; Ellis, Lawson

5 We have run the analysis on the limited sample of years for which total household debt is available, and find that the results hold for owner-occupier housing debt but not investor housing debt. This may reflect the small sample of households with investor housing debt. Because of the importance of owner-occupier debt in total housing debt, its effect on aggregate consumption is likely to dominate the effects of other types of debt.

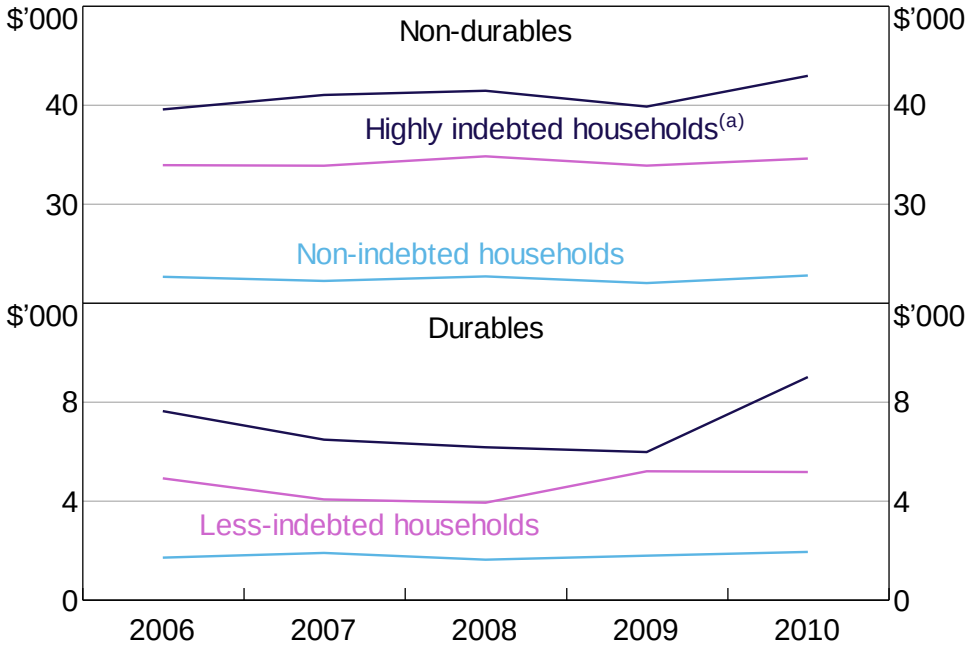
6 Similar results are found if we extend the sample to include previously indebted households.

7 The value of some expenditure items reported in the HILDA Survey, such as consumer durables, are estimated to differ by as much as 10 per cent from the more accurate estimates produced by the cross-sectional Household Expenditure Survey from the Australian Bureau of Statistics. This is mostly due to differences in data collection procedures (Wilkins and Sun 2010).

8 The top and bottom 1 per cent of total spending growth are removed from the sample for the models of total and durables spending, while the top and bottom 1 per cent of non-durables spending growth are removed from the sample for non-durables spending models since it covers a longer time period where total spending is unavailable.

and Roberts-Thomson 2003). Second, during the GFC, which had its peak unemployment effect in Australia in 2009, durables spending fell by more for highly indebted households than for other households. This is consistent with durables spending being more discretionary in nature and more easily postponed than non-durables spending.

Figure 2: Median Household Spending
By indebted status



Notes: 2017/18 dollars
(a) Highly indebted households are in the top quartile of the owner-occupier housing debt distribution
Sources: ABS; Authors' calculations; HILDA Survey Release 17.0

3.2 The Australian Mortgage Market and Liquidity-constrained Households

In examining the drivers of any debt overhang effect, we use several measures for liquidity constraints. One such measure proposed in the literature is whether households are 'hand-to-mouth', that is if they hold little liquid wealth and consume almost all their current income each period. Kaplan, Violante and Weidner (2014) (hereafter, KVW (2014)) provide a framework for identifying such 'hand-to-mouth' households – defined as households whose liquid wealth is less than half their income each pay period.

In the KVW (2014) framework, all housing wealth is illiquid. However, this is not the case in Australia due to several important features of the mortgage market discussed in Appendix B. These features increase the ability of Australian households to prepay their mortgages (at near zero cost) and thereby build up prepayment buffers which are essentially liquid wealth. This implies that prepayment buffers should be taken into account when measuring liquid wealth.

A unique feature of the HILDA Survey is the availability of data on the home purchase history of each home owner. Every four years, households are asked how much their home cost when they originally bought it and how much they borrowed at the time. By combining this information with a standard bank (credit foncier) formula that links loan repayments to the interest rate, loan term and loan amount, we can estimate the scheduled mortgage balance of each household:

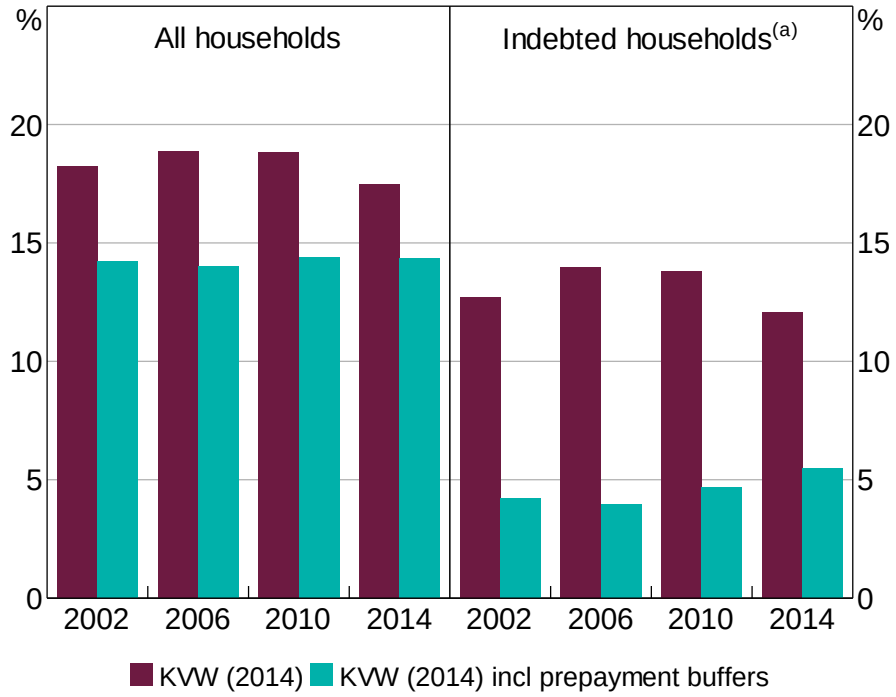
$$D_S = D_0 \frac{\left[(1+i)^T - (1+i)^k\right]}{(1+i)^T - 1}$$

where the scheduled mortgage debt balance (D_S) is a function of the stock of debt at origination (D_0), the nominal mortgage interest rate (i), the age of the loan in years (k), and the term of the mortgage in years (T).[9] The scheduled balance is the total amount that the borrower is contracted to repay at any given time based on this formula. But given the capacity to prepay, most borrowers have an *actual* mortgage balance that is lower than the *scheduled* balance. The difference between the actual and scheduled balance is an estimate of each household's prepayment buffer.

Based on this, we estimate that around 14 per cent of Australian households are liquidity constrained (Figure 3). This is slightly lower than the estimate based on the KVW (2014) definition that does not adjust for prepayments. However, the adjustment only affects home owners with mortgage debt. So the differences are much more pronounced when focusing solely on indebted households. On average, around 5 per cent of indebted homeowners are liquidity constrained using the new measure compared with 13 per cent using the KVW measure.

9 The HILDA Survey provides an estimate of debt at origination and whether the mortgage has a variable or fixed rate, or a combination of both. However, we do not have information on the contract term or the interest rate on the mortgage. We assume a standard 25-year mortgage for the loan term and we assume the mortgage interest rate is equal to a standard mortgage indicator rate based on the year in which the loan was taken out. This standard interest rate is adjusted for average discounts and any reported refinancing by the household. We apply the formula separately for variable-rate and fixed-rate mortgages. To the extent that some households have mortgages with longer maturity, their scheduled mortgage balance at any point in time might be higher than our estimate suggests. As a consequence, prepayment buffers for these households may be larger than estimated.

Figure 3: Hand-to-mouth Households
Share of households



Notes: Based on Kaplan, Violante and Weidner (2014) (KVW (2014))
(a) Households with owner-occupier housing debt
Sources: Authors' calculations; HILDA Survey Release 17.0

4. Does Mortgage Debt Affect Spending?

4.1 Identification

As discussed above, there are several challenges associated with identifying the effect of mortgage debt on spending. To see this, consider a simple regression of spending on mortgage debt at the household level:

$$E_{h,t} = \beta_0 + \beta_1 D_{h,t} + \varepsilon_{h,t}$$

where the dependent variable ($E_{h,t}$) is the level of non-housing spending of household h in year t, and the key variable of interest is the level of owner-occupier mortgage debt ($D_{h,t}$).

First, reverse causality is a problem. A household may choose to spend more than it earns, implying more borrowing and hence a higher stock of debt.[10] To partly mitigate this, we estimate the relationship between households' current spending and the previous year's mortgage debt. It is also worth noting that reverse causality would drive a positive bias in the coefficient estimate, implying that it would be harder to pin down a potential negative debt overhang effect.

Second, omitted variables can influence both spending and mortgage debt. For example, an increase in households' income expectations may lift both their intention to spend and their desire to take on

10 Households in Australia can use their mortgage debt to buy a consumption item (e.g. car, holiday) through their offset or redraw facilities; see Appendix B for more information.

debt. Alternatively, an increase in risk aversion may discourage both spending and borrowing. Again, this is most likely to induce a positive correlation between spending and debt and attenuate any negative debt overhang effect.

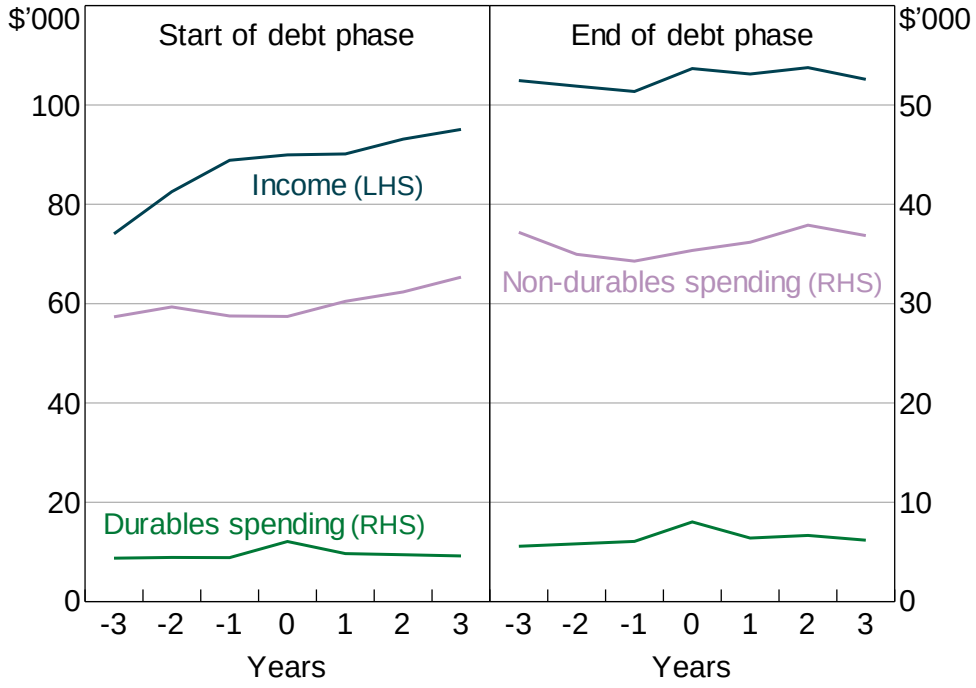
Some of the challenges in identifying the causal effect of mortgage debt on spending are highlighted in an 'event study' around the time of home purchase. Most home purchases in Australia are financed at least in part through mortgage debt. When a household buys a home for the first time (or when they trade up to a larger/higher-quality home) they typically take on a large amount of debt. And when they buy a new home they also tend to spend more on either furnishing the new home or renovating their existing home for sale.

Given the HILDA Survey is longitudinal in nature we can observe the spending, income and debt of a household both before and after home purchase (Figure 4, left panel). In the year of home purchase, there is a notable jump in spending on durable goods. In the year after home purchase, durable goods spending returns to the pre-purchase level. This pattern of home purchase-related debt accumulation and spending in one year followed by lower spending the next year would lead us to empirically find a negative correlation between current spending and lagged mortgage debt. But the relationship would not be causal – it would be driven by an omitted variable – the decision to buy a new home. This would be similar to the 'spending normalisation' hypothesis (Andersen *et al* 2016). In contrast to the findings of Gross (2017) for the United States, we find little evidence of a fall in non-durable spending around the time of home purchase.

Another notable feature of this event study is the rise in household income in the years leading up to the purchase. We find that this is partly due to households working longer hours, presumably to save for a home deposit. But, in line with Gross (2017), it also seems to reflect a 'selection effect'; the households that choose to buy a new home are those that received an increase in income (through, say, a promotion or bonus). Either way, this event study highlights the need to control for factors that influence both debt and spending behaviour, such as the age, income, wealth and labour force characteristics of the household.

A similar event study can be undertaken around the year in which households fully pay off their mortgage. Under the PIH, household spending should not respond to anticipated changes in scheduled debt. We would expect spending to remain constant. At odds with this prediction, and suggesting that debt may constrain spending, we find that durables spending increases in the year that households fully repay their mortgage debt and non-durables spending increases in the years following (Figure 4, right panel). The increase in spending is larger than both the observed increase in disposable income and the average mortgage payment prior to paying off the debt, which suggests that the spending response cannot be fully explained by cash flow effects.

Figure 4: Household Spending and Disposable Income
Indebted households, median



Notes: 2017/18 dollars; households with owner-occupier housing debt
Sources: ABS; Authors' calculations; HILDA Survey Release 17.0

4.2 Household Fixed Effects Model

To deal with the issues highlighted above, we exploit the rich longitudinal information available in the HILDA Survey. To test whether debt levels directly influence spending, we first estimate the following regression model, which we refer to as the fixed effects (FE) model:

$$E_{h,t} = \beta_0 + \beta_1 D_{h,t-1} + \beta_2 Y_{h,t} + \beta_3 A_{h,t-1} + \boldsymbol{\gamma} \mathbf{X}_{h,t} + \delta_h + \varepsilon_{h,t}$$

This model includes the lagged level of owner-occupier mortgage debt ($D_{h,t-1}$) as the key variable of interest, household disposable income ($Y_{h,t}$) and the lagged reported home value ($A_{h,t-1}$). The model also includes a set of control variables ($\mathbf{X}_{h,t}$), to summarise the other observed determinants of spending, including factors associated with a household's permanent income, such as age, education and labour force status of the household reference person.[11] The model includes a household fixed effect (δ_h) which captures household characteristics that determine spending but are plausibly invariant over time (e.g. degree of impatience and risk aversion). Estimates are presented with and without the household fixed effect to gauge the importance of these characteristics. Our results are robust to including year fixed effects.

11 See Table D1 for definitions of the variables used in the regression models. We identify the household reference person as the individual with the longest household membership, the highest personal income, or the highest age, in that order.

4.3 Instrumental Variables Model

To further alleviate any endogeneity concerns about unobserved time-varying confounding factors (such as changes in income expectations or local labour demand shocks), we also adopt an instrumental variables approach. For this, we exploit the home purchase history of each owner-occupier household in the survey. We use information on the timing of their most recent home purchase relative to other home owners in the same postcode as an instrument for the level of owner-occupier housing debt held by the household. The logic behind this instrument is that households living in the same area are exposed to identical time-varying local demand shocks, but differ in their debt holdings based on when they happened to purchase their home. The instrument should therefore be correlated with outstanding mortgage debt but uncorrelated with differences in spending for borrowers in the same postcode other than their level of debt.[12]

To take a hypothetical example, suppose there are two households that own identical homes in the same street. The only difference between them is that household A bought before a local housing boom happened while household B bought after. It is plausible that household A borrowed less (in dollars) than household B because housing prices in the area were lower when household A made their purchase decision. The timing of the purchase decision should not affect the spending of household A relative to household B over and above its impact on their respective levels of indebtedness.

Australia experienced a large housing price boom in the early 2000s. The timing of this boom varied by state, generally starting in 2001 in the larger capital cities of Sydney, Melbourne and Brisbane, and in 2002 in other capital cities. We can think of the households that bought just before the boom in housing prices as the 'lucky' households while the comparable households that bought just after the boom are 'unlucky'. To the extent there are other differences between households that bought before and after the boom that affect their consumption behaviour (such as the level of housing wealth), we can only control for observable differences in the model.

To gauge the relevance of the instrument, we compare the average initial debt holdings of households purchasing homes just before and just after the boom (Figure 5). There is a clear jump in average mortgage debt for those households that were 'unlucky' to buy just after the housing boom compared to the 'lucky' households that bought just before the boom.[13] Based on the weak identification test in Stock and Yogo (2005), the instrument is found to be significantly correlated with the household's current holdings of mortgage debt (even after the age of loan is taken into account).

12 We assume that households make mortgage prepayments at the same speed across the age of the loan.

13 The jump in average household debt levels is unique to the reference years chosen around state housing price booms. We find little difference in the average debt levels when using alternative reference years.

Figure 5: Household Debt
Of pre-boom and post-boom home buyers

Notes: Average debt levels in 2017/18 dollars; debt levels are observed one year after purchase, housing price boom is assumed to have occurred in 2001 for NSW, Vic and Qld and 2002 for other states and territories
Sources: ABS; Authors' calculations; HILDA Survey Release 17.0

This second model is based on a two-stage least squares regression, which we refer to as the instrumental variables (IV) model:

$$D_{hp,t} = \alpha_0 + \alpha_1 BOOM_{hp} + \alpha_2 Y_{hp,t} + \alpha_3 A_{hp,t-1} + \boldsymbol{\rho}\mathbf{X}_{hp,t} + \sigma_p + \mu_{hp,t}$$

$$E_{hp,t} = \beta_0 + \beta_1 \hat{D}_{hp,t-1} + \beta_2 Y_{hp,t} + \beta_3 A_{hp,t-1} + \boldsymbol{\gamma}\mathbf{X}_{hp,t} + \theta_p + \varepsilon_{hp,t}$$

where most of the variables are as denoted before and p denotes the postcode in which household h lives. The main difference is that owner-occupier housing debt is estimated in the first-stage regression using a dummy variable ($BOOM_{hp}$) as an instrument. The dummy variable takes the value of one if a household purchased their home after the early 2000s housing price boom in the state of purchase and zero otherwise.[14] To control for the location choice of the household in their home purchase decision, we drop the household fixed effects and instead include postcode fixed effects (θ_p) in the model. Otherwise the timing of home purchase (the 'birth cohort' of the mortgage) will be absorbed by the household fixed effect. Thus, whilst this approach may help to alleviate endogeneity concerns by controlling for unobserved time-varying factors such as local demand shocks, the resulting estimator will include the effects of household debt on spending both within households (over time) and between households (at a point in time).

14 Purchased after 2001 in New South Wales, Victoria and Queensland, and after 2002 in all other states and territories.

4.4 Results

4.4.1 Baseline models

Table 1 presents the key results from estimating the OLS, FE and IV models for durables, non-durables and total spending (see Appendix F for full table of results).

Table 1: The Debt Overhang Effect – Baseline Models
By type of spending

	Model								
	Non-durables spending 2006–17			**Durables spending 2006–10**			**Total spending 2006–10**		
	OLS	FE	IV	OLS	FE	IV	OLS	FE	IV
Lagged mortgage debt	>–0.00	–0.01**	–0.15***	–0.07*	–0.10*	–0.80***	–0.01	–0.03***	–0.20***
	(0.77)	(0.03)	(<0.00)	(0.05)	(0.10)	(<0.00)	(0.11)	(0.01)	(<0.00)
Income	0.26***	0.10***	0.28***	1.02***	0.36**	1.09***	0.30***	0.09***	0.33***
	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(0.02)	(<0.00)	(<0.00)	(<0.00)	(<0.00)
Lagged home value	0.21***	0.17***	0.32***	0.55***	0.28	1.01***	0.26***	0.11**	0.38***
	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(0.28)	(<0.00)	(<0.00)	(0.04)	(<0.00)
First-stage: Boom dummy			0.46***			0.45***			0.45***
			(<0.00)			(<0.00)			(<0.00)
Household FE	No	Yes	No	No	Yes	No	No	Yes	No
Postcode FE	No	No	Yes	No	No	Yes	No	No	Yes
Observations	21,460	21,460	21,460	6,622	6,622	6,622	6,622	6,622	6,622

Notes: The sample excludes non-indebted households in the previous year and the top and bottom 1 per cent of income growth, spending growth and housing price growth; controls include household income, lagged home value, age dummies, education dummies, number of children, number of adults, marital status, unemployment and not in the labour force status; standard errors are clustered by household; *, **, *** represent statistical significance at the 10, 5 and 1 per cent levels, respectively; *p*-values are in parentheses

Sources: Authors' calculations; HILDA Survey Release 17.0

We find that higher mortgage debt reduces household spending across all specifications. The overall similarity between our FE estimates and the OLS estimates suggests that unobservable time-invariant variables do not play a major role after controlling for a range of household socio-economic characteristics. The FE model specification suggests that the effect of debt on spending is relatively small with a 10 per cent increase in debt reducing households' non-durables, durables and total spending by 0.1, 1.0 and 0.3 per cent, respectively. The stronger response of durables relative to non-durables spending is consistent with the common finding of larger wealth effects for durables spending.

The IV model estimates provide further evidence that the negative debt overhang effect is not driven by unobservable, time-varying factors such as local demand shocks. The first-stage regression estimates indicate that our instrument is relevant and that households that bought after the boom held mortgage debt levels that were about 45 per cent higher than comparable households living in the same area that bought before the boom. The second-stage IV estimates are more economically significant than those in the FE model and suggest that a 10 per cent increase in debt lowers non-durables, durables, and total spending by 1.5, 8.0 and 2.0 per cent, respectively. While the IV model

may help to further remove time-varying confounding factors, it does not account for unobserved household fixed effects. We therefore take the FE model estimates as our benchmark estimates for the remainder of the paper.

In these regressions, we control for household income and the lagged value of *gross* housing assets. As expected, higher household income and housing prices raise spending. In contrast to the estimated effect on debt, the OLS coefficient estimates on income and home value are considerably larger than the FE estimates, suggesting that unobserved time-invariant factors are significant drivers behind the positive relationship between spending and both income and housing prices. For example, it may be the case that impatient households spend more and buy more expensive homes than patient households, and this partly explains the positive link between spending and home values.

We also estimate all three models using three additional debt measures (the debt-to-income, debt-to-assets and debt service-to-income ratios) that are commonly used in the literature. The results are presented in Appendix E. Using the IV model, we find some evidence that higher debt ratios negatively affect household spending, consistent with a number of papers that have found evidence of a significant negative relationship between these debt ratios and spending. In particular, we find that a 10 percentage point increase in the debt-to-assets ratio or debt-servicing ratio significantly reduces total household spending by 0.1 per cent.

4.4.2 Gross versus net housing wealth

In the previous regressions, we control for gross housing wealth. Another possibility is to control for net housing wealth (housing equity), equal to the difference between the reported value of the home and any outstanding mortgage debt. This allows us to directly test whether the composition of household balance sheets matters for spending. The results can be found in Table 2.

Overall, our estimates of the effect of debt on household spending are broadly unchanged when we control for households' housing equity instead of the value of their home. Importantly, this implies that households lower their spending when the gross value of both their debt and their assets increases. In other words, we find that a deepening of household balance sheets is associated with less household spending, even if it is not associated with rising *net* indebtedness. This directly violates conventional consumption theories such as the PIH that assume the composition of a household's balance sheet does not affect consumption (Garriga and Hedlund 2017). Our results suggest a small, and occasionally negative, effect of lagged housing equity on spending. When using contemporaneous housing equity, we recover the expected positive effect.

Table 2: The Debt Overhang Effect – Baseline Models (Housing Equity)
By type of spending

	Model								
	Non-durables spending 2006–17			**Durables spending 2006–10**			**Total spending 2006–10**		
	OLS	FE	IV	OLS	FE	IV	OLS	FE	IV
Lagged mortgage debt	0.02***	–0.01	–0.12***	–0.01	–0.08	–0.75***	0.02*	–0.03**	–0.17***
	(<0.00)	(0.19)	(<0.00)	(0.74)	(0.17)	(<0.00)	(0.06)	(0.04)	(<0.00)
Income	0.33***	0.12***	0.34***	1.19***	0.38**	1.22***	0.38***	0.10***	0.38***
	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(0.01)	(<0.00)	(<0.00)	(<0.00)	(<0.00)
Lagged housing equity	<0.00***	>–0.00	–0.01***	0.01	0.01	–0.05***	0.01**	<0.00	–0.01***
	(0.01)	(0.85)	(<0.00)	(0.47)	(0.59)	(<0.00)	(0.01)	(0.31)	(<0.00)
First-stage: Boom dummy			0.47***			0.44***			0.44***
			(<0.00)			(<0.00)			(<0.00)
Household FE	No	Yes	No	No	Yes	No	No	Yes	No
Postcode FE	No	No	Yes	No	No	Yes	No	No	Yes
Observations	21,460	21,460	21,460	6,622	6,622	6,622	6,622	6,622	6,622

Note: See notes to Table 1
Sources: Authors' calculations; HILDA Survey Release 17.0

5. Why is There a Negative Effect of Debt on Spending?

The results from our models suggest that there is a significant negative relationship between the level of household debt and spending. However, this need not be driven by the debt overhang mechanism. In this section, we explore possible underlying mechanisms.

5.1 The Debt Overhang Channels

We first explore two mechanisms that imply that the link between debt and spending is causal. Following the literature and our theoretical model in Appendix A, these mechanisms are borrowing and liquidity constraints (which we summarise as financing constraints) and precautionary saving motives. To test these hypotheses, we estimate whether the negative effect of debt is driven exclusively by households that we identify as likely to be constrained or have strong precautionary saving motives. Accordingly, we add to our models an interaction term between debt and household characteristics that are plausibly associated with financing constraints or precautionary saving ($Z_{h,t}$). We focus on the FE model and adjust it to the following form:

$$E_{h,t} = \beta_0 + \beta_1 D_{h,t-1} + \beta_2 Y_{h,t} + \beta_3 A_{h,t-1} + \pi_1 D_{h,t-1} \times Z_{h,t} + \pi_2 Y_{h,t} \times Z_{h,t} + \pi_3 A_{h,t-1} \times Z_{h,t} + \beta_4 Z_{h,t} + \boldsymbol{\gamma} \mathbf{X}_{h,t} + \delta_h + \varepsilon_{h,t}$$

5.1.1 Borrowing and liquidity constraints

To test whether borrowing and liquidity constraints drive the negative relationship between debt and spending, we interact indicators of leverage and liquidity with our balance sheet and income measures. We expect borrowing constraints to be binding for households with a high stock of debt relative to assets. For this purpose, we test if households with loan-to-valuation ratios (LVRs) above

80 per cent adjust their spending by more in response to changes in income, wealth or debt, than households with a low LVR.

We proceed similarly when testing for the importance of liquidity constraints. Here, the first indicator is a dummy variable that is equal to one if the household is hand-to-mouth (adjusted for mortgage prepayments) and zero otherwise. The second indicator is a dummy variable that is equal to one if the household reports being behind on their mortgage payments and zero otherwise. A household that is behind on its repayments will have no prepayment buffer with which to offset unexpected income shocks. The third indicator measures the financial stress of each household. This dummy variable is equal to one if the household reports financial problems, such as the inability to quickly raise emergency funds, and zero otherwise.[15]

If financing constraints drive our results, these interaction terms should be negative. However, we find the debt overhang effect to be pervasive across households and not sensitive to our proxies for borrowing or liquidity constraints (Table 3). All interaction coefficients between debt and our proxies for constraints are statistically insignificant. Furthermore, constrained households also do not appear to be more sensitive to changes in their income or home value. While this appears to suggest that financing constraints are not the main drivers of the negative relationship between debt and spending, it is possible that our proxies do not adequately identify these constraints.

Table 3: Debt Overhang and Financing Constraints

Total spending, 2006–10

	Mechanism			
	Borrowing constraints	**Liquidity constraints**		
	Lagged LVR >80%	Hand-to-mouth	Behind on repayments	Financial stress
Lagged mortgage debt	–0.03**	–0.03***	–0.03***	–0.05***
	(0.02)	(0.01)	(0.01)	(<0.00)
Lagged mortgage debt × constrained	–0.02	<0.00	<0.00	0.02
	(0.88)	(0.52)	(0.78)	(0.47)
Income	0.11***	0.09***	0.09***	0.13***
	(<0.00)	(<0.00)	(<0.00)	(<0.00)
Income × constrained	–0.14*	0.03	–0.01	0.01
	(0.02)	(0.61)	(0.82)	(0.81)
Lagged home value	0.09*	0.11**	0.08	0.10*
	(0.08)	(0.03)	(0.12)	(0.06)
Lagged home value × constrained	0.12	–0.04	0.05	0.02
	(0.44)	(0.48)	(0.17)	(0.75)

Note: See notes to Table 1
Sources: Authors' calculations; HILDA Survey Release 17.0

15 See La Cava and Simon (2003) for more details on the measure of financial stress.

We also estimate these models controlling for household cash flow, measured as income after taxes and mortgage payments rather than after-tax income alone. We find that the estimated effect of debt on spending is smaller, but still statistically significant. This provides further indirect evidence that liquidity (or cash flow) constraints are not the sole explanation for the debt overhang effect. So we next consider the role of precautionary saving motives.

5.1.2 Precautionary saving

Unlike most comparable household surveys, the HILDA Survey asks about households' employment type and their expectations of future employment, which helps to identify uncertainty about future income. In this section, we use a household's self-assessed probability of losing their job, as well as the household's casual employment status, to test whether uncertainty significantly influences the effect of debt on spending.[16] Having a high perceived probability of losing a job or low job security as a casual worker should capture households facing high income uncertainty, and therefore having a stronger motive for precautionary saving.

We find that households with lower job security appear to be more sensitive to higher debt levels, but the estimated effects are not statistically significant and the overall negative relationship between debt and spending continues to hold for all households (Table 4). As a result, based on these proxies, we find a persistent negative relationship between debt and spending for all households, and little evidence that uncertainty strengthens the negative relationship between debt and spending.

Table 4: Debt Overhang and Precautionary Saving

Total spending, 2006–10

	Precautionary saving motives	
	Casual worker	Probability lose job >0
Lagged mortgage debt	–0.03**	–0.05***
	(0.01)	(0.01)
Lagged mortgage debt × uncertain	–0.06	0.02
	(0.15)	(0.27)
Income	0.11**	0.15***
	(0.01)	(<0.00)
Income × uncertain	–0.02	–0.10**
	(0.79)	(0.04)
Lagged home value	0.11*	0.11
	(0.08)	(0.10)
Lagged home value × uncertain	0.16	0.03
	(0.11)	(0.53)

Note: See notes to Table 1
Sources: Authors' calculations; HILDA Survey Release 17.0

16 Our proxies for high job uncertainty are the maximum probability of a household member losing their job (equal to one for any positive probability of job loss) and whether the household reference person is employed as a casual worker. Since most households assign a zero probability of losing their job, we identify job-insecure households as households with any positive probability of losing their job. Our results are robust to setting a higher threshold.

5.2 Non-causal Explanations for a Negative Effect of Debt on Spending

5.2.1 The spending normalisation hypothesis

Andersen *et al* (2016) suggest that the presence of a negative effect of debt on spending could be due to 'spending normalisation' rather than the causal debt overhang mechanism. Households take on debt to finance a large purchase and subsequently reduce their spending back to normal levels (as highlighted by the event study earlier). The macroeconomic policy implications of spending normalisation are quite different to those for debt overhang, so it is important to examine this.

To test the spending normalisation hypothesis, we introduce a lagged dependent variable into the FE model and control for any bias introduced by this lag using the Arellano-Bond estimation procedure (Arellano and Bond 1991). The lagged variable should capture any negative effect due to 'spending normalisation' between the previous and current period. We refer to this as the 'dynamic model'.

$$E_{h,t} = \beta_0 + \alpha E_{h,t-1} + \beta_1 D_{h,t-1} + \beta_2 Y_{h,t} + \beta_3 A_{h,t-1} + \boldsymbol{\gamma}\mathbf{X}_{h,t} + \delta_h + \varepsilon_{h,t}$$

In addition, we also follow the approach used in Andersen *et al* (2016) and separately introduce the lagged growth in household debt into our FE and IV models. The advantage of this approach over the dynamic model is that it maintains a larger sample size, since the dynamic model requires multiple lags to be used as instruments. The lagged growth in debt should capture whether the negative effect of debt is due to previous changes in debt (e.g. spending normalisation) or the level of debt (e.g. debt overhang).

The results from the dynamic model, as well as the models controlling for the growth in debt, suggest that spending normalisation cannot explain the negative relationship between debt and spending. This is consistent with the statistically significant negative effect of lagged debt on non-durables spending in Table 1. Non-durables spending is less likely to be affected by spending normalisation since non-durable items tend to be less lumpy and smaller in size. The link between lagged debt and contemporaneous spending persists even after including lagged spending or changes in debt. Moreover, the estimated coefficient remains significant even when using the Arellano-Bond estimation procedure which reduces the sample size considerably. In contrast to Andersen *et al* (2016), we find no evidence that lagged spending or lagged *changes* in debt explain lower spending today.

Table 5: Spending Normalisation
Total spending, 2006–10

	Model		
	Dynamic Arellano-Bond (1991)	**FE** Andersen *et al* (2016)	**IV** Andersen *et al* (2016)
Lagged mortgage debt	–0.01**	–0.03*	–0.27***
	(0.04)	(0.08)	(<0.00)
Lagged spending	–0.09		
	(0.23)		
Lagged growth in mortgage debt		>–0.00	<0.00***
		(0.78)	(<0.00)
Income	0.12***	0.13***	0.35***
	(<0.00)	(<0.00)	(<0.00)
Lagged home value	0.07	0.08	0.43***
	(0.25)	(0.18)	(<0.00)
Observations	4,134	5,494	5,494

Note: See notes to Table 1
Sources: Authors' calculations; HILDA Survey Release 17.0

5.2.2 The housing preferences hypothesis

Next, we consider whether a shift in household preferences towards owner-occupier housing might be driving the correlation between mortgage debt and spending. Note that so far our measure of spending relates specifically to non-housing goods and services. A negative correlation between mortgage debt and non-housing spending could be due to households shifting preferences towards housing and away from other goods and services (with this increased housing consumption at least partly financed through mortgage debt).

To address this, we adjust our measures of household spending and income to include the imputed rent on owner-occupier housing.[17] If the increase in debt reflects a shift towards housing spending alone, we should see no effect of debt when we include owner-occupier housing spending in total spending.

Table 6 presents the results from the FE and IV models using the adjusted measure of household spending and income. In both models, the effect of mortgage debt on total spending is weaker than previously. However, the negative effect of debt persists, suggesting that the shift in household preferences is not the only driver of the relationship between debt and spending. Our estimates suggest that the preference shift accounts for at most one-third to half of the total negative effect of debt on spending.

17 We estimate imputed rent as 5 per cent of the estimated home value less mortgage repayments.

Table 6: Housing Preferences Hypothesis
Total spending including imputed rent, 2006–10

	Model	
	FE	IV
Lagged mortgage debt	–0.02***	–0.14***
	(<0.00)	(<0.00)
Income	0.16***	0.34***
	(<0.00)	(<0.00)
Lagged home value	0.17***	0.49***
	(<0.00)	(<0.00)
Observations	6,622	6,622

Note: See notes to Table 1
Sources: Authors' calculations; HILDA Survey Release 17.0

6. Does Debt Amplify the Effect of Financial Shocks on Spending?

Next, we explore whether the level of debt makes households more sensitive to other financial shocks (the debt amplifier effect). The debt overhang and debt amplifier effects are intrinsically linked, since financing constraints and uncertainty are likely to be more significant during financial shocks. While this makes it hard to disentangle the debt overhang and amplifier effects, especially at times of large financial shocks, significant debt amplifier effects may provide indirect evidence for the importance of financing constraints and precautionary saving motives in driving the effect of debt on spending.

We measure a financial shock in four ways. First, the GFC is used to capture an aggregate shock.[18] Next, we use two measures of a local economic shock: an increase in the regional unemployment rate by more than 1 percentage point in a given year; and a fall in postcode-level housing prices by more than 5 per cent over a year. Finally, we use the household reference person becoming unemployed as a measure of a household-level shock.

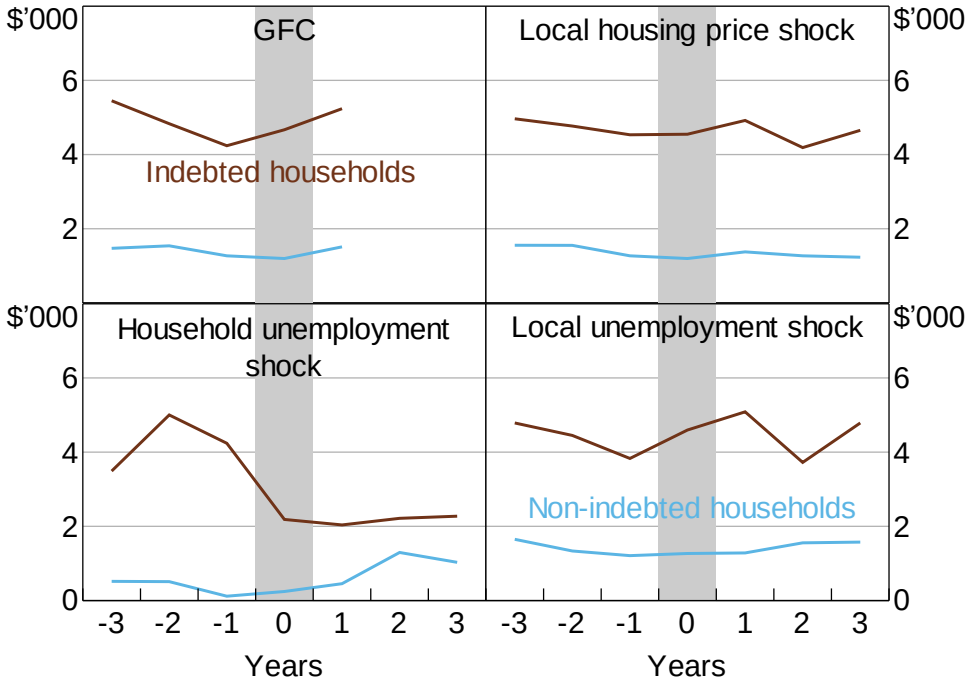
If debt makes households more sensitive to shocks, then the spending of highly indebted households should fall by more than the spending of comparable households with lower levels of debt in response to a negative shock. This is precisely what we see in the event of a household unemployment shock (Figure 6).[19] The indebted household reduces its spending on durable goods by more than the non-indebted in the year of the household unemployment shock and spending remains subdued after the shock.[20] In contrast, the effects of the GFC and local economic shocks appear to have been broadly similar across indebted and non-indebted households, although indebted households tend to increase their spending after local economic shocks.

18 While the financial crisis began in 2007, the effects of the global recession on Australia were not evident until late 2008. From late 2008 to mid 2009, the unemployment rate increased and salary income fell. The unemployment rate peaked in mid 2009, but remained relatively high for the rest of 2009. Given our focus on households as well as the annual frequency of our data, we define the crisis period as 2009.

19 Due to small sample sizes for some shocks, in Figure 6 we compare indebted and non-indebted households rather than highly indebted and less-indebted households.

20 We focus on durables spending in Figure 6 as purchases of durable items are easier to postpone when a shock occurs. However, we find a similar pattern for non-durables spending before and after an unemployment shock.

Figure 6: Median Durables Spending
Years before and after shocks, by indebted status



Notes: 2017/18 dollars; households with and without owner-occupier housing debt
Sources: ABS; Authors' calculations; HILDA Survey Release 17.0

While these event studies provide some evidence that debt levels could amplify households' responses to financial shocks, they fail to take into account differences in the characteristics of indebted and non-indebted households, making it unclear whether it is debt per se that is behind the differences in responses. To address this more formally, we add an interaction term between the level of debt and the $SHOCK$ into the FE model. We then test whether the interaction coefficient is significantly different from zero. For example, the FE model is:

$$E_{h,t} = \beta_0 + \beta_1 D_{h,t-1} + \beta_2 Y_{h,t} + \beta_3 A_{h,t-1} + \beta_4 SHOCK_{h,t} + \varphi_1 D_{h,t-1} \times SHOCK_{ht} + \varphi_2 Y_{h,t} \times SHOCK_{h,t} + \varphi_3 A_{h,t-1} \times SHOCK_{h,t} + \boldsymbol{\gamma} \mathbf{X}_{h,t} + \delta_h + \varepsilon_{h,t}$$

Table 7 presents the results for each financial shock. As before, we find a persistent negative and quantitatively similar effect of debt on spending. This suggests that our results for the debt overhang effect are not driven by a higher sensitivity of indebted households to income or wealth shocks alone. We find some evidence for the debt amplifier effect, though it is not present in all specifications.

The debt interaction coefficient is negative for all shocks, but only significantly different from zero for the GFC and the local housing price shocks. These shocks increase the negative effect of debt on spending to around –0.05 or –0.06 per cent. While the event study suggests that households with more debt reduce their spending by more if they become unemployed, the regression estimates do not confirm this. However, even though the interaction effect of debt with household unemployment shocks is negative, it could be imprecisely estimated due to the small sample of survey respondents that have debt and have become unemployed.

Table 7: Debt Amplifier during Financial Shocks
Total spending, 2006–10

	Global financial crisis	Local housing price shock	Household unemployment shock	Local unemployment shock
Lagged mortgage debt	–0.02*	–0.03**	–0.03**	–0.03**
	(0.07)	(0.03)	(0.01)	(0.04)
Lagged mortgage debt × financial shock	–0.03**	–0.03*	–0.13	–0.02
	(0.03)	(0.07)	(0.34)	(0.22)
Income	0.10***	0.09***	0.09***	0.09***
	(<0.00)	(<0.00)	(<0.00)	(<0.00)
Income × financial shock	<0.00	0.02	0.03	<0.00
	(0.94)	(0.59)	(0.92)	(0.88)
Lagged home value	0.11**	0.11**	0.11**	0.10*
	(0.04)	(0.04)	(0.04)	(0.06)
Lagged home value × financial shock	0.01	0.01	–0.23*	0.02
	(0.64)	(0.73)	(0.09)	(0.54)
Observations	6,622	6,619	6,599	6,622

Note: See notes to Table 1
Sources: Authors' calculations; HILDA Survey Release 17.0

7. Implications for Aggregate Household Spending

The results so far provide some evidence for the debt overhang effect at the household level. A key question for policymakers is whether the results generalise to the aggregate level. Few papers have attempted to infer the aggregate implications from higher debt on spending, with the exception of Bunn and Rostom (2015). In this section, we use our preferred estimates from the FE model to draw some conclusions about the potential aggregate implications. We conduct two thought experiments. In the first experiment we use macro data and ask what aggregate consumption would have looked like had household debt remained at its 2006 level. In the second experiment we use our household-level data and compare actual spending of households in 2010 to their spending had their debt level remained at its 2006 level.

There are several limitations of these approaches and the estimates should be used as a rough guide only. Both experiments identify a partial effect of debt on aggregate spending. In particular, we only capture the (negative) effect on spending of home buyers that take on new mortgage debt but do not capture the (positive) spending response of the seller. But, if one household is buying a house for the first time or trading-up to a larger, more expensive house, often another household is on the other side of the transaction and selling their existing house. This household is liquidating their housing wealth. While the seller may invest in another house again, some share of the liquidated wealth will likely end up in consumption at some point, thereby lifting aggregate spending.[21] Mortgage-financed housing demand may further stimulate construction and, in consequence, lift aggregate consumption. Additionally, an increase in demand for mortgages should raise mortgage

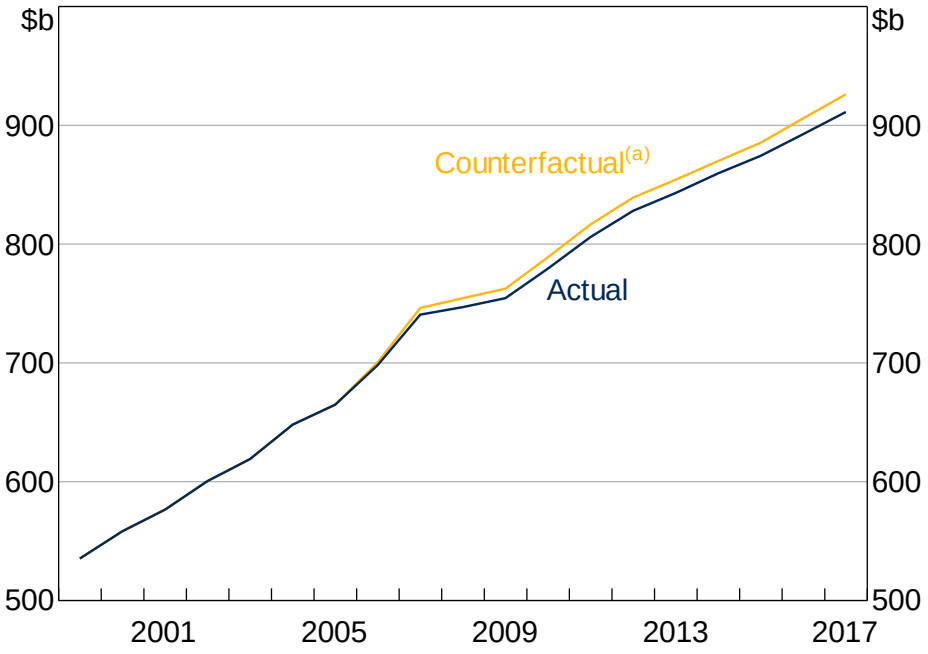
21 Household survey estimates indicate that, in 2004, households spent only around 13 per cent of the equity withdrawn in the process of a property transaction on consumption items, mainly durables, and in particular motor vehicles (Schwartz *et al* 2006).

interest rates (all else equal). This could induce saving by other households and increase the returns to lenders. Finally, for both thought experiments we do not allow the sensitivity of spending to debt to vary across households.[22] Moreover, for the first thought experiment we assume that the aggregate effect of higher debt does not depend on the distribution of that debt, or that distribution, to change over time.

7.1 Using Macro Data

Using macro data allows us to gauge the aggregate effect of debt on consumption beyond the HILDA Survey sample period. Our elasticity estimate of –0.03 from the FE model (Table 1) and the observed average annual growth in real owner-occupier housing debt of around 5 per cent between 2006 and 2017 suggests that real annual consumption growth would have been around 0.15 percentage points higher had debt remained at its 2006 level (all else equal). This suggests that by 2016, consumption would have been around 1.6 per cent higher had there been no increase in debt since 2006 (Figure 7).

Figure 7: Household Final Consumption Expenditure
Estimated effect of increase in debt between 2006 and 2017



Note: (a) Assumes no change in debt between 2006 and 2017, an elasticity estimate of –0.03 and average annual growth in real owner-occupier housing debt of around 5 per cent

Sources: ABS; Authors' calculations

22 To best understand the effect on the aggregate, one could use a structural model that explicitly allows for heterogeneous agents, financing frictions and general equilibrium effects (e.g. Kaplan, Moll and Violante 2018). We leave this for future work.

It is important to stress that this analysis assumes that all other economic trends that supported consumption over the period would have occurred anyway. For instance, housing prices increased strongly between 2006 and 2016, supporting consumption. But some of the increase in housing prices was likely driven by higher debt. Had debt remained at its 2006 level, house prices would not have increased by the same amount. As a consequence, the actual path of consumption includes the stimulatory effect of higher house prices through higher debt. Our estimates of a 1.6 per cent increase in consumption in the absence of an increase in debt therefore assume that housing prices would have increased for non-debt related reasons. Furthermore, we assume that all households increased their debt holdings uniformly and adjusted their spending in the same way.

7.2 Using Micro Data

To address some of the distributional concerns of differential changes in debt across households, we use the HILDA Survey data to examine how much each household changed spending due to changes in its debt holdings between 2006 and 2010, and then sum these differences across all households. In contrast to the previous section, this allows for heterogeneity in debt growth across households.[23] For each household, we compare the observed level of spending ($E_{h,t}$) with a counterfactual level of spending under the assumption that debt did not change ($\hat{E}_t^{cf}$).

The counterfactual level of spending is estimated by taking the difference between the observed spending and the attributed effect of the change in debt of each household and then summing these differences across all households. We use the *level* change in household debt instead of the percentage change in order to keep households in the sample without any debt in 2006 for which the percentage change would be undefined. Using the level change in debt, however, requires us to transform our elasticity estimates (the percentage spending response to a percentage change in debt) to estimates of the marginal propensity to consume (MPC, the level spending response to a level change in debt).

Using the MPC instead of elasticities is in line with the related literature on the effects of changes in wealth on consumption. We can obtain an aggregate MPC out of mortgage debt in two ways. First, we can scale our estimated elasticity coefficient by the ratio of aggregate total consumption expenditure to lagged mortgage debt. From 2006 to 2010, the ratio of annual consumption to owner-occupier mortgage debt averaged at around 105 per cent, which – multiplied with our coefficient of –0.03 from the FE model in Table 1 – implies an aggregate MPC of –3.2 cents per dollar increase in mortgage debt. Second, we can estimate the MPC directly by re-specifying our regression in level changes rather than using the IHS transformation. Our dependent variable is then the change in household spending, and our three main independent variables are level changes in income, lagged housing debt and lagged home value. The average MPC we obtain using this approach is around –2.0 cents per dollar (not statistically significant at the 10 per cent level).[24]

23 It also allows us to consider the full sample of households, not only households with mortgage debt.

24 When we control for level changes in lagged housing equity instead of lagged home value, we obtain an MPC of 2.5 cents per dollar. Our three estimates for the MPC out of mortgage debt are broadly of similar size compared to estimates for the MPC out of housing wealth for Australia of around 2.5 cents per dollar (Dvornak and Kohler 2007; Windsor, Jääskelä and Finlay 2013; Gillitzer and Wang 2015).

Using our estimates for the MPC, we can then obtain the counterfactual level of aggregate spending as:

$$\hat{E}_t^{cf} = \left(\sum_h \left(E_{h,t} - \overline{MPC} \times \Delta D_{h,t} \right) \right)$$

The results of the counterfactual exercise are presented in Table 8. Interestingly, the micro data estimates suggest that the effect of debt on aggregate spending is of similar magnitude to the effect using macro data estimates. Using the elasticity-implied MPC out of debt of –3.2 cents per dollar suggests that the changes in mortgage debt between 2006 and 2010 reduced annual aggregate total spending growth over this period by 0.36 percentage points. Using the directly estimated MPC of –2.0 cents per dollar lowers this estimate to 0.24 percentage points lower aggregate total spending growth annually.

Table 8: Average Effect of Debt on Annual Growth in Aggregate Spending
Assuming no change in debt between 2006 to 2010, percentage points

	Aggregate total spending growth
Elasticity-implied MPC out of debt	–0.36
(–3.1 cents per dollar)	[–0.72, <0.00]
Estimated MPC out of debt	–0.24
(–2.0 cents per dollar)	[–0.71, 0.24]

Note: 95 per cent confidence intervals provided in square brackets
Sources: Authors' calculations; HILDA Survey Release 17.0

Overall, both the macro data and micro data estimates imply that higher aggregate debt levels alone can have an economically significant effect on macroeconomic activity. Again, it is important to note that these estimate do not account for possible stimulatory effects of debt. Furthermore, while this exercise captures differences in changes in debt across households, we do not consider how the MPC varies across households. As discussed in Section 7.1, it is possible that there are meaningful differences in the effect of debt across households and this variation could have important implications for the aggregate effect.

8. Conclusion

Consistent with international research, we find evidence that high levels of owner-occupier mortgage debt reduce household spending. Higher mortgage debt is associated with less spending even when we control for changes to net housing wealth and cash flow (adjusted for mortgage repayments). This implies that a deepening of both sides of the household balance sheet is associated with weaker spending, and that debt matters for spending over and above its effect on net wealth. In other words, we find that the composition of household balance sheets affects household consumption decisions, which contradicts the predictions of conventional theories, such as the PIH.

Overall, the negative effect of debt on spending is pervasive across households with owner occupier mortgage debt. In contrast to previous literature, we find little evidence for borrowing and liquidity constraints or precautionary saving motives to be key drivers of the negative debt overhang effect. While our results do not directly support the debt overhang mechanism, we rule out some non-causal explanations for the negative effect of debt on spending proposed in the literature.

Specifically, we find that neither spending normalisation nor a shift in household preferences to housing consumption can explain the negative effect of debt on non-housing spending. While we find that household spending is more sensitive to debt during adverse shocks such as the GFC and local housing price shocks, the negative effect of debt also persists in more 'normal' times.

Our results also suggest that an increase in aggregate owner-occupier mortgage debt can have important implications for aggregate spending, all else constant, and go at least part of the way to resolving the post-crisis 'puzzle' of unusually weak household spending in Australia.

Appendix A: Debt Overhang Model

Below we set out a highly stylised two-period partial equilibrium model to illustrate the channels through which higher debt levels might affect spending, and hence explain a debt overhang mechanism. The household lives in an endowment economy, faces no uncertainty and has a lifetime utility function given by:

$$V = U(C_1) + \beta U(C_2)$$

where the discount factor is $0 \leq \beta \leq 1$. For simplicity, assume that the utility function is given in logarithmic form.

$$V = \ln(C_1) + \beta \ln(C_2)$$

The household has a budget constraint in the first period given by:

$$C_1 = Y_1 + L_1 - \delta D_0$$

where the household consumes (C_1) in the first period out of their current income (Y_1) and new borrowing (L_1) less repayments on debt (D_0) that they inherit from period 0. The household is assumed to repay a fixed fraction ($0 < \delta < 1$) of the initial debt, and this fraction is exogenously given. The household is also assumed to be endowed with an asset from period 0 (A_0), which can serve as collateral in period 1 but which cannot be liquidated until period 2.

The budget constraint in the second period is:

$$C_2 = Y_2 - (1+r) D_1 + (1+r) A_0$$

where the real interest rate on debt per period is r. We assume that the stock of debt follows a law of motion:

$$D_1 = L_1 + (1-\delta) D_0$$

where the total debt at the end of period 1 is equal to any borrowing during the period plus any outstanding initial debt that the household was born with less the repayment made in the period. The repayment of past debt includes both an interest and principal component. A household that makes a larger principal payment than required (or 'prepayment') will have more liquidity at its disposal in the future than a similar household that makes a smaller (or no) prepayment. When $\delta = 1$ this corresponds to the case of one-period debt.

The household's lifetime budget constraint is:

$$C_1 + \frac{C_2}{(1+r)} = Y_1 + \frac{Y_2}{(1+r)} + A_0 - D_0$$

This says that the household can consume out of the present discounted value of lifetime income plus any net wealth that they are born with.

However, when taking on debt, the household potentially faces a borrowing constraint:

$$D_1 \leq \bar{D} = \bar{\varphi}_D A_0$$

where the maximum LVR in any period is given by $0 \leq \bar{\varphi}_D \leq 1$. This states that the total debt for the household is limited by the value of its gross assets (collateral). Given the law of motion for debt, this implies that the household is potentially constrained in the amount it can borrow in period 1. Moreover, the maximum amount of new borrowing depends on the household's previous debt and any prepayments:

$$\begin{aligned} L_1 &= D_1 - (1-\delta) D_0 \\ L_1 &\leq \bar{L} = \bar{\varphi}_D A_0 - (1-\delta) D_0 = \left[\bar{\varphi}_D - (1-\delta) \gamma_0 \right] A_0 \end{aligned}$$

where $\gamma_0 \leq \bar{\varphi}_D$ is the household's leverage from period 0. Accordingly, if the household was born with the maximum amount of debt $D_0 = \bar{D} = \bar{\varphi}_D A_0$, it can at most borrow the amount it repaid, that is $L_1 \leq \delta \bar{\varphi}_D A_0$.

The household may also face a liquidity (or cash flow) constraint in period 1:

$$D_1 \leq \bar{\bar{D}} = \theta \frac{(Y_1 - r D_0)}{1-\delta}$$

This condition is essentially a debt servicing requirement imposed by mortgage lenders. It states that the household's repayments in period 2 (when it fully repays the loan) ($(1-\delta)D_1$) must be less than some fraction ($0 \leq \theta \leq 1$) of its current disposable income, which is equal to its endowment less the interest payments on the initial debt ($Y_1 - rD_0$). Using the law of motion for debt, this condition again implies a constraint on new borrowing in the first period:

$$L_1 \leq \bar{\bar{L}} = \theta \frac{(Y_1 - \delta D_0)}{1-\delta} - (1-\delta) D_0$$

To see how this works, consider a household that was born with debt and no prepayment ($\delta = 0$). This household will have more disposable income (or cash flow) in period 1, but will be required to make a larger repayment in period 2. This will mean the constraint is more likely to bind in period 1. Another household that fully prepaid the loan ($\delta = 1$) will have less cash flow in period 1, but also no repayments in period 2, and hence a greater stock of liquid resources during that final period. For this household, the liquidity constraint will never bind.

The household chooses consumption in each period to maximise its lifetime utility subject to the lifetime budget constraint, the borrowing constraint and the liquidity constraint.

For the unconstrained household, the consumption function is:

$$C_1^* = \frac{1}{(1+\beta)}\left(Y_1 + \frac{Y_2}{(1+r)} + A_0 - D_0\right)$$

And the sensitivity of spending to outstanding debt for the unconstrained household is:

$$\frac{\partial C_1^*}{\partial D_0} = \frac{-1}{(1+\beta)} \tag{A1}$$

This shows that there is a negative wealth (or income) effect of debt on spending for the unconstrained household.

For a borrowing-constrained household, the consumption function is:

$$C_1^* = Y_1 + \bar{L} - \delta D_0 = Y_1 + \bar{\varphi}_D A_0 - (1-\delta) D_0 - \delta D_0$$

And the sensitivity of spending to outstanding debt for this household is:

$$\frac{\partial C_1^*}{\partial D_0} = -(1-\delta) - \delta = -1 \leq -\frac{1}{(1+\beta)} \tag{A2}$$

When $\beta > 0$ and the borrowing constraint binds, any increase in debt reduces consumption by more than the wealth effect. This works through a reduced ability to borrow ($1 - \delta$) and lower disposable income to meet the required repayments (δ).

For a liquidity-constrained household, the consumption function is:

$$C_1^* = Y_1 + \bar{\bar{L}} - \delta D_0 = Y_1 + \theta \frac{(Y_1 - rD_0)}{1-\delta} - D_0$$

And the sensitivity of spending to outstanding debt for this household is:

$$\frac{\partial C_1^*}{\partial D_0} = -\left(1 + \frac{\theta r}{1-\delta}\right) \leq -1 \tag{A3}$$

This condition holds as long as the real interest rate is positive ($r > 0$). In effect, there is a negative wealth (or income) effect of debt on spending for the constrained households, but also additional borrowing and liquidity effects. So the effect of debt on spending is larger for constrained households than for unconstrained households. This implies that a debt overhang effect will be stronger for households that face binding *financing constraints* (Eggertsson and Krugman 2012).

Next, we consider the role of uncertainty in driving the debt overhang effect (King 1994; Albuquerque and Krustev 2015). For simplicity, suppose the only source of uncertainty is about the

interest rate to be paid on the debt as the household enters the second period.[25] And consider a mean-preserving spread of the interest rate:

$$r = \bar{r} + \varepsilon$$

where the interest rate consists of a constant mean ($\bar{r}$) and a stochastic component (ε). Assume that $E(\varepsilon) = 0$ and $V(r) = \sigma$. For expositional purposes, also assume that $\beta r = 1$. In this case, the household in the first period faces the following decision:

$$C_1^* = \begin{cases} E\left(C_2^*\right), & D_1 < \overline{\overline{D}} \\ Y_1 + \overline{\overline{L}} - \delta D_0, & D_1 \geq \overline{\overline{D}} \end{cases}$$

where the first line is just the optimality condition when the constraint does not bind, while the second line comes from the household budget constraint in period 1 when the constraint does bind. This condition can be rewritten in compound form:

$$C_1^* = \min\left(C_2^*, Y_1 + \overline{\overline{L}} - \delta D_0\right) = \min\left(C_2^*, Y_1\left(1 + \frac{\theta}{1-\delta}\right) - \frac{\theta E(r) D_0}{1-\delta} - D_0\right)$$

Given that we have introduced uncertainty in the model, note that the interest rate enters the equation in expectation. Now suppose that uncertainty about interest rates increases. Very high realisations of interest rates ($\varepsilon > 0$) become more likely, which reduces the household's expected disposable income. As a result this makes the cash flow constraint more likely to bind in the future and reduces the value of $\overline{\overline{L}} = Y_1\left(1 + \frac{\theta}{1-\delta}\right) - \frac{\theta E(r) D_0}{1-\delta} - D_0$. To avoid this, the household reduces consumption in period 1. This precautionary saving effect will be larger for households with more initial debt.

In effect, when there is uncertainty about the ability to meet future mortgage repayments due to an increase in uncertainty about future income or interest rates, the household may choose to consume less today even though they are not currently liquidity constrained, but because they are worried about becoming constrained in the future.

25 The mechanism would apply equally to uncertainty about the future income of the household.

Appendix B: Institutional Features of the Australian Mortgage Market

The theoretical model indicates that liquidity constraints (either now or in the future) can drive the relationship between debt and spending. KVW (2014) outline a model to identify liquidity-constrained or 'hand-to-mouth' households. In this model, the consumption of some households is very sensitive to shocks to current income despite high levels of wealth. Some households hold wealth in illiquid assets, such as housing, and still act as if they are constrained because their liquid wealth is low. These households may adjust their spending even in response to transitory (and predictable) income or wealth changes. KVW (2014) apply this framework to household-level data for a range of countries, including Australia. La Cava, Hughson and Kaplan (2016) extend KVW's Australian results to study the evolution of hand-to-mouth households over time and examine how these households influence the sensitivity of aggregate household spending to monetary policy shocks.

There are a couple of features of the Australian mortgage market that are unique by international standards and affect the extent to which households are 'hand-to-mouth'. Most borrowers have offset accounts or redraw facilities linked to their mortgages. These loan features make housing wealth more liquid than otherwise; they reduce the transaction costs involved in prepaying mortgages and make it easier to build buffers that can be used to offset income or wealth shocks.

An offset account is an at-call deposit that is directly linked to the mortgage. Funds deposited into an offset account reduce the borrower's net debt and the interest payable. A redraw facility enables the borrower to withdraw principal payments that they have made ahead of the required schedule. Mortgages with offset accounts currently comprise around 45 per cent of the total value of residential mortgage debt in Australia. Mortgages with redraw facilities make up around 70 per cent of the total number of residential mortgages in Australia (APRA 2019).

These mortgage features provide a tax-effective method of saving. First, the deposit rate that the borrower earns on the balance is equal to the mortgage interest rate. Second, the account generates no tax liability compared to depositing money into a separate savings account where any interest accruing adds to taxable income. This means there can be large tax advantages for borrowers to retain funds in a mortgage offset account (mortgage interest payments are not tax deductible for owner-occupier loans, though they are for investor loans, which are not considered here).

The main differences between offset accounts and redraw facilities are the degree of liquidity and the effect of withdrawals on home equity. In terms of liquidity, the funds sitting in an offset account are at call and easily accessible for withdrawal and for purchasing goods and services. The money in a redraw facility, while accessible, is not generally available for same day, at call withdrawal. There may also be a fee associated with redrawing money from the loan. A withdrawal from an offset account does not affect the principal balance of the loan, whereas a withdrawal from a redraw facility increases the principal and hence reduces the equity in the home.

Another feature of the Australian market is the high share of mortgages that do not face prepayment penalties. Over 80 per cent of home mortgages in Australia are originated at variable (or adjustable) rates and these mortgages can be prepaid without penalty. The combination of no prepayment penalties, tax incentives and highly liquid offset accounts means that Australian mortgage borrowers typically build up liquidity buffers by prepaying their mortgages. These buffers imply that housing is not as illiquid as that implied by the KVW (2014) framework.

Appendix C: Summary Statistics

Table C1: Descriptive Statistics
2006–10

Variable	Indebted households			Non-indebted households		
	Mean	Median	Std dev	Mean	Median	Std dev
Age group – young (%)	4.3		0.2	0.5		0.1
Age group – middle (%)	40.6		0.5	11.6		0.3
Age group – old (%)	55.0		0.5	87.9		0.3
Employed (%)	70.9		0.5	42.7		0.5
Unemployed (%)	1.0		0.1	0.9		0.1
Not in the labour force (%)	28.1		0.4	56.4		0.5
Casual worker (%)	13.0		0.3	22.8		0.4
Probability of losing job >0	50.6		0.5	45.8		0.5
Became unemployed (%)	0.9		0.1	0.7		0.1
Marital status (%)	72.3		0.4	62.3		0.5
Number of adults	2.1	2.0	0.9	1.9	2.0	0.9
Number of children	0.6	0.0	0.9	0.2	0.0	0.6
Education – high school (%)	37.5		0.5	43.9		0.5
Education – TAFE/diploma (%)	34.9		0.5	33.6		0.5
Education – university (%)	27.6		0.4	22.5		0.4
Financial stress status (%)	20.1		0.4	10.3		0.3
Hand-to-mouth status (%)	13.3		0.3	5.2		0.2
Hand-to-mouth status (adjusted for prepayments) (%)	5.5		0.2	4.7		0.2
Behind mortgage repayments (%)	24.6		0.4	3.0		0.2
Gross household disposable income ($)	96,995.6	88,296.4	70,005.1	77,190.9	57,426.6	71,452.9
Non-durables spending ($)	38,881.3	33,746.1	27,675.4	32,901.7	27,055.4	28,778.6
Durables spending ($)	11,464.8	5,119.3	17,844.7	10,525.2	3,941.7	18,648.6
Total spending ($)	50,346.1	42,343.7	36,859.1	43,426.9	33,662.2	39,154.9
Mortgage debt ($)	226,211.6	184,370.0	218,166.1	39,223.9	0.0	184,283.4
Housing equity ($)	405,601.0	317,879.4	416,202.9	646,730.0	520,801.0	557,539.7
Post-boom home purchase (share of home owners) (%)	43.7		0.5	22.6		0.4
Mortgage debt-to-income ratio (%)	234.2	192.4	265.3	39.1	0.0	140.7
Mortgage debt-servicing ratio (%)	39.7	35.8	31.7	6.2	0.0	21.7
Mortgage debt-to-assets ratio (%)	17.3	11.9	24.4	1.5	0.0	10.5

Notes: Levels expressed in 2017/18 dollars; the main sample of indebted households excludes non-indebted households in the previous year; both samples exclude the top and bottom 1 per cent of income, spending and housing price growth
Sources: Authors' calculations; HILDA Survey Release 17.0

Appendix D: Variable Definitions

Table D1: Definition of Variables

(*continued next page*)

Variable name	Definition
Age group – young	Dummy variable equal to 1 if the oldest person in the household is aged less than 30 years old, 0 otherwise
Age group – middle	Dummy variable equal to 1 if the oldest person in the household is aged over 30 years old and under 50 years old, 0 otherwise
Age group – old	Dummy variable equal to 1 if the oldest person in the household is aged over 50 years old, 0 otherwise
Employed	Dummy variable equal to 1 if household reference person is employed, 0 otherwise
Unemployed	Dummy variable equal to 1 if household reference person is unemployed, 0 otherwise
Not in the labour force	Dummy variable equal to 1 if household reference person is not in the labour force, 0 otherwise
Casual worker	Dummy variable equal to 1 if household reference person is a casual worker, 0 otherwise
Probability of losing job >0	Dummy variable equal to 1 if maximum subjective probability of a worker within the household losing their job is greater than 0, 0 otherwise
Became unemployed	Dummy variable equal to 1 if household reference person became unemployed since last survey, 0 otherwise
Marital status	Dummy variable equal to 1 if household reference person is married or in a de facto relationship, 0 otherwise
Number of adults	Number of adults (≥15 years) in household
Number of children	Number of children (<15 years) in household
Education – high school	Dummy variable equal to 1 if household reference person's highest education attainment is year 10 or year 12, 0 otherwise
Education – TAFE/diploma	Dummy variable equal to 1 if household reference person's highest education attainment is a TAFE certificate or diploma, 0 otherwise
Education – university	Dummy variable equal to 1 if household reference person's highest education attainment is a bachelor degree or higher, 0 otherwise
Financial stress status	Dummy variable equal to 1 if household answered yes to any of the seven financial stress questions (see La Cava and Simon (2003)), 0 otherwise
Hand-to-mouth status	Dummy variable equal to 1 if household is classified as 'hand-to-mouth' (see KVW (2014)), 0 otherwise
Hand-to-mouth status (adjusted for prepayments)	Dummy variable equal to 1 if household is classified as 'hand-to-mouth' (see KVW (2014)) and adjusted for mortgage prepayments, 0 otherwise
Behind mortgage repayments	Dummy variable equal to 1 if household is behind or on schedule with their repayments, 0 otherwise
Gross household disposable income	Dollar value of annual, after-tax household income

Table D1: Definition of Variables
(*continued*)

Variable name	Definition
Non-durables spending	Dollar value of all non-durable expenditure items collected by HILDA Survey (see footnote 4)
Durables spending	Dollar value of durable expenditure items collected by HILDA Survey (see footnote 4)
Total spending	Dollar value of durable and non-durable expenditure items collected by HILDA Survey (see footnote 4)
Mortgage debt	Dollar value of owner-occupier mortgage debt owed by household
Housing equity	Reported value of home less owner-occupier mortgage debt
Post-boom home purchase	Dummy variable equal to 1 if a household purchased their home after the early 2000s housing price boom in the state of purchase (after 2001 in NSW, Vic and Qld and after 2002 in all other states and territories), 0 otherwise
Mortgage debt-to-income ratio	Ratio of mortgage debt to gross household disposable income
Mortgage debt-servicing ratio	Ratio of mortgage repayments to gross household disposable income
Mortgage debt-to-assets ratio	Ratio of mortgage debt to reported value of home
Home value	Reported value of home
Prepayment buffer	Difference between scheduled (assuming a 25-year loan term) and actual mortgage balance
Global financial crisis	Dummy variable equal to 1 if the year is 2009, 0 otherwise
Local housing price shock	Dummy variable equal to 1 if annual average price of housing within postcode falls by more than 5 per cent, 0 otherwise
Local unemployment rate	Unemployment rate in ABS Statistical Area 4
Local unemployment rate shock	Dummy variable equal to 1 if local unemployment rate increased by more than 1 percentage point over the year, 0 otherwise

Appendix E: Alternate Debt Measures

Table E1: The Debt Overhang Effect – Mortgage Debt-to-income Ratio
By type of spending

	Model								
	Non-durables spending 2006–17			Durables spending 2006–10			Total spending 2006–10		
	OLS	FE	IV	OLS	FE	IV	OLS	FE	IV
Lagged mortgage debt-to-income ratio	>–0.00	>–0.00	>–0.00***	>–0.00*	>–0.00	–0.01***	>–0.00	>–0.00	>–0.00***
	(0.89)	(0.11)	(<0.00)	(0.07)	(0.26)	(<0.00)	(0.16)	(0.15)	(<0.00)
Income	0.26***	0.09***	0.07**	0.95***	0.37**	0.17	0.29***	0.10***	0.10**
	(<0.00)	(<0.00)	(0.02)	(<0.00)	(0.02)	(0.39)	(<0.00)	(<0.00)	(0.03)
Lagged home value	0.21***	0.17***	0.40***	0.57***	0.25	1.25***	0.26***	0.10*	0.44***
	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(0.33)	(<0.00)	(<0.00)	(0.06)	(<0.00)
First-stage: Boom dummy			–69.46***			–69.31***			–69.31***
			(<0.00)			(<0.00)			(<0.00)
Household FE	No	Yes	No	No	Yes	No	No	Yes	No
Postcode FE	No	No	Yes	No	No	Yes	No	No	Yes
Observations	21,460	21,460	21,460	6,622	6,622	6,622	6,622	6,622	6,622

Note: See notes to Table 1
Sources: Authors' calculations; HILDA Survey Release 17.0

Table E2: The Debt Overhang Effect – Mortgage Debt-to-assets Ratio
By type of spending

	Model								
	Non-durables spending 2006–17			Durables spending 2006–10			Total spending 2006–10		
	OLS	FE	IV	OLS	FE	IV	OLS	FE	IV
Lagged mortgage debt-to-assets ratio	<0.00	>–0.00	>–0.00***	>–0.00	>–0.00**	–0.02***	>–0.00	>–0.00	–0.01***
	(0.12)	(0.27)	(<0.00)	(0.24)	(0.05)	(<0.00)	(0.69)	(0.12)	(<0.00)
Income	0.25***	0.10***	0.30***	1.01***	0.36**	1.06***	0.30***	0.09***	0.33***
	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(0.02)	(<0.00)	(<0.00)	(<0.00)	(<0.00)
Lagged home value	0.21***	0.16***	0.16***	0.50***	0.16	0.20	0.25***	0.08	0.18***
	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(0.54)	(0.18)	(<0.00)	(0.15)	(<0.00)
First-stage: Boom dummy			–14.15***			–14.64***			–14.64***
			(<0.00)			(<0.00)			(<0.00)
Household FE	No	Yes	No	No	Yes	No	No	Yes	No
Postcode FE	No	No	Yes	No	No	Yes	No	No	Yes
Observations	21,460	21,460	21,460	6,622	6,622	6,622	6,622	6,622	6,622

Note: See notes to Table 1
Sources: Authors' calculations; HILDA Survey Release 17.0

Table E3: The Debt Overhang Effect – Mortgage Debt-servicing Ratio

By type of spending

	Model								
	Non-durables spending 2006–17			**Durables spending 2006–10**			**Total spending 2006–10**		
	OLS	FE	IV	OLS	FE	IV	OLS	FE	IV
Lagged mortgage debt service-to-income ratio	>–0.00*	>–0.00**	–0.01***	>–0.00***	<0.00	–0.05***	>–0.00**	>–0.00*	–0.01***
	(0.10)	(0.01)	(<0.00)	(0.04)	(0.79)	(<0.00)	(0.01)	(0.08)	(<0.00)
Income	0.26***	0.10***	–0.01	1.03***	0.41***	0.20	0.29***	0.13***	0.07
	(<0.00)	(<0.00)	(0.83)	(<0.00)	(0.02)	(0.44)	(<0.00)	(<0.00)	(0.26)
Lagged home value	0.21***	0.17***	0.37***	0.56***	0.18	0.93***	0.26***	0.10*	0.39***
	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(0.50)	(<0.00)	(<0.00)	(0.07)	(<0.00)
First-stage: Boom dummy			–4.42***			–6.38***			–6.38***
			(<0.00)			(<0.00)			(<0.00)
Household FE	No	Yes	No	No	Yes	No	No	Yes	No
Postcode FE	No	No	Yes	No	No	Yes	No	No	Yes
Observations	19,623	19,623	19,620	5,935	5,935	5,934	5,935	5,935	5,934

Note: See notes to Table 1

Sources: Authors' calculations; HILDA Survey Release 17.0

Appendix F: Full Regression Results – The Debt Overhang Effect

Table F1: The Debt Overhang Effect – Full Results

By type of spending

	Model								
	Non-durables spending 2006–17			**Durables spending 2006–10**			**Total spending 2006–10**		
	OLS	FE	IV	OLS	FE	IV	OLS	FE	IV
Lagged mortgage debt	>–0.00	–0.01**	–0.15***	–0.07*	–0.10*	–0.80***	–0.01	–0.03***	–0.20***
	(0.77)	(0.03)	(<0.00)	(0.05)	(0.10)	(<0.00)	(0.11)	(0.01)	(<0.00)
Income	0.26***	0.10***	0.28***	1.02***	0.36**	1.09***	0.30***	0.09***	0.33***
	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(0.02)	(<0.00)	(<0.00)	(<0.00)	(<0.00)
Lagged home value	0.21***	0.17***	0.32***	0.55***	0.28	1.01***	0.26***	0.11**	0.38***
	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(0.28)	(<0.00)	(<0.00)	(0.04)	(<0.00)
Age group – middle	0.10***	0.09***	0.03	–0.10	–0.28	–0.29	0.09*	0.06	0.01
	(<0.00)	(<0.00)	(0.13)	(0.57)	(0.41)	(0.14)	(0.06)	(0.25)	(0.76)
Age group – old	0.10***	0.10***	–0.03	–0.11	–0.05	–0.64***	0.06	0.10	–0.11*
	(<0.00)	(<0.00)	(0.23)	(0.53)	(0.90)	(0.01)	(0.22)	(0.12)	(0.06)
Unemployed	–0.10**	–0.06*	–0.11***	–0.34	0.01	–0.56*	–0.11	–0.01	-0.14*
	(0.02)	(0.09)	(<0.00)	(0.36)	(0.98)	(0.08)	(0.26)	(0.93)	(0.06)
Not in the labour force	–0.10***	–0.01	–0.13***	–0.36**	0.13	–0.68***	–0.13***	0.04	–0.15***
	(<0.00)	(0.46)	(<0.00)	(0.01)	(0.54)	(<0.00)	(<0.00)	(0.36)	(<0.00)
Marital status	0.11***	0.08**	0.09***	0.73***	1.39***	0.63***	0.17***	0.26***	0.13***
	(<0.00)	(0.03)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(<0.00)
Number of adults	0.08***	0.09***	0.09***	–0.13***	0.11	–0.14***	0.05***	0.05**	0.04***
	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(0.30)	(0.01)	(<0.00)	(0.02)	(<0.00)
Number of children	0.08***	0.06***	0.08***	>–0.00	–0.03	0.07	0.05***	0.02	0.06***
	(<0.00)	(<0.00)	(<0.00)	(0.96)	(0.80)	(0.11)	(<0.00)	(0.47)	(<0.00)
Education – TAFE/diploma	0.08***	0.11*	0.07***	0.37***	1.10	0.24**	0.07***	0.04	0.05**
	(<0.00)	(0.06)	(<0.00)	(<0.00)	(0.12)	(0.01)	(<0.00)	(0.58)	(0.04)
Education – university	0.07***	0.11	0.07***	0.53***	0.46	0.59***	0.08***	–0.14	0.08***
	(<0.00)	(0.22)	(<0.00)	(<0.00)	(0.55)	(<0.00)	(<0.00)	(0.34)	(<0.00)
Constant	4.63***	7.23***	4.67***	–10.69***	0.04	–8.12***	3.87***	8.66***	4.34***
	(<0.00)	(<0.00)	(<0.00)	(<0.00)	(0.99)	(<0.00)	(<0.00)	(<0.00)	(<0.00)
First stage: Boom dummy			0.46***			0.45***			0.45***
			(<0.00)			(<0.00)			(<0.00)
Household FE	No	Yes	No	No	Yes	No	No	Yes	No
Postcode FE	No	No	Yes	No	No	Yes	No	No	Yes
Observations	21,460	21,460	21,460	6,622	6,622	6,622	6,622	6,622	6,622

Note: See notes to Table 1

Sources: Authors' calculations; HILDA Survey Release 17.0

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