Labour Force Participation and Household Debt*

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Abstract

In the past decade or so there has been a substantial rise in the indebtedness and debt-servicing obligations of Australian households. This has been accompanied by a trend increase in labour force participation (LFP) for women and more recently for men. Microeconomic data show a clear positive correlation between indebtedness and LFP. This paper models the LFP decision of prime-age Australian women and men accounting for the influence of debt and assets along with a range of other variables found to be important in the literature. The potential two-way causation between debt and labour supply is also addressed.

Data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey are used as it contains recent and detailed data on household wealth along with extensive labour market and demographic data. A cross-section model of LFP is estimated using the detailed measures of household debts and assets available in Wave 2 of the survey. In addition, a panel model, using only measures of owner-occupied housing debt and assets, is estimated using all five currently available waves.

Evidence is presented to suggest that LFP is determined by several factors, including family structure, education, health and indebtedness. In general, most of the effect of indebtedness on an individual's probability of participation in the labour force is captured through the household debt-servicing ratio, although the level of owner-occupied mortgage debt appears important for men. Also, the panel results suggest that accounting for unobserved heterogeneity across individuals is important when examining the influence of debt on labour supply.

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1. Introduction

In the past decade or so there has been a substantial rise in the indebtedness and debt-servicing obligations of Australian households. This has occurred at the same time as a trend increase in labour force participation (LFP) for women and more recently for men. Microeconomic data show a clear positive correlation between indebtedness and LFP. This paper explores the role of household debt in the LFP decisions of prime-age Australian women and men. It accounts for the role of assets in offsetting the impact of higher debt burdens on labour supply. The estimation methodology also allows for the potential two-way causation between debt and labour supply.

Data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey, a panel of Australian households and individuals from 2001 to 2005, show that those with owner-occupied mortgage debt have a higher participation rate than those without (Table 1). For example, over 2001–2005, 79 per cent of women aged 36–50 years with debt participated in the labour force compared to 69 per cent of those without debt. A similar difference was apparent for men of that age group.

Table 1: LFP by Owner-occupied Mortgage Debt and Age
Percentage in the labour force, HILDA 2001–2005

	Has no debt	Has debt
	Women	
Aged 25–35 years	68.7	73.1
Aged 36–50 years	68.5	79.3
	Men	
Aged 25–35 years	91.6	96.5
Aged 36–50 years	85.5	95.6

Source: HILDA Survey 2001–2005, Release 5.0

This paper seeks to extend our understanding of labour market decisions by considering the effect of debt and its servicing obligations on participation. Existing studies are generally framed in terms of a life-cycle model, where the statistical significance of debt in a labour supply regression can be interpreted as evidence that credit constraints bind. If credit constraints are binding, debt is expected to induce an increase in labour supply as additional labour generates additional income which can be used to relax the credit constraints. Most studies concentrate on partnered women, with a significant effect of debt on participation generally found. While this paper closely follows Fortin (1995) and Bottazzi (2004), our analysis includes tenants as well as home owners and single, as well as partnered, women. In addition, we analyse male participation. Like Bottazzi and Fortin, this paper is one of the few that assess the potential endogeneity of debt in the LFP decision.

The HILDA Survey is used to estimate separate probit models of LFP for men and women. Wave 2 of the survey – corresponding to 2002 – contains full balance sheet information on household debts and assets including owner-occupied housing, investment property and financial assets. Using these data, a cross-section is first analysed. The endogeneity of debt is considered using an instrumental variables approach exploiting available data on house prices, year of house purchase and ownership status. In contrast to earlier Australian studies, we exploit the panel data in the HILDA Survey to control for unobserved heterogeneity. In the panel, the effects of owner-occupied housing debt and assets are considered; data on non-owner occupied housing assets and debt are only available for 2002.

In line with existing studies, we find that family structure, education and health status are important determinants of LFP. Indebtedness is also found to have a significant effect on current

LFP. We typically find that the debt-servicing ratio has a positive and significant effect on the probability of LFP. The effect is generally larger for women than for men. While it seems plausible that debt and LFP are jointly determined (particularly over the longer term), there is no statistical evidence that debt depends on current LFP. This may reflect the fact that borrowing decisions associated with large purchases are often re-examined only infrequently and, therefore, that they can be treated as pre-determined when making current LFP decisions.

2. Literature Review

2.1 Previous Empirical Findings

A series of earlier papers have examined the relationship between labour supply and debt in a range of countries using cross-section and panel data. For example, Fortin (1993, 1995) and Worswick (1999) study Canada, Del Boca and Lusardi (2003) study Italy, Aldershof, Alessie and Kapteyn (1999) study the Netherlands, Bottazzi (2004) studies the United Kingdom and O'Brien and Hawley (1986) and Shack-Marquez and Wascher (1986) study the United States. With one exception (Shack-Marquez and Wascher 1986), the findings suggest that debt and its servicing obligations have a positive and significant effect on labour supply. Fortin (1995) and Aldershof *et al* (1999) find that the effect of debt generally outweighs the negative effect that young children have on female labour supply, while Bottazzi finds the overall effect remains negative. The focus of most of these papers is on housing debt and its influence on partnered female labour supply.

The intertemporal life-cycle model is the commonly used framework in these studies. The significance of debt for labour supply has been interpreted as evidence that credit constraints bind for some individuals. Intuitively, binding credit constraints can be expected to increase

labour supply since working is a means by which such constraints can be eased. For example, some individuals may not be able to borrow any funds from financial institutions, while for others, banks may impose an upper bound on the amount of credit available. However, in both cases the individual may be able to relax these credit constraints by working. Those with existing debt may, at some point, have made a decision to work in order to access credit, absent some alternative income source. They may also find that credit constraints bind in the face of an unexpected income or expenditure shock. In this case also, increasing labour supply provides a means to ease the credit constraint and may be less costly than renegotiating a loan or selling assets.[1]

In Fortin (1995) and Bottazzi (2004), credit constraints are introduced into the model through the addition of a mortgage-related borrowing constraint, which is assumed to hold in every period.[2] This style of model is also appropriate to the Australian case. Australian banks typically require that scheduled loan repayments not exceed a nominated proportion of a borrower's regular income. This proportion has traditionally been set at around 30 per cent of gross income, though in more recent years a higher ratio has been used, particularly for higher income earners.

Aldershof *et al* (1999) incorporate a more general borrowing constraint. Del Boca and Lusardi (2003), on the other hand, model the labour force and mortgage decisions in a simultaneous equation system. To identify the direction of the effect between debt and LFP, they exploit two

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1 Other papers assess the importance of credit constraints by using indicators such as whether the person has little or no liquid or total wealth (see, for example, Dau-Schmidt 1997 and Domeij and Flodén 2006) or whether the person has been denied access to credit (see, in particular, Jappelli 1990).

2 Bottazzi argues that this is reasonable as long as refinancing is possible; on application to refinance, the bank is able to reassess income and reapply the mortgage borrowing constraint.

exogenous changes in the Italian mortgage market, between 1989 and 1993, that served to expand consumers' access to credit.

Each of the above papers includes a role for borrowing constraints. Dau-Schmidt (1997) suggests that debt also imposes a second type of constraint, in that ongoing debt-servicing obligations represent an expenditure commitment that may be difficult to change at short notice in the face of an adverse shock. For example, while a home owner might ultimately sell their home and move to cheaper housing, there may be limited scope to do this in the short run, particularly in the face of significant adjustment costs.

This literature intersects with studies concerned with the effect of the housing tenure decision on labour force supply. These models are not only concerned with home owners, who may be constrained by debt holdings, but also those planning to purchase a home who may be constrained by the need to accumulate a down payment. Yoshikawa and Ohtake (1989) develop a model for Japan and find that a down-payment constraint induced women planning to purchase a home to work more than other women.

Some Australian studies have included a role for housing debt or home ownership as an explanator for LFP, using cross-section or panel data. Shamsuddin (1998), using cross-section data, finds that total mortgage debt has a significant positive effect on the LFP and hours worked of immigrant women. Drago, Wooden and Black (2006), in a panel study using HILDA data, find that the debt-to-income ratio has a significant and positive effect on the propensity for long hours of work. However, Kidd and Ferko (2001) find no significant effect of home ownership on

participation and hours worked in an investigation of the effect of the gender wage gap on employment.

Two Australian studies examine this issue using macroeconomic data. Connolly (1996) finds a negative correlation between female full-time LFP and the affordability of home and consumer loans. Connolly and Kirk (1996) find that the affordability of consumer loans and housing costs each affect the LFP of older Australian men.

2.2 The Treatment of Endogeneity in the Literature

The discussion above suggests that while indebtedness may prompt individuals to supply more labour, debt may also depend on the LFP decision, as financial institutions often include employment or current income in their lending criteria. The endogenous determination of debt might also arise as households simultaneously choose a future path for work and debt, say in relation to plans to purchase a home or start a family. However, the case for endogenous debt is not clear cut. In the face of temporary shocks to income (or expenditure), a household might generally treat debt as pre-determined, especially if changing debt quickly involves a large adjustment cost, and be more willing to adjust labour first.

Despite the bias that can occur in the presence of endogeneity, few papers test or control for it. Del Boca and Lusardi (2003) are a notable exception in that they model the participation and mortgage decisions simultaneously. Fortin (1993) finds evidence that mortgage payments are exogenous to the labour force decision using Canadian data. Bottazzi (2004) tests for the endogeneity of the mortgage constraint on LFP in her UK study using house prices as an instrumental variable and also finds that mortgage payments are exogenous to the labour force

decision. Section 3.2 details the identification strategy used in this paper to control for the potential endogeneity. Testing suggests that debt is exogenous to current LFP. This result is discussed in Section 5.2.

3. The Modelling Strategies

Using the available HILDA Survey data, we estimate both a cross-section and a panel model for LFP. Within the cross-section framework, we test for the potential endogeneity using an instrumental variables approach.

3.1 Cross-section Model

The relationship between debt and LFP is modelled using cross-section data from the 2002 HILDA Survey, which allows us to make use of the more detailed household balance sheet information collected in that year. The propensity to participate in the labour force is modelled as a function of a vector of **Assets**, of **Debts** and of personal and family characteristics, **X**. As only the outcome of the LFP decision is observed, a latent variable approach is used. The dependent variable, *LFP*, is defined as 1 if the individual is employed or looking for work in the week prior to the interview and 0 otherwise, and *LFP** is the latent variable:

$$\begin{aligned} LFP_i^* &= X_i\beta + Assets_i\gamma_{\mathbf{1}} + Debts_i\gamma_{\mathbf{2}} + u_i \\ LFP_i &= \mathbf{1}\left[LFP_i^* > \mathbf{0}\right] \end{aligned} \tag{1}$$

More specifically, the probability of LFP is modelled using a probit specification:

$$P(LFP_i = \mathbf{1} \mid X_i, Assets_i, Debts_i) = \Phi(X_i\beta + Assets_i\gamma_{\mathbf{1}} + Debts_i\gamma_{\mathbf{2}}) \tag{2}$$

where Φ is the cumulative normal distribution.

Consistent with the literature, we choose a model of individual LFP. The literature often finds more significant effects associated with the decision to work rather than for the decision between positive hours (Heckman 1993). Rather than estimating a model for the household jointly, the labour force status and income of the individual's partner are included as explanatory variables. Assets may be an important determinant of LFP as they capture a potential wealth effect and may also better capture the effects of non-labour income. In addition, asset holdings may reduce the effect of any credit constraints.

3.2 Accounting for the Potential Endogeneity

The potential endogeneity of debt in the LFP decision, discussed in Section 2.2, is tested using a two-step instrumental variables approach, as suggested by Rivers and Vuong (1988).[3] Along with Equation (1), the system of equations includes a reduced-form equation for **Debts**:

$$Debts_i = X_i\delta_{\mathbf{1}} + Assets_i\delta_{\mathbf{2}} + Z_i\delta_{\mathbf{3}} + v_i \tag{3}$$

Debts are modelled as a function of all of the exogenous variables in Equation (1) and a set of instrumental variables, **Z**. These instrumental variables, **Z**, appear in Equation (3) but not Equation (1) and are used to isolate the variation in **Debts** that is exogenous to LFP. The test developed by Rivers and Vuong will find that debt is endogenous to LFP if u and v are correlated. The instruments used are discussed in Section 5.2.

The instrumental variables strategy provides a solution to the potential endogeneity if two conditions are satisfied. The first, which can be tested explicitly, is that the instruments must be correlated with **Debts**. The second condition is that the instruments must not be correlated with

[3] While accumulated assets may be a result of previous labour force activity, it is reasonable to assume that assets are exogenous to current labour force status. In any case, there are no reliable instruments available to test for the endogeneity of assets.

u, the error term in Equation (1). In general, this second condition must be maintained by assumption. However, where there are more instruments available than potentially endogenous variables, an overidentification test can be performed to assess whether the instruments are correlated with u.

3.3 Exploiting the Longitudinal Data

A panel model is also estimated using the longitudinal data from the HILDA Survey. These data enable each individual's unobservable and time-invariant characteristics to be controlled for, although the available assets and debt data are less comprehensive than for the cross-section model. Ignoring this unobserved individual heterogeneity can potentially result in biased estimates (Baltagi 2005).

Both a fixed-effects and a random-effects model are used to explicitly account for the longitudinal nature of the data. The model is similar to Equation (1) above but with data available for each individual i over time t:

$$\begin{aligned} LFP_{it}* &= X_{it}\beta + Assets_{it}\gamma_{\mathbf{1}} + Debts_{it}\gamma_{\mathbf{2}} + c_i + u_{it} \\ LFP_{it} &= \mathbf{1}[LFP_{it}* > \mathbf{0}] \end{aligned} \tag{4}$$

where the individual effect c_i captures the unmeasured characteristics of each individual that are stable over the sample period. These might include risk preferences, attitudes to, and aptitudes for, work, or unobserved permanent components in wages (Chamberlain 1984). Both methodologies, fixed- and random-effects, 'eliminate' c_i from the estimating equation and so the potential bias from the unobserved heterogeneity is eliminated. Baltagi (2005) and Wooldridge (2002) each provide a detailed exposition of both methodologies, along with the form for the probability model as per Equation (2).

For the fixed-effects estimation, a logit functional form is assumed and a conditional fixed-effects logit is estimated. By conditioning on $\mathbf{X}_i$, $\mathbf{Assets}_i$, $\mathbf{Debts}_i$ and c_i, and by excluding those individuals that are always in or always out of the labour force, $\boldsymbol{\beta}$, $\boldsymbol{\gamma}_1$ and $\boldsymbol{\gamma}_2$ are consistently estimated and the influence of c_i is eliminated.[4]

For the random-effects model, a probit functional form is used. To consistently estimate $\boldsymbol{\beta}$, $\boldsymbol{\gamma}_1$ and $\boldsymbol{\gamma}_2$, it is assumed that the $\mathbf{X}_{it}$, $\mathbf{Assets}_{it}$ and $\mathbf{Debts}_{it}$ are independent of c_i, as well as u_{it}, for all i and t.[5] Only if this assumption holds is c_i 'eliminated' from the estimating equation. It is a strong assumption but can be tested using a Hausman test of the random- and fixed-effects estimates. If the random-effects point estimates are not found to differ from the fixed-effects estimates, random effects is preferred as it is more efficient.

The advantage of fixed-effects estimation is that it produces consistent estimates, and indicates how people *change* their LFP in *response to* changes in debt over time. However, only observations on individuals who change labour force status during the sample period can be included in the estimation. As a result, only a sub-sample of less than a quarter of the size of the full sample of women and around 10 per cent of the full sample of men is available for estimation.[6] In addition, no time-invariant characteristics may be entered in the model.

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4 Fixed-effects probits cannot be estimated because a conditional distribution that does not depend on c_i cannot be found (Wooldridge 2002).

5 That is, $c_i \mid X_{it}, Debts_{it}, Assets_{it} \sim Normal(\mathbf{0}, \boldsymbol{\sigma}_c^2)$.

6 Tests of the characteristics of these sub-samples show that those who vary their labour force status are quite different from those who remain in or out of the labour force. For example, those women who changed status were more likely to have a partner, young children, less debt or no university education. Men who changed status were less likely to have debt, a partner, university education, English proficiency or be Australian born.

On the other hand, the random-effects model is favoured because it can be estimated on the full sample, and Baltagi (2005) argues that random-effects is appropriate if the sample is drawn randomly from a large population and is broadly representative. This is the type of sample available from the HILDA Survey. In addition, the random-effects estimates can be easily used to examine the marginal effect of debt on LFP probabilities.

4. The Data

Data are sourced from the first five waves of the HILDA Survey (Release 5.0).[7] Along with detailed information on employment, income, housing and housing wealth available in each wave, Wave 2 contains a detailed module on households' holdings of assets and outstanding debts. The survey is broadly representative of the Australian population and population weights are available to correct for the most obvious differences. See Goode and Watson (2007) for information on sampling, response rates and attrition.

In this paper, the LFP of women and men are analysed separately due to their distinct labour supply patterns.[8] Full-time students and the self-employed are excluded as their labour market attachment is likely to be influenced by different factors from those which affect the general population. For the cross-section, the sample is restricted to those aged between 25 and 50 years; this excludes those approaching retirement age, whose participation decision might be influenced by additional factors such as asset accumulation for retirement, health and so forth. This leaves a sample of 2 999 women and 2 568 men, after removing those with missing data.

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7 The in-confidence unit record data are used.

8 A considerably larger proportion of prime-age males participate in the labour force compared to women. Empirical studies have found that men's LFP is relatively wage inelastic (Pencavel 1986) whereas women are generally found to have a more flexible attachment to the labour force (Killingsworth and Heckman 1986; Birch 2005).

For the panel analysis, an unbalanced panel of individuals who responded to the survey in at least two waves is used. To match the selection of those aged between 25 and 50 years in the cross-section, the panel sample includes individuals aged between 24 and 49 years in wave 1 (in 2001) and progresses through to those aged between 28 and 53 years in wave 5 (in 2005). A similar selection criterion was used in Booth and Wood (2006). This leaves a sample of 3 350 women and 2 822 men, after removing those with missing data. Approximately 86 per cent of women in the sample were present in at least three waves, and 50 per cent were in all five waves. For men, the figures are 85 per cent and 48 per cent respectively.

4.1 Description of Variables

Demographic variables relevant to life-cycle considerations and human-capital are likely to be important influences on LFP decisions; these are described in Appendix A. Labour income – earned through wages, salaries or business – is not included as an explanator since the wage offer is not observed for those who are not working. However, each individual's potential wage can be captured through the set of individual characteristics in the model (such as education and labour force history).

While the non-labour income variables are also outlined in Appendix A, the family tax benefit variables (FTB A and FTB B) warrant clarification. For each individual, the family tax benefit that would be due to the household if they *did not* work is imputed.[9] The rationale for constructing these potential benefits is to account for an individual's basic reservation wage –

[9] The counterfactual family tax benefit was constructed by adapting code supplied by the Melbourne Institute of Applied Economic and Social Research, which applies the historical benefit rules as published by the Department of Families, Community Services and Indigenous Affairs (<http://www.facs.gov.au/guides_acts/fag/faguide-3/faguide-3.6.html>).

that is, the income that they could expect to receive from the government given their family characteristics if they were not working.[10]

For the panel, only owner-occupied mortgage debt is available. Detailed data on debt (and assets) were only collected in one year of the survey, 2002, and are used for the cross-section analysis. For the cross-section, the vector of **Debts** includes the owner-occupied mortgage debt and other debt of that individual's household. Other debt combines debts on investment properties, credit card debts, HECS, car loans, overdrafts and other personal loans. Statistical tests show that these variables can be combined.

Debts are included in three ways. First, each debt variable is specified in *levels*. Second, because the ability to pay is likely to be important for LFP, the *debt-to-income ratio* is also included for both the owner-occupied mortgage and other debt. Finally, since data on yearly repayments on the owner-occupied mortgage are available, these are included as a ratio of household income (excluding the labour income of the individual). This variable is described as the *debt-servicing ratio*.

It is important to note that household income used in the denominator of both the debt-to-income ratios and the debt-servicing ratio *excludes* the labour income of the individual but *includes* the partner's labour income. Intuitively, these ratios provide a guide as to whether the household can or cannot service their debt under the scenario that the individual does not work. For those with no debt, these ratios are set to zero. For those with no household income (exclusive of the labour

[10] Other potential government benefits, such as unemployment benefits, are not imputed in a similar manner due to the complexity associated with such a task. Most government payments are means or asset tested and are strongly related to other demographic factors. As a result, their effects should be captured elsewhere in the model.

income of the individual), the ratio is set equal to the numerator (which is debt or repayments depending on the ratio in question).[11] Throughout the paper, when we refer to household income we are referring to this measure, that is, household income excluding the labour income of the individual but including the partner's labour income.

The square-root of the debt-servicing ratio is also included to account for this variable's non-linearity. The non-linearity is the result of large ratios for those individuals where household income is very small or zero.[12] Repayment information is not available for non-mortgage debts. Two measures of household assets are included separately in the cross-section model: financial and non-financial assets. Financial assets are the sum of equity and cash investments, trust funds and household bank accounts. These should be relatively liquid and thus may provide readily available funds in the case of an adverse shock. Superannuation assets are excluded because they are illiquid, particularly for the age group under consideration. Non-financial assets include the home, other property values, vehicles and collectibles.[13] In the panel, only the value of the owner-occupied home is available.[14]

4.2 Descriptive Statistics

Tables A2 and A3 in Appendix A present the summary statistics for the cross-section and panel samples. Men have a higher attachment to the labour force, with 92 per cent participating compared to around 73 per cent of women.

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[11] This is equivalent to assigning those individuals with negative or zero household income (exclusive of the labour income of the individual) with one dollar of household income. Drago *et al* (2006) adopt a similar approach.

[12] The effects of this non-linearity can be observed in the average ratios which are very large (presented in Tables A2 and A3 in Appendix A).

[13] Net business wealth was considered. However, its inclusion made no qualitative difference.

[14] Note that in the cross-section model, imputed wealth data are used.

Table 2: Summary Statistics – Assets and Debts

	Percentile			Per cent with positive debt or assets	Percentile			Per cent with positive debt or assets
	25	Median	75		25	Median	75	
Women								
	Wave 2; 2 999 observations				Panel; 13 672 observations			
Owner-occupied mortgage debt outstanding ($'000)	0	8.0	98.0	50.9	0	12.0	110.0	51.6
Owner-occupied mortgage debt-to-income ratio	0	0.2	2.0	50.9	0	0.2	2.2	51.6
Debt-servicing ratio	0	0	0.2	48.2	0	0	0.2	49.0
Other debt ($'000)	0	3.6	18.5	67.7	na	na	na	na
Other debt-to-income ratio	0	0.1	0.5	67.7	na	na	na	na
Value of owner-occupied home ($'000)[(a)]	–	–	–	–	0	200.0	350.0	69.4
Non-financial assets ($'000)	38.0	213.5	378.0	95.8	na	na	na	na
Financial assets ($'000)	1.2	7.0	27.4	98.3	na	na	na	na
Men								
	Wave 2; 2 568 observations				Panel; 11 374 observations			
Owner-occupied mortgage debt outstanding ($'000)	0	10.0	100.0	51.4	0	19.0	115.0	52.5
Owner-occupied mortgage debt-to-income ratio	0	0.3	4.1	51.4	0	0.5	4.5	52.5
Debt-servicing ratio	0	0	0.4	48.5	0	0	0.5	49.6
Other debt ($'000)	0	4.6	19.0	68.3	na	na	na	na
Other debt-to-income ratio	0	0.2	1.1	68.3	na	na	na	na
Value of owner-occupied home ($'000)[(a)]	–	–	–	–	0	200.0	350.0	68.5
Non-financial assets ($'000)	30.0	203.8	361.5	96.5	na	na	na	na
Financial assets ($'000)	1.3	7.0	29.2	97.7	na	na	na	na

Notes: Full descriptions of all variables are available in Appendix A, Table A1.
(a) Summary statistics for the value of the owner-occupied home are not reported for the cross-section as it is captured in non-financial assets.

More detailed summary statistics for assets and debt are shown in Table 2. In Wave 2, median owner-occupied mortgage debt is approximately $10 000. This rises to $100 000 among those with a mortgage (not shown). The proportion with an owner-occupied mortgage and the median outstanding owner-occupied mortgage debt are each slightly higher in the panel sample. This

likely reflects the increase in indebtedness and in the number of indebted home owners over the first half of this decade.

The median ratio of owner-occupied mortgage debt to household income is 20 per cent for women overall and 210 per cent for women with a mortgage, using the panel data. For men, the equivalent ratios are 50 per cent and 430 per cent respectively. The differences between men and women for the debt-to-income and debt-servicing ratios at the median (and also at the 75th percentile) reflect that men generally have a lower household income. This is because men often earn more than their partners, and our measure of household income excludes the individual's own labour income.

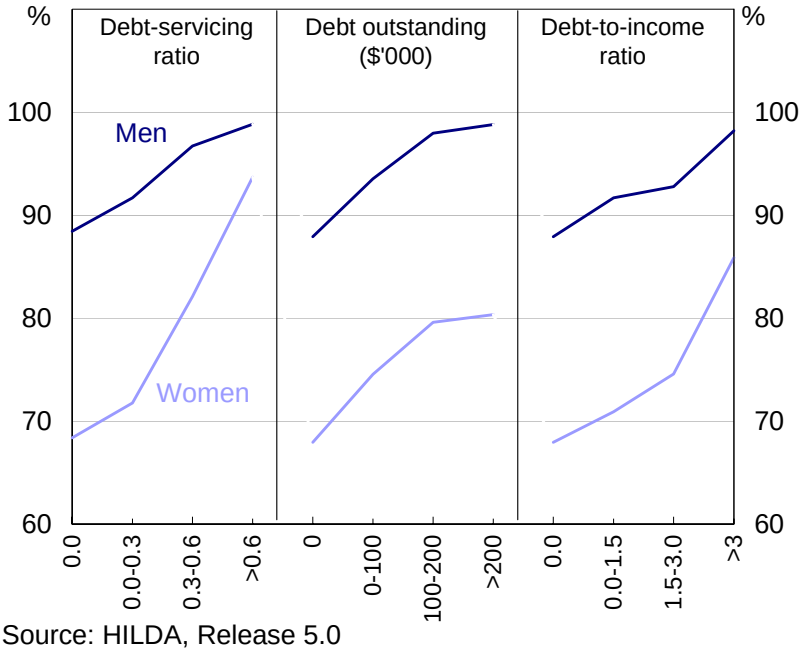
Around half of the sample does not make any mortgage repayments. Among those with mortgage repayments, the median debt-servicing ratio (where the denominator is household income, excluding individual labour income) is 0.23 for women and 0.46 for men in the panel sample (not reported in the table). For women, around 5 per cent of the sample has a debt-servicing ratio equal to or greater than 1, that is, their household income is less than the amount of annual housing debt repayments paid. In contrast, for men, around 13 per cent have a debt-servicing ratio equal to or greater than 1, reflecting their higher labour income relative to their partner.

Higher rates of LFP are associated with a higher debt-servicing ratio for both men and women (Figure 1). As might be expected, this relationship is generally stronger for women than for men. LFP is also associated with higher levels of owner-occupied mortgage debt and debt-to-income ratios.

Table 2 also shows that the value of non-housing-related debt is relatively small. Other debt outstanding and other debt as a ratio to household income are also positively correlated with increases in LFP. The vast majority of respondents have some assets, with median values of less than $10 000 for financial assets and around $200 000 for non-financial assets in the cross-section. In the panel, 70 per cent of the sample own, or are purchasing, their own home; the median value of homes is approximately $200 000.

Figure 1: LFP versus Various Measures of Owner-occupied Mortgage Debt

Percentage of sample in the labour force



Source: HILDA, Release 5.0

5. Estimation Results

Detailed results from the cross-section and panel models for the debt and asset variables are presented in Sections 5.1 and 5.3 respectively. The results from our tests for the endogeneity of debt are discussed in Section 5.2. In general, we find that in both the cross-section and panel models, coefficients on the standard variables that typically enter into labour supply equations have the expected sign and are consistent with other studies.[15] For example, partnered females are less likely to work while the opposite is true for partnered males. Those with a university education are significantly more likely to work, while those with poor health are less likely. Women with young children are significantly less likely to participate in the labour force, reflecting the well-known M-shaped pattern in LFP with peaks at ages 20–24 and 45–54, before and after the key child-rearing ages. For men, these effects are not so apparent.

In line with the literature, the coefficients and marginal effects on participation are smaller and less significant for men than women. This finding is consistent with men's greater attachment to the labour force and higher average participation rate (Killingsworth and Heckman 1986; Pencavel 1986; Birch 2005).[16]

5.1 Cross-section Results

Results from the cross-section probit models are shown in Tables B1 and B2 in Appendix B. Table 3 provides more detailed results for debt and assets; in particular, the marginal effects of debt and assets conditional on strictly positive debt holdings are given. Overall, debt has the expected positive and significant effect on participation. After controlling for the effects of debt,

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[15] Full results for the cross-section and panel models are available in Tables B1, B2, B3 and B4 in Appendix B.

[16] In addition, due to the large proportion of men with $LFP = 1$, and the flattening of the probit curve at this upper range, it is not surprising to find smaller effects for men.

income and demographic characteristics, assets are not found to have a significant effect on participation.

Most of the effect of owner-occupied mortgage debt is captured by the debt-servicing ratio, with a positive and significant effect on the probability of LFP for both men and women. For men, of all debt variables in the model, only the debt-servicing ratio has a positive and significant effect. For men and women, the marginal effect of the debt-servicing ratio is positive and significant over the relevant range of the ratio. The marginal effect shown in Table 3 is for an increase in the ratio of 0.1 (from its non-zero median, that is, the median ratio of all strictly positive ratios).[17] For women, this is estimated to increase the probability of participation in the labour force by 0.47 percentage points, all other things being equal and at their median values. For men, it increases the propensity to participate by a much smaller 0.01 percentage points, when considering a man with median characteristics.

The level of owner-occupied mortgage debt does not appear to have a significant effect on the probability of LFP. However, for women, the ratio of owner-occupied mortgage debt to income does have a positive and significant, albeit small, effect on LFP propensities.

For women, the level of other debt is statistically significant. Every $1 000 of additional other debt is associated with a 0.02 percentage point increase in the probability of participation. The ratio of other debt to income is not found to have a significant effect on the probability of LFP. Further analyses of the predicted probabilities are presented in Section 6.

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[17] For women, an increase of that size corresponds to a movement along the distribution of strictly positive debt-servicing ratios from the median to around the 70th percentile. For men, to induce a similar movement along the distribution, a larger increase in the ratio of 0.4 is needed.

Table 3: Cross-section Estimates of the Effect of Assets and Debts on LFP

	Coefficients	Median (non-zero mortgage debt)	Selected unit	Marginal effects[(a)] (percentage points)
Women				
Owner-occupied mortgage debt outstanding	-3.62×10^{-7}	$98 000	$10 000	-3.96×10^{-2}
Owner-occupied mortgage debt-to-income ratio	1.66×10^{-5}***	1.91	0.1	1.81×10^{-5}***
Debt-servicing ratio	-2.35×10^{-3}***	0.22	0.1	4.73×10^{-1}***
Sq root of debt-servicing ratio	4.05×10^{-1}***			
Other debt outstanding	1.54×10^{-6}***	$3 000	$1 000	1.69×10^{-2}***
Other debt-to-income ratio	3.63×10^{-5}	0.08	0.1	3.97×10^{-5}
Financial assets	8.60×10^{-9}	$6 700	$1 000	9.41×10^{-5}
Non-financial assets	-1.09×10^{-7}	$212 000	$10 000	-1.19×10^{-2}
Observations	2 999	Pseudo R^2	0.35	
Men				
Owner-occupied mortgage debt outstanding	1.64×10^{-6}	$100 000	$10 000	4.30×10^{-2}
Owner-occupied mortgage debt-to-income ratio	9.73×10^{-6}	3.90	0.1	2.56×10^{-6}
Debt-servicing ratio	-5.29×10^{-4}***	0.42	0.1	1.36×10^{-2}***
Sq root of debt-servicing ratio	6.72×10^{-2}***			
Other debt outstanding	1.73×10^{-6}	$4 000	$1 000	4.55×10^{-3}
Other debt-to-income ratio	3.02×10^{-6}	0.15	0.1	7.95×10^{-7}
Financial assets	-2.44×10^{-7}	$6 800	$1 000	-6.42×10^{-4}
Non-financial assets	1.26×10^{-7}	$198 000	$10 000	3.32×10^{-3}
Observations	2 568	Pseudo R^2	0.48	

Notes: ***, ** and * represent significance at the 1, 5 and 10 per cent levels respectively.
(a) Marginal effects estimated at the median of strictly positive (or non-zero) owner-occupied mortgage debt, with other characteristics set at sample medians. See Appendix B, Tables B1 and B2 for full results.

The models have reasonable explanatory power. For women, the pseudo R^2 is 0.35, and for men it is 0.48. The average predicted probabilities also appear reasonable; for women, the average

predicted probability of participation is 72.3 per cent. This is equal to the actual proportion of the sample in the labour force. For men, the average predicted probability is 92.3 per cent and is also equal to the actual proportion of the sample in the labour force.

For discrete choice models, Greene (2003) also suggests a summary measure of predictive ability based on the proportion of the sample for which labour force status is correctly predicted. For women, labour force status is correctly predicted for 82 per cent of the sample, with correct predictions for 92 per cent of those in the labour force and for 59 per cent of those not in the labour force. These results can be compared with that which would be found using a naïve model in which every woman is predicted to be in the labour force. Under a naïve model, correct predictions of participation would be made 72 per cent of the time. Thus, the model gives an improvement of 10 percentage points in predictive ability over the uninformed guess.

For men, labour force status is correctly predicted for 95 per cent of the sample overall, with correct predictions for 98 per cent of those in the labour force but only for 50 per cent of those not in the labour force. In comparison to the naïve prediction, the model provides an improvement of only 3 percentage points, reflecting the fact that men are more likely to participate. As a result, there is less to gain from modelling their participation decision.

We carried out a number of robustness checks. To account for possible non-linearity in the debt-servicing ratio, we replaced the debt-servicing ratio and its square root with a dummy variable as an indicator of large debt-servicing ratios, and the interaction of this dummy variable with the level of the debt-servicing ratio; qualitatively similar results were found. Results were also

similar when each debt variable was winsorised at the 97.5th percentile.[18] Furthermore, when owner-occupied mortgage debt and its ratio to income were omitted, the debt-servicing variables remained significant and the coefficient estimates were broadly similar. Removing the debt-servicing variables yielded a positive but insignificant coefficient on the level of owner-occupied mortgage debt for women, while for men the level became significant at the 10 per cent level.

Domeij and Flodén (2006) argue that ignoring the effects of assets and debts can bias coefficient estimates towards zero. We found that this may be the case. In a model excluding the asset and debt variables, the marginal effects of many of the demographic and income variables appear smaller; the debt and assets are jointly significant when included.

5.2 Testing for the Endogeneity of Debt

As described in Section 0, the exogeneity of debt to labour supply can be tested using the two-step instrumental variables approach of Rivers and Vuong (1988). This requires valid instruments for the six debt variables. Valid instruments must be correlated with debt but not with the error in the labour supply equation.

Measures of house prices are used elsewhere in the literature as an instrumental variable (Bottazzi 2004). They are correlated with owner-occupied mortgage debt and repayments but are less likely to be correlated with current LFP. Two sources of house price data are available: self-reported data from HILDA for the price of one's home when purchased, and postcode-matched

[18] Winsorising involved replacing data above the 97.5th percentile of the distribution with the value at the 97.5th percentile.

house price data sourced from Australian Property Monitors (APM) for 1993.[19] For the self-reported data, the assumption of no correlation between the house price and the error in the labour supply equation is less likely to hold for more forward-looking households. However, shocks to LFP and house prices in the years since the house purchase should ensure that house prices are exogenous to current LFP.

Testing for endogeneity is conducted using each of these sources of house price data in turn. In each case, the house price and its square are used as instruments, giving two instruments. The house price as a ratio to household income (excluding individual labour income) provides a third instrument.[20]

Whether or not the house is the first home ever purchased should also influence the level of owner-occupied mortgage debt and repayments – with the mortgage and repayments likely to be higher if it is the first home because first-home buyers are less likely to have accumulated a substantial deposit. Indeed, the data show that those living in their first home ever purchased have larger debts (in levels) than non-first-home buyers. Moreover, whether it is their first home ever purchased or not should not be directly related to LFP. Thus, a categorical variable is used which equals 0 if the home is rented, 1 if the person is a first-home buyer and 2 otherwise.

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[19] The APM data provide median quarterly house and unit prices for suburbs grouped by price deciles for the main capital cities (Sydney, Melbourne, Brisbane, Adelaide, Perth and Canberra). The suburbs are matched to postcode data; the postcode and price data are then matched to the HILDA sample. If postcodes appear in more than one of the price deciles (because the same postcode is often used for neighbouring suburbs), the matched prices were averaged to give one price per postcode. The calendar-year average of the median quarterly house price is used. Because data are only available for the cities listed above, around 40 per cent of the sample is lost when these house price data are used. However, testing suggested that there was no systematic difference between the full sample and the sub-sample of those living in one of these capital cities.

[20] The denominator, household income (excluding individual labour income), should also be exogenous to the individual's current LFP as it is household income excluding the individual's earned income.

In a similar manner, the year in which the house was purchased should be directly related to debt and repayments, as a house purchased more recently is likely to have a greater amount of debt outstanding on it. Again, the year of purchase should not be related to current LFP, particularly the further into the past the house was purchased.

Other instruments considered were the initial level of owner-occupied mortgage debt at the start of the loan, the number of credit cards and measures of how much financial risk the individual is willing to take. The first of these was found to offer little additional independent variation beyond that of the house price when purchased. The number of credit cards and the measures of willingness to take financial risk were judged to be invalid as the number of credit cards is likely to be related to LFP just as debt is, while the appetite for risk may be influenced by whether they have a job as well as their job security.

To test for endogeneity, the order condition must be satisfied; the number of instruments must be at least equal to the number of endogenous variables. Since only five instruments are available and there are six potentially endogenous debt variables, subsets of the debt variables were tested for endogeneity while the remaining debt variables were assumed exogenous or omitted. First, one debt variable was assumed endogenous, while the remaining five were assumed exogenous or omitted. Instruments were chosen if they were significant in the reduced-form debt equation (Equation (3)) at the 5 per cent level. When more than one instrument was relevant, overidentifying restrictions were tested using generalised residuals (Gourieroux *et al* 1987). Next, the exogeneity of relevant pairs of debt variables were tested; owner-occupied mortgage debt and its ratio to income, other debt and its ratio, and debt-servicing ratio with its square root.

In this case, two or more instruments needed to be relevant. Similarly, the procedure was repeated for groups of three endogenous debt variables and then four.

The overidentification tests pointed to valid instruments in a large number of cases, although the instruments were generally weaker for owner-occupied mortgage debt to income, other debt to income and the debt-servicing ratio, particularly for men. Potentially, the instruments were weaker for the debt-servicing ratio because those making excess repayments were more likely to be in the labour force. When two or more variables were assumed endogenous, the overidentification test was less likely to suggest valid instruments.

For both men and women, the evidence suggests that debt is exogenous to labour supply when using either the self-reported data or postcode-matched house price data.[21] That is, it appears that increased indebtedness induces greater participation, while the reverse effect, that greater current participation leads to higher indebtedness, is not found to be statistically significant.[22] A caveat is that this result is conditional on the instrumental variables methodology.[23] In addition, the result may reflect the fact that borrowing decisions associated with large purchases are often re-examined only infrequently and, therefore, that they are largely pre-determined when making current LFP decisions. Also, while our model accounts for the spouse's labour force status, we are essentially modelling the individual. In order to obtain a loan (or increase debt), a bank

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[21] Endogeneity tests were also carried out on a sub-sample of younger women (aged 25–35 years) using the self-reported house price data. Young people are more likely to be making joint decisions on debt, LFP and family formation – Del Boca and Lusardi (2003) also separately examine younger women. However, the evidence suggests that debt is also exogenous for the sub-sample of younger women.

[22] Fortin (1993) also found mortgage debt to be exogenous to labour supply for partnered women in Canada.

[23] An alternative approach is to model LFP and indebtedness in a simultaneous equation framework. Del Boca and Lusardi (2003) estimate such a model and find a marginally significant effect of participation on the likelihood of having a mortgage. However, they were able to exploit an exogenous change in the institutional structure of the Italian mortgage market in order to identify the direction of causality, while we have been unable to identify any exogenous variation to use for identification in the Australian case.

would examine the circumstances of the household overall, and our model may not adequately capture this.

Overall, since the explanators are generally exogenous, the probit estimates of Section 0 are preferred over the less efficient instrumental variables estimates of this section (for brevity, these results are not presented).

5.3 Panel Results

This section details the panel data results, which control for individual heterogeneity but assume that debt can be treated as exogenous. Full results from the panel models are shown in Tables B3 and B4 in Appendix B. Table 4 presents the estimates of the coefficients on owner-occupied mortgage debt and assets using both the random- and fixed-effects estimation methodologies. The random-effects estimates are preferred: they are estimated on the full sample rather than on the subset of those who have changed labour force status at least once during the sample period and, unlike fixed-effects, random-effects allows an examination of the marginal effects and associated predicted probabilities of participation.

The random-effects estimates show that owner-occupied mortgage debt has a significant positive effect on the LFP decision (Table 4). The level of owner-occupied mortgage debt is an important influence and its coefficient is highly significant and positive. The debt-servicing ratio also has a significant impact on participation, as in the cross-section results. The value of the owner-occupied home, a measure of housing assets, is not significant. Estimates of the marginal effects are also shown in Table 4. For each of the four owner-occupied mortgage debt variables, the marginal effects are reported according to a reasonable increase in the respective debt variables

from their non-zero medians (the exact units are indicated in the table; all other variables, including the value of the owner-occupied home, are set at the sample median).

Table 4: Panel Estimates of the Effect of Housing Debt on LFP

	Probit random-effects				Logit coefficients	
	Coefficients	Median[(a)]	Selected unit	Marginal effects[(a)] (percentage points)	Random effects	Conditional fixed effects
Women						
Owner-occupied mortgage debt outstanding	4.87×10^{-7}*	$110 000	$10 000	1.77×10^{-2}	9.45×10^{-7}**	-2.84×10^{-7}
Owner-occupied mortgage debt-to-income ratio	-2.04×10^{-6}	2.08	0.1	-7.42×10^{-7}	-4.57×10^{-6}	1.58×10^{-5}
Debt-servicing ratio	-1.32×10^{-4}	0.22	0.1	1.11×10^{-2}***	-2.49×10^{-4}*	-3.99×10^{-4}
Square root of debt-servicing ratio	2.92×10^{-2}***				5.58×10^{-2}***	4.03×10^{-2}
Value of owner-occupied home	-9.80×10^{-8}	$210 000	$10 000	-3.56×10^{-3}	-1.55×10^{-7}	3.37×10^{-8}
Observations	13 672				13 672	3 375
Number of women	3 350				3 350	890
Men						
Owner-occupied mortgage debt outstanding	2.10×10^{-6}***	$113 000	$10 000	3.76×10^{-3}	3.99×10^{-6}***	3.73×10^{-6}**
Owner-occupied mortgage debt-to-income ratio	7.62×10^{-6}	4.30	0.1	1.37×10^{-7}	1.25×10^{-5}	3.53×10^{-5}
Debt-servicing ratio	-2.33×10^{-4}***	0.46	0.1	4.12×10^{-4}***	-4.22×10^{-4}***	-9.00×10^{-4}
Square root of debt-servicing ratio	3.13×10^{-2}***				5.94×10^{-2}***	7.94×10^{-2}
Value of owner-occupied home	4.07×10^{-7}	$200 000	$10 000	7.31×10^{-4}	6.67×10^{-7}	4.73×10^{-7}
Observations	11 374				11 374	1 018
Number of men	2 822				2 822	253

Notes: ***, ** and * represent significance at the 1, 5 and 10 per cent levels respectively.
(a) Marginal effects estimated at the median of strictly positive (or non-zero) owner-occupied mortgage debt, with other characteristics set at sample medians. See Appendix B, Tables B3 and B4 for full results.

The marginal effects for the debt-servicing ratio are statistically significant, although small. The effects are smaller than those found in the cross-section model, although a direct comparison is difficult to make as the methodology differs and the non-housing debt and asset variables are not available in the panel. Nonetheless, as was the case for the cross-section results, the marginal effect of the ratio is smaller for men than for women.

For a woman with median characteristics, the marginal effect of an increase in the debt-servicing ratio of 0.1 from the non-zero median of 0.22 is estimated to increase the probability of participation in the labour force by 0.01 percentage points, other things being equal. For a man with median characteristics, an increase of 0.1 in the ratio is estimated to increase the probability of participation by 0.0004 percentage points. Further interpretation of the results is offered in Section 6.

The conditional fixed-effects logit estimates are imprecisely estimated, potentially due to the much smaller sample size. The exception is the level of owner-occupied mortgage debt for men, where a positive and significant effect is found. Although the coefficient on this variable is similar to the random-effects estimate, the Hausman test for the consistency of the random-effects logit favours the fixed-effects logit estimates for both men and women.[24] Nevertheless, for the reasons discussed in Section 0, the random-effects estimates are preferred.

[24] A Chamberlain random-effects probit was also estimated (Wooldridge 2002). It assumes that the correlation between the unobserved individual effect and the explanatory variables follows a conditional normal distribution with a linear expectation and constant variance, rather than assuming that they are independent. The Chamberlain model also rejects the traditional random-effects estimates, although for women the debt-servicing ratio retains its significant positive effect on participation, and for men the level of home loan debt outstanding also remains significant and positive. The results are available from the authors on request.

The random-effects models fit the data reasonably well. For women, labour force status is correctly predicted for 82 per cent of the sample overall; an improvement of 9 percentage points in comparison with the naïve predictor. For men, labour force status is correctly predicted for 95 per cent of the sample overall, representing an improvement of 3 percentage points in comparison with the naïve prediction. Also, the average predicted probabilities from the model are close to the actual proportions of those participating. For women, the average predicted probability is around 77 per cent for the random-effects models compared to 73 per cent of the sample that reports being in the labour force. For men, these figures are 94 per cent and 92 per cent respectively.

Some sensitivity tests were undertaken to ascertain whether attrition over the sample period influenced the results. For women, some simple tests suggested by Verbeek and Nijman (1992) imply that attrition over the waves is not having a significant effect on our estimates. For men, the same tests suggest that attrition may have some influence on the results, but results from estimation over a balanced sub-panel were qualitatively similar.

Much of the empirical literature focuses exclusively on home owners' labour supply response to debt. Renters face a down-payment constraint and so are likely to need to work before obtaining a mortgage. Thus, using the sub-sample of home owners, 70 per cent of the total sample in this case, may yield stronger results for the debt coefficients. However, the results (not reported) show that this was not the case; for both the random- and fixed-effects models, the coefficients remained largely unchanged, although for women, the level of owner-occupied mortgage debt became insignificant.

The literature also assumes that partnered women have greater flexibility in their participation decisions, and so their response to changes in debt would be larger than the response of single women. The models were re-estimated using the sample of partnered women. While the debt-servicing ratio coefficients were smaller and became insignificant, the coefficient on owner-occupied mortgage debt increased and retained its significance. Thus, changing the sub-sample to be consistent with other studies made little qualitative difference to the results.

6. Discussion

In addition to examining the estimated marginal effects of the debt and asset variables individually, the change in the predicted probability of participation in response to a change in a range of the household balance sheet variables is also of interest. These balance sheet variables can be expected to move together and sometimes by much larger increments than those used to calculate the marginal effects in Sections 0 and 0 above. Table 5 shows the difference between the predicted probabilities of participation for two women, where one has housing debt and the other does not, using the results from both the cross-section and the panel random-effects probits.

For example, take two 'median' women; one purchases a $200 000 house using $20 000 of her existing assets as a 10 per cent deposit, while the other simply holds the $20 000 in financial assets.[25] The purchaser has owner-occupied mortgage debt of $180 000 and a corresponding debt-to-income ratio of 4.5 and debt-servicing ratio of 0.36 (assuming a 25-year loan at 6.5 per

[25] Among those living in a capital city, the median owner-occupied home is valued at $200 000 in 2002. The median value rises to $250 000 in the panel sample; however the results are not qualitatively different when that value is applied in the scenario.

cent interest[26]). Her non-financial assets (or the value of the owner-occupied home for the panel) are now higher as a result of the house purchase, totalling $200 000. Other than for the given criteria, the two women are assumed to have median characteristics.[27]

Using the cross-section estimates, the purchaser, with a partner who is in the labour force and who has a child between the ages of 0 and 4 years, has a propensity to participate that is 6.2 percentage points higher than it is for the woman without debt, a statistically significant difference. For the panel estimates, the difference is smaller, but still statistically significant, at 3.3 percentage points.

The difference in the effects across the panel and cross-section estimates may indicate that the cross-section results are biased because they ignore unobserved individual heterogeneity. However, data on other debt and non-owner-occupied housing assets are not available for the panel. These omissions may mean that the effect of owner-occupied mortgage debt on participation propensities is harder to estimate precisely.

Table 5 also shows that the difference in the propensity to participate between the two 'median' women is moderated if the women have a university degree or have no children, as each of these characteristics in and of themselves would make both women more likely to participate.

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26 The interest rate of 6.5 per cent reflects the 2001–2005 average rate paid on outstanding mortgages.

27 These 'median' women are 38 years of age, have not finished Year 12, have spent 14 years in and 1 year out of the labour force, are proficient at English, Australian born, living in a capital city, do not have a health condition that adversely affects their ability to work, have zero investment income, receive no family tax benefits and have $40 000 of household income (excluding their own). For the cross-section analysis, they are assumed to have household other debt of $3 000 and an other debt-to-income ratio of 0.075. Financial assets are set equal to the median of $6 700 for the purchaser, and to $26 700 for the non-purchaser who does not use the $20 000 as the deposit for a house.

Table 5: Difference in Predicted Probabilities With and Without Owner-occupied Housing Debt

Women, percentage points

	Has children aged 0–4 years	Has no children
Cross-section probit		
Has a partner; spouse is in the labour force	6.2**	1.3*
– also has a university degree	5.6**	0.4
Single	6.0**	1.5*
– also has a university degree	5.9**	0.5*
Panel random-effects probit		
Has a partner; spouse is in the labour force	3.3*	0.1
– also has a university degree	1.4*	0.0
Single	3.4*	0.2
– also has a university degree	1.6*	0.0

Note: ***, ** and * represent significance at the 1, 5 and 10 per cent levels respectively.

A similar analysis can be conducted for men. However, while the house purchase does imply a greater propensity to participate, a significant difference is only found for single men with no children and with only a basic level of education.

In comparison to the size of the marginal effect associated with a small change in just one of the debt variables, this analysis shows a larger net effect for a reasonable shift in a set of assets and debts associated with a house purchase. Nevertheless, for women, the positive effect of the house purchase on the propensity to participate does not offset the strong negative effect on participation of having a young child (results not reported). This is consistent with results found for the UK (Bottazzi 2004), but is in contrast to results found for the Netherlands (Aldershof *et al* 1999) and Canada (Fortin 1995).

The model estimates can also be used to make some 'back-of-the-envelope- calculations' about the effect of indebtedness on aggregate LFP. That is, a measure of the contribution of the

recently observed increases in household indebtedness to the observed change in LFP can be roughly estimated. To do this, the average predicted probability of participation in the labour force, with debts and the value of the owner-occupied home set equal to their 1998/99 median (from the Household Expenditure Survey (HES)), is compared to the predicted probability of participation when debts and the value of the owner-occupied home are set equal to their 2005 median (from the HILDA Survey data). To keep the exercise relatively simple, all those with positive owner-occupied mortgage debt are assigned the non-zero median value of debts and assets.[28]

Table 6 shows that the average predicted probability of participation across all women (both with and without owner-occupied mortgage debt) is 77.2 per cent in 1998/99 and 78.6 per cent in 2005 (columns I and III, row 3), an increase of 1.4 percentage points. This is smaller than the actual increase of 4.4 percentage points in the aggregate LFP rate between 1998/99 and 2005 for women aged 25–54 (ABS 2006). That is, the model attributes around one-third of the rise in aggregate LFP rates as being due to the rise in debt.

Table 6 also allows an investigation of the likely source of this predicted increase in the probability of participation. The analysis suggests that the increase in the *level* of indebtedness has had little practical effect on the predicted probability of LFP. For women, among those with debt, the predicted probability of participation actually decreased slightly from 83.9 per cent in 1998/99 to 83.5 per cent in 2005 (columns I and III, row 2).[29] Instead, the analysis suggests that

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[28] The estimated coefficients from the panel random-effects probit are used to generate predicted probabilities for 1998/99 and 2005 with all demographic, family and income characteristics held constant at their 2005 values.

[29] For those without debt, the average predicted percentage in the labour force is around 73 per cent for women in 1998/99 and 2005 (columns I and III, row 1). These predicted probabilities should be quite similar by construction as only the asset value of the owner-occupied home varies.

the change in the probability of participation, and thereby some part of the increase in the aggregate LFP rate, is likely to be due to a compositional effect associated with the increase in the proportion of those with owner-occupied mortgage debt (from around 38 per cent of households to just over 50 per cent of households).

Table 6: Change in LFP Using Debt from HES and HILDA

	1998/99		2005	
	Average *predicted* percentage in the labour force	Actual percentage of the sample with and without debt	Average *predicted* percentage in the labour force	Actual percentage of the sample with and without debt
	I	II	III	IV
		Women		
Has no debt	73.0	61.8	73.1	47.3
Has median debt	83.9	38.2	83.5	52.7
Total	77.2		78.6	
		Men		
Has no debt	89.6	61.1	89.4	46.8
Has median debt	97.0	38.9	96.4	53.2
Total	92.5		93.1	

For men, the aggregate LFP rate has fallen by 0.4 percentage points over the same period. In contrast, the model predicts that changes in debt and asset values imply an increase in the average probability of participation of 0.6 percentage points (columns I and III, row 6). This suggests that despite an increase in the proportion of those with owner-occupied mortgage debt, other factors have dominated and have driven the participation rate down between 1998/99 and 2005.

To assess whether or not the magnitude of the predicted increase is reasonable, it can be compared to the size of the predicted increase in LFP associated with a change in the proportions

of individuals with different levels of education, a change which is widely accepted to have had a strong effect on participation propensities. Between 1998/99 and 2005, the proportion of individuals with tertiary education has increased, and the predicted effect on LFP (based on the random-effects model) is estimated to be an increase of 2.3 percentage points for women and 1.0 percentage point for men in this age group.

7. Conclusions

This paper examines the extent to which rising household indebtedness has led to higher labour force participation among prime-age Australians. Data from the HILDA Survey are used as it contains recent and detailed data on household wealth along with extensive labour market and demographic data.

A cross-section probit model is estimated using detailed measures of household debt and assets. In addition, a panel model, using only measures of owner-occupied housing debt and assets, is estimated over 2001–2005. The panel results suggest that accounting for unobserved heterogeneity across individuals is important when examining the influence of debt on labour supply.

The potential two-way relationship between debt and labour supply is investigated using an instrumental variables approach as the identification strategy. The tests suggest that, statistically, debt is exogenous to current labour force participation. However, the results generally suggest that indebtedness increases the probability of participating in the labour force, particularly as households have a commitment to meet the ongoing servicing obligation of that debt. Despite the finding of statistical significance, the size of the estimated effect of debt on participation depends

on the characteristics of the individuals being considered. The results suggest larger effects for women with young children than those without, and much smaller effects again for men. This ordering mirrors generally accepted conceptions of these groups' respective attachment to the labour force.

While the marginal effects appear modest, it is important to remember that large, discrete changes in debt holdings are not uncommon, for example, those associated with the purchase of a new home. This means that the predicted probabilities (as presented in Section 6) are likely to provide a more meaningful guide than marginal effect estimates. For example, these results suggest that a woman with young children who purchases a $200 000 home and takes on a commensurate amount of debt will have a propensity to participate that is, on average, 3.3–6.2 percentage points higher than the same woman without debt.

Appendix A: Variable Definitions and Descriptive Statistics

Table A1: Variable Definitions *(continued next page)*

Variable	Description
Labour force participation	Equal to 1 if participating in the labour force – i.e., working or unemployed – and equal to 0 if not in the labour force
Household income (excluding individual labour income)	Annual gross household income *excluding* the individual's labour income but *including* the partner's (and other family members') labour income. It is not used separately in any estimation but is used as the denominator in the owner-occupied mortgage debt-to-income, the other debt-to-income and the debt-servicing ratios.
Owner-occupied mortgage debt outstanding	Sum of all outstanding debt on owner-occupied home – imputed value for the cross-section but reported values for the panel
Owner-occupied mortgage debt-to-income	Ratio of owner-occupied mortgages outstanding to household income (excluding individual labour income). Set equal to 0 if there is no owner-occupied mortgage debt outstanding and to the level of debt if household income (excluding individual labour income) is 0.
Other debt outstanding	Sum of imputed other property, total credit card, HECS (Higher Education Contribution Scheme – a loan for higher education repayable contingent on income) and other household debts
Other debt-to-income	Ratio of other debt outstanding to household income (excluding individual labour income). Set equal to 0 if there is no other debt outstanding and to the level of debt if household income (excluding individual labour income) is 0.
Debt-servicing ratio	Annual actual repayments on first and second owner-occupied mortgages divided by the household income (excluding individual labour income). Note that actual repayments can be in excess of required repayments. Set equal to 0 if there is no outstanding owner-occupied mortgage debt and to the repayment if household income (excluding individual labour income) is 0.
Value of owner-occupied home	Self-reported value of the owner-occupied home
Non-financial assets	Sum of imputed home value, other property values, vehicles and collectibles
Financial assets	Sum of imputed equity and cash investments, trust funds and household bank accounts
Investment income	Imputed financial year income from investments
Other income	The annual sum of private pension (superannuation and worker's compensation) and foreign income, other household income (total gross household income less personal gross income), and private transfers (child support and other regular private income).
Family Tax Benefit A	Imputed annual amount of Family Tax Benefit A that would be received by the household assuming no labour income was received by the individual
Family Tax Benefit B	Imputed annual amount of Family Tax Benefit B that would be received by the household assuming no labour income was received by the individual

Table A1: Variable Definitions *(continued)*

Variable	Description
Age	Age previous birthday as at June 30
Age^2	Age squared
Years in the labour force	The sum of years spent in paid work and looking for work
Years in the labour $force^2$	Years in the labour force squared
Years not in the labour force	The number of years spent not working and not looking for work
Years not in the labour $force^2$	Years not in the labour force squared
University educated	Equal to 1 if has a postgraduate degree, graduate diploma or certificate, or bachelor degree, 0 otherwise
Has a diploma	Equal to 1 if has an advanced diploma or certificates, 0 otherwise
High school qualification	Equal to 1 if high school is highest qualification, 0 otherwise
Did not finish Year 12	Equal to 1 if has not completed Year 12, 0 otherwise
Married or de facto	Equal to 1 if married or de facto, 0 otherwise
Single	Equal to 1 if single, widowed, divorced or separated, 0 otherwise
Spouse's labour force status	Equal to 1 if spouse is participating in the labour force, 0 otherwise
Has child aged 0–4 years	Equal to 1 if has one or more own resident children aged 0–4 years, 0 otherwise
Has child aged 5–14 years	Equal to 1 if has one or more own resident children aged 5–14 years, 0 otherwise
Has child aged 15–24 years	Equal to 1 if has one or more own resident children aged 15–24 years, 0 otherwise
Has child aged 25 years or older	Equal to 1 if has one or more own resident children aged 25 years or older, 0 otherwise
Has children aged 0–4 and 5–14 years	Equal to 1 if has one or more own resident children 0–4 years and one or more own resident children 5–14 years, 0 otherwise
Has health condition	Equal to 1 if long-term health conditions or a disability limit the type or amount of work, 0 otherwise
Speaks English well	Equal to 1 if English is spoken at home or if it is spoken well or very well (self-reported), 0 otherwise
Australian born	Equal to 1 if born in Australia, 0 otherwise
Born in an English-speaking country	Equal to 1 if born in Canada, Ireland, New Zealand, South Africa, United Kingdom or United States of America, 0 otherwise
Born in a non-English-speaking country	Equal to 1 if born in another country, 0 otherwise
Resides in a capital city	Equal to 1 if resides in a capital city (excluding Hobart and Darwin) or the Australian Capital Territory, 0 otherwise
Resides in a major city	Equal to 1 if resides in a major or inner regional city other than a capital (including Hobart and Darwin), 0 otherwise
Resides in a rural area	Equal to 1 if resides in a regional or remote area, 0 otherwise

Table A2: Sample Summary Statistics – Women

	Cross-section 2002; 2 999 observations		Panel 2001–2005; 13 672 observations	
	Mean	Std dev	Mean	Std dev
Labour force participation	0.72	0.45	0.73	0.45
Owner-occupied mortgage debt outstanding ($m)	0.06	0.09	0.07	0.11
Owner-occupied mortgage debt-to-income	1 538.37	16 053.02	2 199.02	21 095.90
Debt-servicing ratio	168.57	1 640.33	212.62	1 937.60
Other debt outstanding ($m)	0.03	0.08		
Other debt-to-income	528.16	9 204.50		
Value of owner-occupied home ($m)	0.21	0.25	0.25	0.29
Non-financial assets ($m)	0.29	0.43		
Financial assets ($m)	0.05	0.24		
Investment income ($'000)	0.81	7.16	1.07	7.87
Other income ($'000)	45.83	47.39	47.69	49.13
Family Tax Benefit A ($'000)	2.80	3.68	3.01	3.92
Family Tax Benefit B ($'000)	1.20	1.12	1.30	1.18
Age	37.71	7.14	38.63	7.26
Years in the labour force	15.29	7.85	16.02	7.99
Years not in the labour force	5.79	6.42	5.89	6.52
University educated	0.26	0.44	0.27	0.44
Has a diploma	0.24	0.43	0.25	0.43
High school qualification	0.17	0.37	0.16	0.37
Did not finish Year 12	0.33	0.47	0.32	0.47
Married or de facto	0.73	0.44	0.73	0.44
Spouse's labour force status	0.62	0.48	0.63	0.48
Has child aged 0–4 years	0.24	0.43	0.24	0.43
Has child aged 5–14 years	0.45	0.50	0.45	0.50
Has child aged 15–24 years	0.23	0.42	0.24	0.43
Has child aged 25 years or older	0.01	0.10	0.01	0.12
Has children aged 0–4 and 5–14 years	0.13	0.33	0.12	0.33
Has health condition	0.11	0.31	0.13	0.33
Speaks English well	0.98	0.14	0.98	0.12
Australian born	0.77	0.42	0.78	0.42
Born in an English-speaking country	0.09	0.29	0.09	0.29
Born in a non-English-speaking country	0.14	0.34	0.13	0.34
Resides in a capital city	0.60	0.49	0.60	0.49
Resides in a major city	0.27	0.44	0.28	0.45
Resides in a rural area	0.12	0.33	0.12	0.33

Table A3: Sample Summary Statistics – Men

	Cross-section 2002; 2 568 observations		Panel 2001–2005; 11 374 observations	
	Mean	Std dev	Mean	Std dev
Labour force participation	0.92	0.27	0.92	0.27
Owner-occupied mortgage debt outstanding ($m)	0.06	0.09	0.07	0.12
Owner-occupied mortgage debt-to-income	2 272.33	18 611.35	3 713.43	28 690.10
Debt-servicing ratio	259.77	1 898.73	352.88	2 573.39
Other debt outstanding ($m)	0.03	0.09		
Other debt-to-income	1 411.24	15 497.29		
Value of owner-occupied home ($m)	0.20	0.24	0.24	0.27
Non-financial assets ($m)	0.28	0.41		
Financial assets ($m)	0.04	0.18		
Investment income ($'000)	1.22	8.34	1.83	14.27
Other income ($'000)	26.62	28.18	27.25	29.40
Family Tax Benefit A ($'000)	2.12	3.32	2.30	3.53
Family Tax Benefit B ($'000)	0.98	1.12	1.09	1.20
Age	37.75	7.19	38.75	7.26
Years in the labour force	19.63	7.92	20.51	7.98
Years not in the labour force	1.40	3.04	1.46	3.12
University educated	0.25	0.43	0.26	0.44
Has a diploma	0.40	0.49	0.41	0.49
High school qualification	0.11	0.32	0.11	0.31
Did not finish Year 12	0.24	0.42	0.22	0.42
Married or de facto	0.71	0.45	0.73	0.44
Spouse's labour force status	0.50	0.50	0.52	0.50
Has child aged 0–4 years	0.22	0.41	0.22	0.42
Has child aged 5–14 years	0.33	0.47	0.34	0.47
Has child aged 15–24 years	0.15	0.36	0.16	0.36
Has child aged 25 years or older	0.00	0.06	0.01	0.07
Has children aged 0–4 years and 5–14	0.09	0.29	0.09	0.29
Has health condition	0.11	0.32	0.13	0.34
Speaks English well	0.99	0.12	0.99	0.10
Australian born	0.78	0.42	0.78	0.41
Born in an English-speaking country	0.11	0.31	0.11	0.31
Born in a non-English-speaking country	0.12	0.32	0.11	0.31
Resides in a capital city	0.60	0.49	0.60	0.49
Resides in a major city	0.28	0.45	0.28	0.45
Resides in a rural area	0.12	0.33	0.12	0.33

Appendix B: Tables of Results

Table B1: Cross-section LFP Model Results – Women *(continued next page)*

	Coefficients	Median	Selected unit	Marginal effects at the median
Owner-occupied mortgage debt outstanding	-3.62×10^{-7} (4.97×10^{-7})	$0	$10 000	-5.01×10^{-4} (6.94×10^{-4})
Owner-occupied mortgage debt-to-income	1.66×10^{-5}*** (5.58×10^{-6})	0	0.1	2.29×10^{-7}*** (9.95×10^{-8})
Debt-servicing ratio[(a)]	-2.35×10^{-3}*** (8.31×10^{-4})	0	0.1	–
Square root of debt-servicing ratio	4.05×10^{-1}*** (1.45×10^{-1})			
Other debt outstanding	1.54×10^{-6}*** (4.35×10^{-7})	$3 000	$1 000	2.13×10^{-4}*** (7.77×10^{-8})
Other debt-to-income	3.63×10^{-5} (3.48×10^{-5})	0.08	0.1	5.02×10^{-7} (4.95×10^{-7})
Financial assets	8.60×10^{-9} (1.59×10^{-7})	$6 700	$1 000	1.19×10^{-6} (2.20×10^{-5})
Non-financial assets	-1.09×10^{-7} (8.78×10^{-8})	$212 000	$10 000	-1.50×10^{-4} (1.26×10^{-4})
Investment income	-4.00×10^{-7} (7.10×10^{-6})	$0	$100	-5.53×10^{-6} (9.82×10^{-5})
Other income	-9.39×10^{-7} (7.57×10^{-7})	$40 213	$1 000	-1.30×10^{-4} (1.07×10^{-4})
Family Tax Benefit A	-2.80×10^{-5}** (1.10×10^{-5})	$1 029	$100	-3.87×10^{-4}** (1.82×10^{-4})
Family Tax Benefit B	1.57×10^{-4}*** (4.47×10^{-5})	$1 645	$100	2.16×10^{-3}*** (6.17×10^{-4})
Age	–0.096 (0.059)	38	1 year	0.004 (0.003)
Age^2	0.002** (0.001)			
Years in the labour force	0.067*** (0.024)	14.08	1 year	–0.001 (0.003)
Years in the labour force^2	–0.003*** (0.000)			
Years not in the labour force	–0.167*** (0.023)	4	1 year	–0.020*** (0.003)
Years not in the labour force^2	0.003*** (0.001)			

Table B1: Cross-section LFP Model Results – Women *(continued)*

	Coefficients	Median	Selected unit	Marginal effects at the median
University educated	0.609*** (0.098)	0	Compared to did not finish Year 12	0.053*** (0.017)
Has a diploma	0.194** (0.079)	0	Compared to did not finish Year 12	0.023** (0.011)
High school qualification	0.151 (0.094)	0	Compared to did not finish Year 12	0.019 (0.013)
Married or de facto	–0.182* (0.108)	1	Compared to single	–0.022* (0.013)
Spouse's labour force status	0.291*** (0.093)	1	Compared to spouse not in the labour force	0.049** (0.020)
Has child aged 0–4 years	–1.944*** (0.156)	0	Compared to no children aged 0–4 years	–0.614*** (0.045)
Has child aged 5–14 years	–0.348*** (0.115)	0	Compared to no children aged 5–14 years	–0.061*** (0.021)
Has child aged 15–24 years	0.284*** (0.085)	0	Compared to no children aged 15–24 years	0.032*** (0.012)
Has child aged 25 years or older	–0.022 (0.231)	0	Compared to no children aged 25 years or older	–0.003 (0.033)
Has children aged 0–4 and 5–14 years	1.011*** (0.148)	0	Compared to no children aged 0–4 or 5–14 years	0.066*** (0.018)
Has health condition	–0.898*** (0.093)	0	Compared to no health condition	–0.216*** (0.041)
Speaks English well	0.525** (0.255)	1	Compared to does not speak English well	0.103 (0.066)
Australian born	0.181* (0.097)	1	Compared to born in a non-English-speaking country	0.028 (0.018)
Born in an English-speaking country	0.186 (0.134)	0	Compared to born in a non-English-speaking country	0.022 (0.015)
Resides in a major city	0.038 (0.072)	0	Compared to living in a capital city	0.005 (0.010)
Resides in a rural area	0.060 (0.100)	0	Compared to living in a capital city	0.008 (0.013)
Constant	1.959* (1.047)			
Observations	2 999			
Pseudo R^2	0.35			

Notes: Robust standard errors in parentheses. ***, ** and * represent significance at the 1, 5 and 10 per cent levels respectively.
(a) Marginal effect cannot be measured at zero due to the square root.

Table B2: Cross-section LFP Model Results – Men *(continued next page)*

	Coefficients	Median	Selected unit	Marginal effects at the median
Owner-occupied mortgage debt outstanding	1.64×10^{-6} (1.02×10^{-6})	\$0	\$10 000	6.82×10^{-4} (5.90×10^{-4})
Owner-occupied mortgage debt-to-income	9.73×10^{-6} (6.63×10^{-6})	0	0.1	4.05×10^{-8} (3.19×10^{-8})
Debt-servicing ratio[(a)]	-5.29×10^{-4}*** (1.06×10^{-4})	0	0.1	–
Square root of debt-servicing ratio	6.72×10^{-2}*** (1.65×10^{-2})			
Other debt outstanding	1.73×10^{-6} (1.69×10^{-6})	\$4 000	\$1 000	7.21×10^{-5} (8.01×10^{-5})
Other debt-to-income	3.02×10^{-6} (5.37×10^{-6})	0.15	0.1	1.26×10^{-8} (2.34×10^{-8})
Financial assets	-2.44×10^{-7} (3.56×10^{-6})	\$6 800	\$1 000	-1.02×10^{-5} (1.56×10^{-5})
Non-financial assets	1.26×10^{-7} (2.37×10^{-6})	\$198 000	\$10 000	5.26×10^{-5} (1.01×10^{-4})
Investment income	-8.45×10^{-6}* (4.68×10^{-6})	\$0	\$100	-3.52×10^{-5} (2.79×10^{-5})
Other income	-3.10×10^{-6}* (1.68×10^{-6})	\$21 078	\$1 000	-1.29×10^{-4} (9.30×10^{-5})
Family Tax Benefit A	-4.69×10^{-5}*** (1.77×10^{-5})	\$0	\$100	-1.96×10^{-4}* (1.10×10^{-4})
Family Tax Benefit B	4.03×10^{-5} (8.84×10^{-5})	\$0	\$100	1.68×10^{-4} (3.77×10^{-4})
Age	0.115 (0.108)	38	1 year	0.001 (0.002)
Age^2	–0.001 (0.001)			
Years in the labour force	–0.068 (0.058)	19.28	1 year	–0.002 (0.002)
Years in the labour $force^2$	0.000 (0.001)			
Years not in the labour force	–0.295*** (0.043)	0	1 year	–0.012*** (0.002)
Years not in the labour $force^2$	0.007*** (0.001)			
University educated	0.830*** (0.192)	0	Compared to did not finish Year 12	0.015* (0.009)
Has a diploma	0.257** (0.124)	0	Compared to did not finish Year 12	0.008 (0.006)

Table B2: Cross-section LFP Model Results – Men *(continued)*

	Coefficients	Median	Selected unit	Marginal effects at the median
High school qualification	0.209 (0.191)	0	Compared to did not finish Year 12	0.007 (0.007)
Married or de facto	0.282* (0.165)	1	Compared to single	0.016* (0.009)
Spouse's labour force status	0.434*** (0.148)	0	Compared to spouse not in the labour force	0.012 (0.007)
Has child aged 0–4 years	–0.241 (0.277)	0	Compared to no children aged 0–4 years	–0.013 (0.018)
Has child aged 5–14 years	–0.038 (0.200)	0	Compared to no children aged 5–14 years	–0.002 (0.009)
Has child aged 15–24 years	0.051 (0.166)	0	Compared to no children aged 15–24 years	0.002 (0.006)
Has child aged 25 years or older	0.188 (0.464)	0	Compared to no children aged 25 years or older	0.006 (0.013)
Has children aged 0–4 and 5–14 years	0.534 (0.344)	0	Compared to no children aged 0–4 or 5–14 years	0.013* (0.008)
Has health condition	–1.249*** (0.113)	0	Compared to no health condition	–0.174*** (0.058)
Speaks English well	–0.163 (0.378)	1	Compared to does not speak English well	–0.006 (0.012)
Australian born	0.175 (0.173)	1	Compared to born in a non-English-speaking country	0.009 (0.011)
Born in an English-speaking country	–0.099 (0.211)	0	Compared to born in a non-English-speaking country	–0.005 (0.011)
Resides in a major city	0.043 (0.121)	0	Compared to living in a capital city	0.002 (0.005)
Resides in a rural area	–0.225 (0.144)	0	Compared to living in a capital city	–0.012 (0.010)
Constant	0.242 (1.829)			
Observations	2 568			
Pseudo R^2	0.48			

Notes: Robust standard errors in parentheses. ***, ** and * represent significance at the 1, 5 and 10 per cent levels respectively.
(a) Marginal effect cannot be measured at zero due to the square root.

Table B3: Panel LFP Model Results – Women *(continued next page)*

	Probit random effects			Logit coefficients	
	Coefficients	Median (non-zero mortgage debt)	Marginal effects[(a)]	Random effects	Conditional fixed effects
Owner-occupied mortgage debt outstanding	4.87×10^{-7}*	$110 000	1.77×10^{-4}	9.45×10^{-7}**	-2.84×10^{-7}
	(2.74×10^{-7})		(1.12×10^{-4})	(4.58×10^{-7})	(6.45×10^{-7})
Owner-occupied mortgage debt-to-income	-2.04×10^{-6}	2.08	-7.42×10^{-9}	-4.57×10^{-6}	1.58×10^{-5}
	(3.90×10^{-6})		(1.43×10^{-8})	(7.19×10^{-6})	(1.90×10^{-5})
Debt-servicing ratio	-1.32×10^{-4}	0.22	1.11×10^{-4}***	-2.49×10^{-4}*	-3.99×10^{-4}
	(8.11×10^{-5})		(4.18×10^{-5})	(1.45×10^{-4})	(3.31×10^{-4})
Square root of debt-servicing ratio	2.92×10^{-2}***			5.58×10^{-2}***	4.03×10^{-2}
	(1.10×10^{-2})			(2.10×10^{-2})	(2.86×10^{-2})
Value of owner-occupied home	-9.80×10^{-8}	$210 000	-3.56×10^{-5}	-1.55×10^{-7}	3.37×10^{-8}
	(1.10×10^{-7})		(4.11×10^{-5})	(1.79×10^{-7})	(3.19×10^{-7})
Investment income	1.24×10^{-6}	$0	4.51×10^{-6}	1.49×10^{-6}	7.29×10^{-7}
	(3.03×10^{-6})		(1.10×10^{-5})	(5.15×10^{-6})	(5.81×10^{-6})
Other income	-9.61×10^{-7}	$43 025	-3.49×10^{-5}	-1.72×10^{-6}*	-6.71×10^{-7}
	(5.89×10^{-7})		(2.36×10^{-5})	(9.86×10^{-7})	(1.45×10^{-6})
Family Tax Benefit A	-2.02×10^{-5}**	$1 486	-7.32×10^{-5}*	-3.63×10^{-5}**	-3.93×10^{-6}
	(9.10×10^{-6})		(4.18×10^{-5})	(1.50×10^{-5})	(2.33×10^{-5})
Family Tax Benefit B	1.16×10^{-4}***	$1 814	4.22×10^{-4}***	1.96×10^{-4}***	1.11×10^{-4}
	(3.47×10^{-5})		(1.47×10^{-4})	(5.82×10^{-5})	(7.30×10^{-5})
Age	–0.022	39	0.001	–0.046	–
	(0.055)		(0.001)	(0.088)	
Age^2	0.001			0.001	–0.003
	(0.001)			(0.001)	(0.003)
Years in the labour force	0.136***	15	0.001	0.222***	0.384
	(0.025)		(0.001)	(0.039)	(0.268)
Years in the labour force^2	–0.004***			–0.006***	–0.010***
	(0.001)			(0.001)	(0.004)
Years not in the labour force	–0.227***	4	–0.007***	–0.376***	–0.695***
	(0.023)		(0.001)	(0.036)	(0.258)
Years not in the labour force^2	0.004***			0.006***	0.018***
	(0.001)			(0.001)	(0.005)
University educated	1.039***	0	0.014***	1.737***	1.712
	(0.104)		(0.005)	(0.164)	(1.309)
Has a diploma	0.381***	0	0.009**	0.631***	0.788*
	(0.085)		(0.004)	(0.134)	(0.448)
High school qualification	0.279***	0	0.007**	0.468***	0.145
	(0.103)		(0.004)	(0.161)	(0.677)
Married or de facto	–0.300***	1	–0.008**	–0.490***	–0.492*
	(0.099)		(0.003)	(0.162)	(0.268)

Table B3: Panel LFP Model Results – Women *(continued)*

	Probit random effects			Logit coefficients	
	Coefficients	Median (non-zero mortgage debt)	Marginal effects[(a)]	Random effects	Conditional fixed effects
Spouse's labour force status	0.414*** (0.083)	1	0.024** (0.009)	0.707*** (0.137)	0.500*** (0.192)
Has child aged 0–4 years	–2.284*** (0.122)	0	–0.523*** (0.051)	–3.974*** (0.208)	–2.785*** (0.265)
Has child aged 5–14 years	–0.595*** (0.097)	0	–0.041*** (0.011)	–0.996*** (0.161)	–1.198*** (0.270)
Has child aged 15–24 years	0.370*** (0.071)	0	0.009*** (0.003)	0.639*** (0.117)	0.037 (0.175)
Has child aged 25 years or older	0.099 (0.216)	0	0.003 (0.006)	0.166 (0.354)	–0.316 (0.518)
Has children aged 0–4 and 5–14 years	1.131*** (0.118)	0	0.014*** (0.005)	1.984*** (0.200)	1.465*** (0.270)
Has health condition	–0.968*** (0.073)	0	–0.097*** (0.025)	–1.709*** (0.123)	–0.789*** (0.171)
Speaks English well	0.641*** (0.231)	1	0.047 (0.030)	1.169*** (0.380)	0.686 (0.622)
Australian born	0.175 (0.107)	1	0.008 (0.006)	0.285* (0.167)	–
Born in an English-speaking country	0.133 (0.147)	0	0.004 (0.004)	0.210 (0.230)	–
Resides in a major city	0.089 (0.074)	0	0.003 (0.003)	0.163 (0.118)	–0.036 (0.300)
Resides in a rural area	0.054 (0.097)	0	0.002 (0.003)	0.137 (0.155)	–0.769** (0.381)
Wave 2 (2002)	0.031 (0.057)	0	0.001 (0.002)	0.053 (0.097)	0.481 (0.348)
Wave 3 (2003)	–0.013 (0.059)	0	–0.000 (0.002)	–0.015 (0.100)	0.771 (0.662)
Wave 4 (2004)	0.056 (0.062)	0	0.002 (0.002)	0.104 (0.106)	1.283 (0.985)
Wave 5 (2005)	0.215*** (0.068)	0	0.006** (0.003)	0.376*** (0.116)	2.010 (1.317)
Constant	0.609 (0.983)			1.232 (1.584)	
Observations (person-years)	13 672			13 672	3 375
Cases (number of individuals)	3 350			3 350	890

Notes: Standard errors in parentheses. ***, ** and * represent significance at the 1, 5 and 10 per cent levels respectively.

(a) Marginal effects shown are for the selected units shown in Table B1.

Table B4: Panel LFP Model Results – Men *(continued next page)*

	Probit random effects			Logit coefficients	
	Coefficients	Median (non-zero mortgage debt)	Marginal effects[(a)]	Random effects	Conditional fixed effects
Owner-occupied mortgage debt outstanding	2.10×10^{-6}*** (6.56×10^{-7})	$113 000	3.76×10^{-5} (2.57×10^{-5})	3.99×10^{-6}*** (1.23×10^{-6})	3.73×10^{-6}** (1.86×10^{-6})
Owner-occupied mortgage debt-to-income	7.62×10^{-6} (8.00×10^{-6})	4.30	1.37×10^{-9} (1.72×10^{-9})	1.25×10^{-5} (1.46×10^{-5})	3.53×10^{-5} (2.98×10^{-5})
Debt-servicing ratio	-2.33×10^{-4}*** (7.75×10^{-5})	0.46	4.12×10^{-6}*** (1.35×10^{-6})	-4.22×10^{-4}*** (1.38×10^{-4})	-9.00×10^{-4} (5.58×10^{-4})
Square root of debt-servicing ratio	3.13×10^{-2}*** (1.02×10^{-2})			5.94×10^{-2}*** (1.95×10^{-2})	7.94×10^{-2} (6.09×10^{-2})
Value of owner-occupied home	4.07×10^{-7} (2.60×10^{-7})	$200 000	7.31×10^{-6} (6.98×10^{-6})	6.67×10^{-7} (4.52×10^{-7})	4.73×10^{-7} (9.81×10^{-7})
Investment income	-2.66×10^{-6} (3.58×10^{-6})	$0	-4.77×10^{-7} (7.07×10^{-7})	-4.91×10^{-6} (6.29×10^{-6})	5.88×10^{-6} (1.42×10^{-5})
Other income	-2.41×10^{-6}* (1.41×10^{-6})	$21 755	-4.33×10^{-6} (3.85×10^{-6})	-4.17×10^{-6}* (2.44×10^{-6})	-8.32×10^{-6}* (4.63×10^{-6})
Family Tax Benefit A	-8.34×10^{-5}*** (1.48×10^{-5})	$0	-1.50×10^{-5} (1.04×10^{-5})	-1.52×10^{-4}*** (2.56×10^{-5})	-8.56×10^{-5} (5.43×10^{-5})
Family Tax Benefit B	1.29×10^{-4}** (5.72×10^{-5})	$0	2.32×10^{-5} (1.91×10^{-5})	2.09×10^{-4}** (1.03×10^{-4})	8.58×10^{-5} (1.47×10^{-4})
Age	–0.066 (0.091)	39	–0.000 (0.000)	–0.121 (0.156)	–
Age^2	0.000 (0.001)			0.001 (0.002)	0.022*** (0.007)
Years in the labour force	0.006 (0.041)	20.17	0.000 (0.000)	0.010 (0.070)	0.827 (0.558)
Years in the labour force^2	0.000 (0.001)			0.001 (0.001)	–0.020** (0.008)
Years not in the labour force	–0.387*** (0.035)	0	–0.001*** (0.000)	–0.663*** (0.058)	–1.400*** (0.503)
Years not in the labour force^2	0.011*** (0.001)			0.019*** (0.002)	0.014 (0.014)
University educated	1.260*** (0.168)	0	0.001 (0.000)	2.192*** (0.291)	–[(b)]
Has a diploma	0.303*** (0.112)	0	0.000 (0.000)	0.500*** (0.190)	–1.713 (1.543)
High school qualification	0.290* (0.172)	0	0.000 (0.000)	0.438 (0.293)	–3.082 (2.006)
Married or de facto	0.452*** (0.133)	1	0.002* (0.001)	0.831*** (0.231)	1.181** (0.469)

Table B4: Panel LFP Model Results – Men *(continued)*

	Probit random effects			Logit coefficients	
	Coefficients	Median (non-zero mortgage debt)	Marginal effects[(a)]	Random effects	Conditional fixed effects
Spouse's labour force status	0.313*** (0.112)	0	0.000 (0.000)	0.590*** (0.200)	0.027 (0.312)
Has child aged 0–4 years	–0.287 (0.193)	0	–0.001 (0.001)	–0.530 (0.346)	–0.091 (0.524)
Has child aged 5–14 years	0.019 (0.157)	0	0.000 (0.000)	0.091 (0.280)	–0.470 (0.541)
Has child aged 15–24 years	0.028 (0.131)	0	0.000 (0.000)	0.051 (0.230)	–0.026 (0.439)
Has child aged 25 years or older	–0.748* (0.431)	0	–0.005 (0.007)	–1.446** (0.726)	–1.232 (1.713)
Has children aged 0–4 and 5–14 years	0.372* (0.222)	0	0.000 (0.000)	0.647* (0.392)	0.493 (0.684)
Has health condition	–1.530*** (0.089)	0	–0.039** (0.017)	–2.717*** (0.155)	–1.625*** (0.260)
Speaks English well	0.058 (0.312)	1	0.000 (0.001)	0.116 (0.539)	–0.232 (0.869)
Australian born	0.116 (0.151)	1	0.000 (0.000)	0.184 (0.261)	–
Born in an English-speaking country	0.020 (0.197)	0	0.000 (0.000)	–0.006 (0.338)	–
Resides in a major city	–0.178* (0.105)	0	–0.000 (0.000)	–0.329* (0.182)	–0.707 (0.586)
Resides in a rural area	–0.299** (0.129)	0	–0.001 (0.001)	–0.497** (0.222)	–1.358** (0.622)
Wave 2 (2002)	0.036 (0.098)	0	0.000 (0.000)	0.067 (0.178)	–1.449* (0.755)
Wave 3 (2003)	0.033 (0.101)	0	0.000 (0.000)	0.053 (0.181)	–2.980** (1.438)
Wave 4 (2004)	0.079 (0.106)	0	0.000 (0.000)	0.155 (0.190)	–4.421** (2.134)
Wave 5 (2005)	0.217* (0.113)	0	0.000 (0.000)	0.415** (0.204)	–5.524* (2.846)
Constant	4.137*** (1.604)			7.309*** (2.769)	
Observations (person-years)	11 374			11 374	1 018
Cases (number of individuals)	2 822			2 822	253

Notes: Standard errors in parentheses. ***, ** and * represent significance at the 1, 5 and 10 per cent levels respectively.

(a) Marginal effects shown are for the selected units shown in Table B1.

(b) No men in the conditional fixed-effects sample complete a university education during the sample period.

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