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Abstract

We study the portfolio allocation decisions of Australian households using the relatively new Household Income and Labour Dynamics in Australia (HILDA) survey. We focus on household allocations to risky financial assets. Our empirical analysis considers a range of hypothesised determinants of these allocations. We find background risk factors posed by labour income uncertainty and health risk are important. Credit constraints and observed risk preferences play the expected role. A positive age gradient is identified for risky asset holdings and homeownership is associated with greater risky asset holdings. A unifying theme for many of our empirical findings is the important role played by financial awareness and knowledge in determining risky asset holdings. Many non-stockholding households appear to lack the experience and financial literacy that might enable them to benefit from direct investment in stocks.

1. Introduction

Household portfolio allocation is a simple business according to the stylized classical model of portfolio allocation dating back as far as Markowitz (1952). However, as Campbell (2006), Guiso *et al* (2002) and many others point out, the empirical evidence is that households do not follow the predictions of portfolio theory. Many households hold no risky financial assets (stocks or corporate bonds), while of those that do, many hold only one or a very small number of stocks rather than a diversified portfolio. There is a growing body of empirical and theoretical research into household financial decisions that seeks to either develop models that explain and predict observed portfolio patterns or to empirically identify factors that explain household portfolio allocations or some combination of the two; see Campbell (2006) for a discussion of this literature.

In this paper, we add to this literature by considering the portfolio allocation decisions of Australian households, using data collected by the Household, Income and Labour Dynamics in Australia (HILDA) survey. The HILDA survey is a relatively new household panel much like the US Panel Study of Income Dynamics or the UK British Household Panel Survey. An additional wealth survey module was included in the second wave (2002), thus enabling us to add Australia to the number of countries for which the determinants of portfolio decisions regarding risky financial assets have been empirically studied.

The richness of the HILDA data allows us to bring together into one reduced form model many of the hypothesised explanations of portfolio allocation decisions. In addition to a range of demographic controls, we are able to consider the relative roles of observed preferences, credit constraints, investment substitutes, retirement status and 'background risks' deriving from labour income uncertainty, health status and committed expenditures in accounting for the low risky financial asset holdings of Australian households. The comparative richness of the data furthermore allows us to produce multiple alternative measures of many of the factors of interest, facilitating a more detailed and robust analysis of effects.

Our analysis has implications for the theoretical and modelling literature on portfolio decisions. Institutional structures unique to Australia, such as mandatory employer based retirement savings, provide further insights for modelling portfolio behaviour that can only be derived by considering the diversity of such institutional structures across countries. For example, for a decade and a half, Australia has had in place a mandatory employer-based retirement saving scheme in parallel with a longstanding public pay-as-you-go pension

scheme.[1] Since July 1992, employers have been required by federal law to make contributions (initially at least 3% of gross salary, progressively rising to 9% by July 2002) to individual retirement accounts for most employees.[2] Clearly, employer based retirement accounts such as 401(k) plans in the United States are important parts of the retirement saving and investment landscape, but are not mandatory. Australia's experience in this area may have some policy relevance for retirement saving in other countries and the ownership of risky assets through compulsory retirement accounts adds an interesting dimension to the stockholding puzzle for working households.

Consistent with other studies in the area, our empirical approach is to estimate models of the ratio of risky financial asset holdings to total financial asset holdings. We also examine separately the sub-sample comprising households in which the head is employed and the sub-sample comprising households in which the head is retired. We focus on the employed households sub-sample because labour market risks generally apply only to employed households. We focus on the retired households sub-sample because the determinants of portfolio composition are likely to differ from those of working households. In particular, retired households are permitted to make choices regarding their retirement savings, such as draw down on balances, that working households cannot. In addition, as a consequence of this difference between retired and other households, we treat retirement savings accounts (colloquially referred to as superannuation) as financial assets for the retired sub-sample, whereas for the other samples retirement savings are treated as non-financial assets.

The main class of risky financial assets considered is shares or common stock. Share ownership is reasonably widespread in Australia. According to the population weighted estimates from the HILDA data, 44 per cent of households in Australia have direct holdings of shares. Indirect share ownership via mandatory private pension contributions is even higher, with 78 per cent of households holding private pensions, most of which will in part consist of shares. According to the HILDA data, the mean value of shareholdings of shareholder households was approximately $80,000 in 2002 (which is likely to be an

[1] Unlike most pay-as-you-go pension schemes internationally, the Australian public scheme is universal, flat-rate (not dependent on past earnings) and subject to income and assets tests.

[2] Approximately 90% of employees have retirement account contributions made by employers (ABS, 2006). Employers are not required to make contributions for employees that are either over 70 years of age, earning less than $450 per month, or under 18 years of age and working fewer than 30 hours per week.

underestimate because extremely wealthy households are unlikely to be in the HILDA sample), while mean household superannuation holdings among households with superannuation was $108,000.

We find that, of the various background risk factors that have been considered in the literature, there is (i) a significant negative effect of labour income risk on the risky asset ratio; (ii) a positive and statistically significant, but economically insignificant, effect of committed (mortgage) expenditures on the risky asset ratio; and (iii) a negative and statistically significant effect of poor health status on the risky asset ratio, although this was evident only for employed households. The committed expenditure results are in contrast with those of Fratantoni (1998), who finds a negative effect of mortgage commitments. In addition to this result, we find a strong positive effect of home ownership (either outright or mortgaged) which might offer some explanation for the committed expenditure result. These results suggest that households might be leveraging off their home-ownership to diversify their portfolios and raise their risky financial asset holdings, hence producing the positive correlations.

The health effects are not as strong as found by other studies, such as Guiso *et al* (1996) and Rosen and Wu (2005), which we attribute to our explicit inclusion of variables capturing risk and intertemporal consumption preferences. That is, it appears that health primarily affects risky asset holdings via its effects on these preferences. Indeed, our observed preference variables have strong and predictable effects. Households that consider themselves financially risk averse have a much lower risky asset ratio, while the length of a household's planning horizon has a positive impact on the risky asset ratio. Consistent with the planning horizon finding, we find that households making additional voluntary superannuation contributions have higher risky asset ratios as well.

Other notable findings include a positive impact of self-funded retiree status. The risky asset ratio of self-funded retirees, all else equal, is 0.15 higher than that of other households. In our empirical specification we employ a range of age dummies, similar to Bertaut (1998), rather than impose a restrictive parametric form. We find all age dummies have positive and significant coefficients, showing a positive gradient with age up to the 65-69 age category, and only dropping off for the 70+ age group. This is inconsistent with the typical view and financial advice that households rotate out of risky assets as they approach retirement age (see, for example Carroll, 2002), though it is consistent with the growth in knowledge of the investment landscape and opportunities that comes with age, as posited by King and Leape

(1987). Unsurprisingly, credit constraints are found to be associated with a negative effect on the risky asset ratio. Several of our results paint a broad picture, consistent with findings in Bertaut (1998) and Bertaut and Starr-McCluer (2002), that educational attainment, age and immigrant status all reflect an important role for financial literacy and awareness in determining household portfolio choices. It is perhaps surprising, however, that we find no impact on the risky asset ratio of potential investment substitutes, in the form of private business ownership, ownership of second homes or superannuation balances; see for example Heaton and Lucas (2000a, b) for the importance of private business ownership for portfolio decisions.

The remainder of the paper proceeds as follows. Section 2 contains a brief review of the empirical literature on household portfolio allocation and risky asset holdings, in particular focusing on background risk. In Section 3 we discuss our data and explain the empirical approach we employ. We present and analyse our empirical results in Section 4, with a number of sensitivity analyses also presented. We provide conclusions in Section 5.

2. Theory and Literature

Households do not typically follow the predictions of portfolio theory in their allocation of wealth across different asset classes. Many households directly hold no equity securities, while those that do hold equities do not hold diversified portfolios, as portfolio theory suggests they ought do.[3] The well known equity premium puzzle as highlighted by Mehra and Prescott (1985) suggests a clear motive for households to increase direct equity holdings. The persistent underinvestment in *risky* assets suggests that it may not be inefficiency in portfolio allocation that drives this underinvestment – households seem to want to hold *too little* of their wealth in equities. Researchers have sought to extend the standard models of portfolio choice to explain underinvestment in equities. These extensions involve the relaxation of assumptions such as access to credit for the purposes of investment and the introduction of various background risks that cannot be diversified away through equity holdings. In this section we examine a number of extensions and discuss some of the empirical literature that examines these concepts in the context of household portfolio allocation.

[3] All of the empirical studies of household risky asset holdings cited in this paper find some clustering of households around zero holdings of direct equities. This results in the use of Tobit estimation methods in many cases.

The assumptions of perfect credit markets and unlimited borrowing and lending at fixed rates are important for predictions regarding household portfolio allocations. This can manifest either through a precautionary effect, with conservative households that might not have access to credit markets in case of emergencies deliberately avoiding or limiting risky asset holdings. Alternatively, households that would like to hold larger positions in risky assets through leverage may find themselves unable to take the kinds of financial risks they desire.

It is almost standard in empirical studies that some sort of measure for credit or liquidity constraints be included when available. Using the 1989 Bank of Italy Survey of Household Income and Wealth (SHIW), Guiso *et al* (1996) consider data about whether Italian households were denied or discouraged from using credit. They find some evidence that credit constraints reduce household's risky asset holdings. A similar approach and results are found by Fratantoni (1998), using the 1989 Survey of Consumer Finances (SCF) for US households. Households were classified as liquidity constrained after having been repeatedly denied credit or not having applied for fear of being turned down. Fratantoni (1998) considers a model incorporating committed expenditure risk and finds that liquidity constraints have a negative impact on risky asset holdings. In Yamishita (2003), data from the SCF on whether households pay off debts is used to measure credit constraints and it is also found to have a negative affect on risky asset holdings. Using data from the Canadian Survey of Financial Security 1999 (SFS) and the Canadian Survey of Labour and Income Dynamics 1996-2001 (SLID), Alan (2006) employs a survey question about the ability to raise emergency funds at short notice to reflect credit constraints. In his study, credit constraints are found to increase precautionary savings. Across the board, the empirical literature consistently finds that households are less likely to hold risky assets if they face borrowing constraints of some form.

Background risk is a term that is used to describe uncertainty and risks that cannot be diversified away through portfolio allocations. Intuitively, the background risk persists and allocations to risky assets in an attempt to diversify away some of these background risks simply increase overall uncertainty rather than reduce it. The classic background risk in the empirical portfolio allocation literature is labour income risk. Another background risk to receive prominent attention is health risk. Health risk is in some ways closely related to labour income risk, since deterioration in health will often have adverse labour market effects, although effects associated with health risk may also derive from other sources, such as implications for life expectancy and anticipated health care costs. Some authors have additionally considered committed expenditure risk. In most instances, this reflects large fixed

expenditure commitments which are not income contingent, typically mortgage repayments and to a lesser extent rental commitments.

In Guiso *et al* (1996), labour income risk and health risk are considered together and, as expected, found to both have significant and negative impacts on risky asset holdings. In their study, health risk is proxied by the head of household's number of days ill and income variance is imputed from survey respondent expectations about inflation and nominal wage increases. The role of subjective income uncertainty is studied in Hochguertel (2003), in which, rather than risky assets, holdings of low-risk, highly-liquid assets are considered for their precautionary role. As expected, labour income uncertainty has a strong positive impact on these precautionary holdings, implying an aversion to risky assets.

Fratantoni (1998) considers a range of background risks, including labour income variance and health status. The study's key innovation is the inclusion of a committed expenditure risk measure, equal to the proportion of household income committed to mortgage repayments or rent. The greater this committed expenditure measure, the greater the background risk. His results suggest greater income uncertainty and lower health status are correlated with lower risky asset holdings, in line with expectations. He also finds that committed expenditures, in the form of mortgage repayments, have a negative impact on risky asset holdings, supporting their interpretation as a form of background risk. This finding is incorporated into simulation models by Fratantoni (2001) and Hu (2005) to show that homeownership can operate in a way that induces temperance in risky asset holdings.

The role of housing in portfolio allocation is complicated by the dual role it plays for households – as a durable consumption good providing a stream of shelter services as well as its role as a risky non-financial investment. This is related to theoretical models, as housing is typically highly geared and forms a large proportion of net worth that is not divisible, thereby making portfolio allocation decisions more difficult. However, more recent innovations in Australian mortgage markets have enabled financially literate households to draw on housing equity for other investment purposes, thereby reducing the incidence of corner-solution type portfolio outcomes where households have close to 100% portfolio weight in real estate. For a discussion of mortgage finance and household choice between fixed rate mortgages (FRM's) and adjustable rate mortgages (ARM's), see Campbell (2006).

The role of entrepreneurial and proprietary business income risk is considered in Heaton and Lucas (2000a, 2000b). The former study provides a calibrated theoretical model incorporating

labour income risk and proprietary business risk and shows that such background risks offer potential explanations for some of the low risky asset holdings of households. Heaton and Lucas (2000b) support their theoretical modelling with empirical analysis using both the Panel of Individual Tax Returns and the SCF for the US. They find evidence that households facing greater proprietary business income risk hold fewer risky assets, consistent with the associated background risk.

The background risks induced by ill-health and associated health risks are the focus of Rosen and Wu (2004). They use data from the Health and Retirement Study (HRS) to show that poor health leads households to hold fewer risky assets and hold greater proportions of relatively safe assets. The HRS is a survey of primary respondents born between 1931-1941, implying that the sample comprises more mature households with on average higher net worth and greater numbers of health risks than the general population. The authors also consider factors such as attitudes to risk and planning horizon, which are often found to be significant in portfolio decisions, finding that health effects are robust to their inclusion.

As can be seen, a range of background risk factors have been found to exhibit some explanatory power over household portfolio allocation. In particular, background risks like labour income, committed expenditure, proprietary business income and health risks all offer some explanation in various studies. One of the key strengths of our empirical analysis below is that we consider all of these background risk factors simultaneously in an attempt to identify their relative roles in explaining household portfolio choice.

Another factor that may influence risky asset holding by households is indirect holdings of risky assets through structured retirement savings. These retirement savings can take two broad forms. One is a defined benefit pension scheme where a set of employment history parameters determine the stream of retirement income. In these cases, the only (nominal) risk is that of default by the insurer. In terms of private risky asset holdings, we would expect that such savings would not substitute for risky assets. It might be expected that reduced uncertainty about retirement incomes may actually induce greater risky asset holdings. The other broad class of retirement savings is a defined contribution plan. Under such schemes, regular contributions are made by the employee or by the employer on behalf of the employee. Savers are entitled to a share of a portfolio that is invested on their behalf. This will have the opposite effect to the defined benefit pension scheme: since it provides indirect exposure to risky assets, households are more likely to substitute these risky retirement savings for private risky asset holdings.

Last, and possibly most obvious, are household attitudes to financial risk and saving horizon. Households may simply be more impatient and risk averse than expected by theorists. As pointed out by Guiso *et al* (2002), omission of any risk aversion variables is an important issue and likely to bias results. Any data available on these issues are typically included as controls. As we discuss in Section 3, the dataset we use in this study contains information on both saving horizon and attitudes to risk. The variables we create based on this information play an important part in our empirical analysis.

Many empirical studies of household portfolio decisions focus on a subset of the factors outlined above, sometimes for only a subset of the community, such as older persons. In some instances, this is due to limited data availability, implying that some hypotheses cannot be considered. In other cases, a theoretical hypothesis is proposed and a reduced form specification is used to test that given hypothesis. In our case, we have data that allows us to consider all of the factors outlined above, for a sample that is representative of the entire community. In particular, we have several variables that measure different aspects of credit constraints and labour income uncertainty. As a consequence, our approach is to consider a broad reduced form specification that includes a range of background risk variables along with credit constraints, investment substitutes and attitudes to savings and risk. In this way, we allow the various hypothesised sources of background risk to compete as possible explanations of household's risky asset holdings, allowing us to identify dominant effects.

3. Data and Empirical approach

3.1 Data

Our data source is the Household, Income and Labour Dynamics in Australia (HILDA) Survey, a nationally representative household-based panel study which began in 2001. In each wave, information is collected on socio-demographic characteristics, income, labour market activity, health, and a range of other personal and family characteristics. The key wave of this panel for our purposes is Wave 2 (2002), where a special wealth module was incorporated into the questionnaires. This survey instrument forms the foundation of our analysis of financial asset holdings.

The Wave 2 data file contains information on 14,020 respondents over the age of 15 residing in 7,245 households. We restrict our analysis to the 6,784 households that are 'standard' families: single person, couple, sole parent or couple with children. Our analysis is of household asset holdings and our unit of analysis is correspondingly the household rather than

the individual. Personal characteristics that we examine relate to the 'head' of the household, defined to be the adult male in couple households. Only households with complete information on all of the characteristics used in the analysis are retained, reducing the estimation sample to 5,290 observations. We also undertake analysis on two sub-samples. First, we consider the sub-sample of employed persons only, which facilitates inclusion of additional covariates related to labour income risk. This has the effect of excluding most persons over 65 years of age and many persons under 65 years of age with very low financial assets. The employed household sample contains 3,512 observations. Second, models are estimated on the sub-sample of households in which the head is retired and over 55 years of age. The retired household sample contains 1,195 observations.

3.2 Empirical method and asset measures

Our empirical approach is to study the determinants of the proportion of financial assets held as risky assets. It is based on Guiso *et al* (1996), who study the role of background risk in the portfolio decisions of Italian households. Household demand for risky assets is treated as a two stage decision, whereby households first decide whether to hold risky assets or not, and then decide on the allocation among assets. As a consequence, we find that some households hold no risky financial assets, while for others the only financial assets held are risky. Given our dependent variable is the risky asset share of financial assets, this clustering at zero and one is handled by estimating a Tobit model.

Facilitated by the comparative richness of our data source, we build on the empirical approach of Guiso *et al* (1996) by considering in more detail the roles of different sources of background risk, as well as further investigating effects of credit and liquidity constraints. We also consider the impact of mandated savings vehicles and other potential substitutes for risky assets. We thus estimate a model that takes the following form:

$$y_i = \alpha + \beta x_i + \chi br_i + \delta c_i + \phi s_i + \gamma p_i + \varepsilon_i$$

where for household *i*, y_i is the risky asset share of total financial assets and x_i is a vector of household control variables, including age, family type and size, educational attainment, country of birth, location of residence and income. The vector br_i contains a range of variables measuring background risk, including labour income, committed expenditure, proprietary business income and health risks. Variables measuring credit constraints are included in c_i, while s_i contains variables for holdings of investment substitutes for risky

financial assets and p_i contains variables for directly observed attitudes to saving and risk. The error term is given by ε_i.

The wealth module in Wave 2 of the HILDA Survey obtained information on the value of each of a number of individual components of wealth, allowing the separate identification of the following components of financial assets:

(1) Equity investments, comprising shares, managed funds (mutual funds) and property trusts (real estate investment trusts, or REIT's).
(2) Cash investments, comprising government bonds, corporate bonds, debentures, certificates of deposit, mortgage-backed securities.
(3) Trust funds, including children's trust funds but excluding property trusts.
(4) Bank accounts.
(5) Cash-in value of redeemable life insurance policies (excluding policies only payable on death).
(6) Superannuation or structured retirement savings (pension plans).

Typically, the risky financial asset class would include equity holdings (direct and indirect), and a range of debt instruments excluding government bonds. In our analysis, we assume risky financial assets comprise category (1) above. Categories (2), (3) and (6) also potentially contain risky financial assets. However, few households own cash investments or trust funds (3% of the sample in each case), so results are little-affected by how these asset categories are treated.

Our core approach treats superannuation as a non-financial asset (i.e., excludes superannuation, category (6)). The risky asset ratio is therefore the value of category (1) as a proportion of the sum of the values of categories (1) to (5). The exclusion of superannuation is warranted by its essentially mandatory nature, making it inappropriate to interpret such holdings as a choice variable. It is also highly illiquid for persons below the 'preservation age,' the minimum age at which these retirement savings can be accessed, which in 2002 was 55 years of age. These two properties imply superannuation does not have all of the characteristics typical of financial assets. Our approach is, furthermore, consistent with the treatment of retirement savings schemes in other studies. For example, Fratantoni (1998) and Guiso *et al* (1996) both exclude retirement savings from financial assets, while Rosen and Wu (2004) consider retirement savings (IRAs and Keoghs) as a distinct financial asset class that is neither 'risky' nor 'non-risky'.

Although superannuation is excluded from the dependent variable, as noted in Section 2, there is strong potential for substitution effects arising from superannuation balances. As a response, we include several variables for superannuation balances as explanatory factors for risky asset holdings. Furthermore, for the retired household sub-sample, we take an alternative approach to defining financial assets, treating superannuation as a risky financial asset. For this approach, the risky asset ratio is equal to equity holdings plus superannuation holdings (categories (1) and (6)) divided by the sum of categories (1) to (6).[4]

Table 1 presents summary measures of distributional features for the financial assets, risky financial assets and risky asset ratio variables. To put the information in context, the table also presents information on annual disposable income, 'equivalised' annual disposable income, net worth and superannuation holdings. Equivalised annual income adjusts income for household size using the OECD equivalence scale, whereby total household income is divided by 1 plus 0.5 for each adult other than the head and 0.3 for each child. For example, income is divided by 2.1 for a family of two adults and two children. Net worth is the sum of household financial and non-financial assets, less all debts. Non-financial assets comprise property (including own home), business assets, collectibles and vehicles. Debts comprise credit card debt, student loans, other personal debt, business debt, home debt and debt on other property. The top panel of Table 1 presents estimates for all households, the middle panel restricts to households in which the head is employed, while the bottom panel restricts to households in which the head is retired and over 55 years of age. For this last sample, we present the risky asset ratio that treats superannuation as a risky financial asset.

Excluding superannuation, the mean holding of risky assets among all households is $35,800. As in other countries, the distribution is highly positively skewed, with the median household holding no risky assets, the household at the 75th percentile holding $10,000 worth of risky assets, and the household at the 90th percentile holding $78,000 in risky assets. Distributions of asset holdings are strikingly similar when we restrict to households in which the head is employed. This would seem to be the net outcome of omission of two categories of household: retired households, who – as the bottom panel of Table 1 indicates – tend to have

[4] Upon retirement in Australia, superannuation is usually paid out as a lump sum which is in turn typically "rolled over" into an allocated pension with favourable tax treatment relative to the take the money up front option. An allocated pension comprises a diversified risky portfolio from which earnings and capital are used to distribute regular pension payments.

high levels of assets; and non-employed working-age households, who – by inference – tend to have few assets.

Table 1: Distributions of financial variables

	Mean	Std dev.	Percentiles					Proportion positive
			10th	25th	50th	75th	90th	
All households								
Income ($'000)	47.3	38.7	12.1	21.9	40.3	63.2	85.9	0.995
Equivalised income ($'000)	29.0	21.4	11.1	15.3	24.9	36.9	51.0	0.995
Net worth ($'000)	409.8	637.3	5.0	60.8	225.9	506.2	931.1	0.959
Financial assets ($'000)	73.6	209.9	0.2	1.7	11.4	52.0	172.8	0.981
Risky assets ($'000)	35.8	137.6	0.0	0.0	0.0	10.0	78.0	0.436
Superannuation ($'000)	82.1	159.4	0.0	0.8	23.0	83.0	245.0	0.776
Risky asset ratio (%)	23.2	33.8	0.0	0.0	0.0	45.8	85.4	-
Households with head employed								
Income ($'000)	57.6	40.7	22.2	34.0	51.8	71.5	94.2	0.996
Equivalised income ($'000)	34.1	22.4	15.5	21.8	30.1	41.7	55.8	0.996
Net worth ($'000)	438.0	661.7	10.5	75.1	242.8	546.7	990.0	0.961
Financial assets ($'000)	67.5	198.4	0.4	2.1	10.8	45.0	153.9	0.981
Risky assets ($'000)	31.2	126.6	0.0	0.0	0.0	10.0	60.0	0.475
Superannuation ($'000)	97.7	163.0	2.0	11.0	36.5	105.0	285.0	0.957
Risky asset ratio (%)	24.5	33.7	0.0	0.0	0.0	48.4	85.0	-
Households with head retired								
Income ($'000)	26.4	21.1	10.7	12.4	19.4	31.7	52.8	0.996
Equivalised income ($'000)	19.4	13.3	10.4	11.6	14.8	22.6	34.7	0.996
Net worth ($'000)	435.8	632.2	12.7	112.6	265.0	513.8	919.8	0.988
Financial assets ($'000)	108.8	253.6	0.5	5.0	27.0	93.6	270.1	0.990
Risky assets (excl. super) ($'000)	61.7	167.8	0.0	0.0	0.0	35.1	205.0	0.433
Superannuation ($'000)	58.9	182.5	0.0	0.0	0.0	25.0	150.0	0.339
Risky assets (inc. super) ($'000)	120.5	280.6	0.0	0.0	4.5	116.0	365.0	0.546
Risky asset ratio (inc. super) (%)	37.4	40.8	0.0	0.0	13.8	84.2	96.5	-

Note: Data come from Wave 2 of the HILDA Survey.

3.3 Explanatory variables

As indicated, a range of factors potentially impacting on risky asset holdings are considered, including labour income risk, health risk, committed expenditure risk, liquidity and credit constraints, mandatory retirement savings and risk and time preferences. A variety of variables are created to capture these effects, details of which follow.[5]

Labour income risk

Our primary measure of labour income risk is realised variability of household labour income over the five waves (years) of data available, which we interpret as a proxy for subjectively assessed labour income risk. A key advantage of this measure is that it can account for the

[5] Definitions of the explanatory variables are proved in Table A1 in the Appendix and sample means of the variables are presented in Table A2.

many potential unobserved sources of labour income risk, such as family structure changes and knowledge of individuals' labour market plans. The main limitation is that individuals may not fully anticipate realised volatility. A further concern is that labour income risk may be endogenous with respect to risky financial asset holdings. However, we think it unlikely that labour market activities are significantly affected by risky asset holdings, since it is considerably easier for individuals to affect risk exposure in financial assets than to affect income risk exposure in the labour market. In any case, such endogeneity does not invalidate the analysis. The question of interest is whether there is evidence that individuals substitute between the two forms of risk, which does not require causality to run in only one direction.[6]

Realised variability is measured by the coefficient of variation of age- and time-adjusted labour income over the 2001-2005 period. The labour income variable is household annual labour income. Age- and time-adjustments are obtained by first regressing income on age, age squared and a linear time trend, and then for waves 2-5 subtracting the predicted change in labour income between wave 1 and that wave. Note, therefore, that variability deriving from lifecycle ageing and economy-wide time trends are excluded from this measure of risk – that is, it is a measure of variability *relative* to age and time trend.

A supplementary or substitute measure of labour income risk is provided by a dummy variable equal to one if there are two or more earners in the household. All else equal, two earners in a household will correspond to lower labour income risk than one earner in the household, as long as individual labour income is imperfectly correlated among household members. For the analysis of all households, an additional dummy variable is defined for households with no earners to avoid confounding the two-earner versus one-earner effect with the two-earner versus no-earner effect.

We also consider various other measures of labour income risk that are defined only for households in which the head is employed and are therefore only included in specifications estimated on an employed households sample. These measures comprise variables for casual employment status, self-employment status, sector of employment, subjective assessment of job prospects, satisfaction with job security, job tenure, and earnings share of the household's highest earner.

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[6] This does not, of course, repudiate concerns of endogeneity stemming from correlations of labour income variability with unobserved determinants of risky asset holdings, but there is no obvious candidate for this source of endogeneity.

Casual employment, a form of employment peculiar to Australia, is generally perceived to be less secure than other forms of employment because employers face fewer legal constraints on reducing hours of work or dismissing employees altogether. The absence of sick leave entitlements also increases risk, since illness requiring time off work will reduce labour income. Being employed on a casual basis is thus interpreted as greater exposure to labour income risk. Self-employment and employment in the private for-profit sector are likewise interpreted as increased exposure to labour market risk.

Self-assessed job prospects are measured by the individual's assessment of the probability of holding the current job, or one at least as good, in one year's time. This is derived from survey questions on the probability of losing the current job within the next year and the probability that, in the event of job loss, the individual could secure another job at least as good as the current job within the next year. The measure is constructed such that higher values correspond to a greater probability of job loss, which approximately corresponds to greater perceived labour income risk. In principle, a higher probability of job loss could, beyond some point, be interpreted as increased certainty about future labour income: relatively certain future job loss becomes a known adverse change to future labour income, rather than increased uncertainty about future labour income. However, in practice, this self-assessed probability is less than 0.5 for 99% of employed persons in the sample, so that an individual with a higher value of this probability than another individual therefore nearly always faces greater uncertainty.

Satisfaction with job security is rated on an eleven-point scale from completely dissatisfied to completely satisfied. Job tenure, measured in years, provides a further measure of job security and/or stability and therefore labour income risk. The final variable, the share of labour income earned by highest income earner in the household, is a measure of diversification of the labour income portfolio. All else equal, the greater this share, the greater the risk.

Health risk

Poor health can be viewed as a source of labour income risk as well as a source of 'expense' risk – the possibility that financial resources will be required to meet health care expenses. Although Australia in principle has universal access to publicly funded health care, in practice health care is often associated with considerable private expense. Further, it is not legally possible to obtain private health insurance for most out-of-hospital medical treatments. Poor health may also impact on time preferences, particularly if life expectancy is correlated with

health, although we attempt to independently control for time preferences in some of the specifications estimated.

Our health measure is obtained from respondent self-assessments of general health on a five-point scale. We classify individuals as in either 'good' health (assess health to be excellent or very good), 'fair' health (assess health to be good or fair) or 'poor' health (assess health to be poor).

Committed expenditure risk

Fratantoni (1998) proposes that committed expenditures, most particularly in the form of mortgage repayment commitments, constitute a background risk that will impact on financial portfolio composition. In principle, there are other potential committed expenditures, such as private school tuition fees and non-housing loan repayments, but we follow Fratantoni (1998) and focus on mortgage and rent expenses tied to the primary residence. Potential endogeneity of committed expenditures with respect to portfolio choice is an issue that concerned Fratantoni. However, as we have argued for labour income risk, our key empirical question is whether there is a relationship between risky financial asset holdings and committed expenditure. Indeed, the causal effect of the latter on the former is not meaningful because the two quantities are clearly *jointly* determined by the household.[7]

Liquidity and credit constraints

Liquidity and credit constraints are included in the model through two variables. The first is a qualitative variable that measures the household's ability to raise a relatively large amount of funds – $2,000 – at short notice. For this variable, we define a dummy indicator equal to one if the household head could not raise $2,000, or would have to do something drastic, such as sell an important possession, to raise the money. The second credit constraint variable uses information on whether household credit cards are paid off in full on a monthly basis. A dummy indicator is employed for households which do not usually pay off most or all of the credit card debt each month. We take this as a measure of credit constraints because credit cards are relatively easily accessible but are generally a very expensive commercially

[7] As we noted in respect of labour income risk, endogeneity concerns may persist if committed expenditures are thought to be correlated with unobserved determinants of risky asset holdings. However, this does not appear to be the basis for Fratantoni's (1998) concerns. Another measure of committed expenditure risk we considered was the respondent's subjective assessment of adequacy of income relative to needs and commitments. However, we did not find any statistically significant effects associated with this variable.

available source of funds. If a household was not credit constrained, they would likely substitute cheaper alternative sources of funds for credit card debt.[8] We additionally include a dummy variable equal to one if the household does not hold any credit cards. Although not necessarily the case, our prior expectation is that this is a measure of low access to credit, since it is likely many of these households do not hold cards because of a more general inability to obtain credit.

Investment substitutes

Potential effects of risky non-financial investment holdings on the risky financial asset ratio are considered by including indicator variables for home-ownership, second-house ownership and business ownership.[9] Note that it is not clear ex ante that there should be observed substitution effects between non-financial asset holdings and the share of financial assets that are risky, or the direction of these effects. This is because non-financial assets may be substitutes not only for risky financial assets, but also for non-risky financial assets.

Mandatory retirement savings

In the main analysis, which treats superannuation as a non-financial asset, we allow for superannuation balances to affect the risky asset share of financial asset holdings. Like non-financial investment holdings, the primary hypothesised effect is a substitution effect. Effects of superannuation should in principle depend on the type of superannuation product held. There are two broad classes of superannuation products held by employees. The accumulation-style account, the predominant form of superannuation, is typically of uncertain value, often largely comprising equities, and would therefore be expected to negatively impact on the risky asset ratio. The second type of product, the defined-benefit account, is of somewhat deterministic value, based on salary and years of employment. We further distinguish superannuation balances of retired persons, since the illiquidity that characterises superannuation for non-retired persons does not apply to retired persons. Thus, models estimated on all persons contain three variables for superannuation balances – accumulation, defined benefit and retired – all expressed as proportions of net worth.

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[8] Alternatively, it may reflect poor financial awareness and financial errors on behalf of the household, as discussed more generally with respect to household finance in Campbell (2006).

[9] Models which included variables for the proportion of wealth accounted for by each asset class were estimated, but these variables were always insignificant and so excluded from the reported specifications.

We additionally consider effects associated with making voluntary contributions to a superannuation fund using a dummy variable equal to one if the respondent makes voluntary contributions (whether regularly or occasionally). Such voluntary contributions have the potential to impact on risky asset holdings, particularly since they will invariably be to accumulation-style accounts that are largely comprised of risky assets. Clearly, however, this is not capturing effects of mandatory retirement savings and instead reflects a preference for retirement style savings accounts, potentially for tax reasons or because of the highly illiquid nature of these accounts.

Preferences

Direct measures of preferences with respect to both risk and time are available in the HILDA Survey data. Information on attitudes to financial risk was gathered via the question *"Which of the following statements comes closest to describing the amount of financial risk you are willing to take with your spare cash? That is, cash used for savings or investment."* We classify those who responded that they were reluctant to take any risks as risk averse. A further categorical variable is created from the response "I never have any spare cash". It is not clear what risk preference this embodies. We interpret it as greater risk aversion, but it may also reflect other factors, such as low income.

The rate of time preference is measured by responses to a survey question on the individual's financial planning horizon, for which possible responses were 'next week', 'next few months', 'next year', 'next 2-4 years', 'next 5-10 years' or 'more than 10 years'. A longer savings horizon would be expected to be associated with greater willingness to bear risk on financial assets.

Other factors

We consider the possibility that retirement has implications for preferences with regard to risky asset holdings, and allow this effect to differ depending on whether the retiree is self-funded (more than half of income coming from private sources) or government-reliant (more than half of income comes from government). Since we control for age, and there is in any case considerable overlap in the age distributions of retired and non-retired persons, these variables are capturing retirement effects, not age effects. We also include variables for household type, educational attainment, country of birth, English proficiency, region of residence, income and wealth (net worth). Details for these and all other variables are provided in the Appendix.

4. Results

4.1 Full sample

In Table 2 we present our main results for the full estimation sample, treating superannuation as a non-financial asset. Model 1 is our core specification, with Models 2 to 4 presenting variations in specification. Model 2 excludes directly observed preferences, on the basis that reported preferences could be affected by other characteristics. For example, health may impact on the risky asset ratio, but this may be primarily via its impact on time and risk preferences. Model 3 adds to Model 1 further measures of labour income risk as well as potential investment substitutes. Model 4 then excludes 'realised labour income risk' from Model 3 to investigate sensitivity of other estimates, on the basis of endogeneity concerns.[10]

Standard Controls

Age plays an important role in risky asset holdings. We include dummies for different age categories and find the relationship between age and the risky asset ratio does not fit the quadratic parametric form which is often assumed by researchers. Prime-age individuals are usually expected to be willing and able to take greater investment risks, which should be reflected in the coefficients of the 25-34 and 35-44 dummies having the greatest coefficients. However, we obtain stable coefficients over the 25-54 years age range, and rising coefficients over the 55 to 69 years age range, the latter age range being a time when we might expect households to be reducing exposure to risk due to the imminence of retirement and subsequent dependence on savings and related income streams. For ages beyond 70 years, we do observe a decrease in the coefficient but the positive impact of being in this age category (0.306) is still greater than all categories below 64. These results are consistent with the growth in knowledge of the investment landscape and opportunities that comes with age; see King and Leape (1987).

Variables included for retirement status furthermore show that self-funded retiree status has a positive and statistically significant impact on the risky asset ratio, raising it by 0.144 relative to households where the head of household is not retired. It should be reiterated that this result is found after we have controlled for age and net worth. It suggests that self-funded retirees are financing their retirement through greater levels of risky assets relative to other households.

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[10] Other variable exclusions and inclusions were explored but did not reveal any parameter sensitivities.

Table 2: Determinants of the risky asset ratio – All households

	Model 1		Model 2		Model 3		Model 4	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
*Age (*15-24 *omitted)*								
25-34	0.150**	0.061	0.157**	0.062	0.156**	0.061	0.165**	0.061
35-44	0.244**	0.062	0.225**	0.063	0.250**	0.062	0.259**	0.062
45-54	0.221**	0.063	0.215**	0.064	0.225**	0.064	0.235**	0.063
55-59	0.227**	0.068	0.205**	0.069	0.228**	0.068	0.234**	0.068
60-64	0.293**	0.071	0.263**	0.072	0.296**	0.071	0.305**	0.071
65-69	0.437**	0.076	0.381**	0.077	0.440**	0.076	0.431**	0.076
70+	0.306**	0.073	0.238**	0.074	0.313**	0.074	0.312**	0.074
Retirement status								
Self-funded retiree	0.144**	0.04	0.151**	0.041	0.152**	0.049	0.156**	0.049
Other retiree	-0.058	0.044	-0.071	0.045	-0.043	0.052	-0.032	0.052
*Family status (*Single *omitted)*								
Sole parent	-0.030	0.04	-0.067*	0.041	-0.034	0.041	-0.038	0.04
Couple	0.028	0.028	0.028	0.028	0.027	0.029	0.025	0.029
Couple with dep children	0.022	0.03	0.019	0.03	0.018	0.033	0.016	0.033
Number of dep children	-0.004	0.012	-0.010	0.012	-0.005	0.012	-0.005	0.012
Divorced	0.021	0.034	0.017	0.035	0.022	0.034	0.022	0.034
*Educational attainment (*Did not complete high school *omitted)*								
Degree+	0.106**	0.028	0.142**	0.029	0.104**	0.028	0.106**	0.028
Other PS qualification	0.061**	0.024	0.082**	0.024	0.061**	0.024	0.062**	0.024
Completed high school	0.110**	0.035	0.117**	0.036	0.110**	0.035	0.109**	0.035
ESB migrant	-0.041	0.028	-0.038	0.028	-0.040	0.028	-0.042	0.028
NESB migrant	-0.096**	0.031	-0.101**	0.032	-0.093**	0.031	-0.095**	0.031
Poor English	-0.460**	0.142	-0.486**	0.146	-0.459**	0.141	-0.458**	0.141
City	0.015	0.02	0.022	0.02	0.013	0.02	0.016	0.02
Equivalised income	8.8e-4	8.3e-4	1.6e-3*	8.6e-4	6.9e-4	8.5e-4	9.0e-4	8.5e-4
Equivalised income squared	-2.2e-7	3.8e-6	-1.7e-6	3.9e-6	5.5e-7	3.9e-6	5.2e-7	3.8e-6
Net worth	4.3e-4**	4.0e-5	5.4e-4**	4.0e-5	4.5e-4**	4.2e-5	4.4e-4**	4.2e-5
Net worth squared	8.4e-8**	8.7e-7	1.0e-7**	8.8e-9	-8.5e-8**	8.9e-9	-8.4e-8**	8.9e-9
Credit constraints								
Difficult to raise $2,000	-0.171**	0.032	-0.256**	0.031	-0.169**	0.033	-0.169**	0.033
No credit card	-0.152**	0.023	-0.184**	0.023	-0.149**	0.023	-0.148**	0.023
Don't pay off credit card	-0.065**	0.027	-0.103**	0.027	-0.064**	0.027	-0.063**	0.027
*Health (*Good health *omitted)*								
Okay health	-0.023	0.019	-0.041**	0.02	-0.024	0.019	-0.025	0.019
Poor health	-0.028	0.055	-0.070	0.056	-0.025	0.056	-0.032	0.056
Labour income risk								
Realised labour income risk	-0.053**	0.018	-0.052**	0.018	-0.045**	0.019		
Household - multiple earners					0.001	0.025	0.008	0.025
Household - no earners					-0.026	0.039	-0.043	0.038
Committed expenditure								
Mortgage ratio	0.010**	0.004	0.009**	0.005	0.010**	0.004	0.010**	0.004
Rent ratio	0.010	0.007	0.011*	0.007	0.010	0.007	0.010	0.007
Investment substitutes								
Home owner	0.093**	0.026	0.086**	0.026	0.089**	0.026	0.091**	0.026
Own second house					-0.019	0.025	-0.018	0.025
Own a business					-0.033	0.03	-0.044	0.029
Super share of NW - accum					0.002	0.004	0.002	0.004
Super share of NW - defined					-0.035	0.059	-0.032	0.059
Super share of NW - retired					0.042	0.114	0.037	0.114
Voluntary super contributions					0.044*	0.026	0.050*	0.026
Directly observed preferences								
Saving horizon	0.018**	0.007			0.018**	0.007	0.018**	0.007
Risk averse	-0.253**	0.022			-0.253**	0.022	-0.253**	0.022
No cash	-0.270**	0.034			-0.271**	0.034	-0.272**	0.034
Constant	-0.372**	0.07	-0.470**	0.069	-0.371**	0.07	-0.408**	0.068
Log-likelihood	-3415.8		-3500.2		-3412.8		-3415.7	

Notes: Sample size: 5,290; Left-censored: 2982; Right-censored: 27. Tests of joint significance were conducted on: (a) the health variables; (b) the labour income risk variables; (c) the two investment substitute dummies 'own second house' and 'own a business'; and (d) the variables for the superannuation share of net worth. Tests were only conducted for those cases where none the individual variables in the relevant group (a, b, c or d) was significant at the 10% level on its own. For example, the health variables were jointly tested for Model 1, but not Model 2. We failed to reject the null at the 10% level for all such variable groups in all models.

Family type has no apparent relationship to risky asset holdings, but educational attainment does. Households in which the reference person has not completed high school and holds no post-school qualifications have significantly lower risky asset ratios, all else equal. Those with non-university post-school qualifications also have somewhat lower risky asset holdings than university degree-holders and those who have completed high school but not obtained post-school qualifications. Non-university post-school qualifications comprise trade qualifications that, until recently, were usually completed without the individual ever graduating from high school. The results by educational attainment are therefore consistent with holdings being affected by knowledge and financial literacy about direct investments in stocks, as discussed in Campbell (2006) and Guiso *et al* (2002). The significant and negative coefficients on *NESB migrant* and *Poor English* are likewise consistent with this hypothesis. The large negative coefficient on *Poor English* strikingly highlights the importance of being able to understand financial institutions and markets as a determinant of a household's risky financial asset holdings.

The coefficients on the net worth variables are both positive and statistically significant, which translates to an increasing quadratic function: as net worth increases, it has a larger positive impact in the risky asset ratio. For a household with mean net worth ($417,000, as given in Table 1), an increase in net worth of $100,000 raises the risky asset ratio by 0.0511. Point estimates for the household income indicate a positive effect that is decreasing in income, but almost all coefficients are statistically insignificant.[11]

Credit Constraints

The estimates for the variables capturing credit constraints imply that constrained households are less likely to hold risky financial assets. All three of our credit constraint variables have negative and significant coefficients, suggesting each captures different dimensions of credit constraints. Not regularly paying off the credit card, which would seem to reflect either inability to access cheaper credit or imperfect information about credit options, is associated with a 0.065 lower risky asset ratio. Not possessing a credit card is associated with even lower risky asset holdings, acting to decrease the risky asset ratio by 0.152. Households with no credit cards are either poor candidates for credit or deliberately avoid credit, suggesting either

[11] Specifications were estimated that contained dummy variables for income and net worth as an alternative to the quadratic specifications reported. Inferences on wealth and income effects were not affected, and no other coefficient estimates were noticeably affected.

high income uncertainty or poor financial awareness has a negative impact on risky asset holdings. Although one might expect difficulty raising $2,000 to be highly correlated with failure to regularly pay off credit cards, we nonetheless find a statistically and economically significant effect of such a financial constraint. An inability to raise this level of funds lowers the risky asset ratio by 0.171 and suggests binding credit constraints or a lack of liquidity.

Background Risk: Health

Neither of the dummy variables for health status is significant in explaining the household's risky asset ratio in our core specification. This is at odds with findings of previous researchers, such as Guiso *et al* (1996) and Rosen and Wu (2005). However, turning to Model 2 in Table 2, where we exclude the risk and time preference variables, a substantial ordering by health status opens up – although the coefficient on the 'poor health' dummy is still not significant. We infer, therefore, that health does influence risky financial asset holdings, but the primary mechanism is via its effects on risk and time preferences – rather than, for example, altering the perceived risk situation of the individual. We also note that previous studies, for example Rosen and Wu (2005), have included quadratic terms for age rather than the age dummies we include. We did indeed find (in unreported analysis) that health effects are stronger when the parametric specification is adopted. Given the very strong correlation between health status and age, we would argue that coefficients on health variables in previous studies have been confounding lifecycle and health effects on the risky asset ratio.

Background Risk: Labour Income

In the first two specifications reported in Table 2, exposure to labour income risk is measured by realised labour income risk, as measured by the coefficient of variation of household labour income over the five years following the initial survey. As would be expected of a variable capturing labour income risk, we find a negative and statistically significant effect, with a one-unit increase in the coefficient of variation associated with a 0.05 decrease in the risky asset ratio. As discussed in Section 3, we assume that this variable is a good proxy for perceived labour income risk faced by the household, and therefore we interpret this as showing that households reduce risky assets as a proportion of the household financial asset portfolio when they perceive they face greater labour income risk. Model 3 includes additional measures of household labour income risk: a dummy variable for the presence of more than one employed person in the household and a dummy variable for the absence of any employed persons in the households. The coefficient on the realised labour income risk

variable is little-affected. The estimates for the additional variables are not significant, and omission of the realised labour income risk variable (Model 4) does not change this.

Background Risk: Committed Expenditures

Variables for the ratio of mortgage repayments to income and the ratio of rent payments to income are included as measures of committed expenditure risk. We find that committed expenditures reflected by the mortgage ratio have a positive and statistically significant effect on the risky asset ratio, while the rent ratio is not statistically significant. However, given that the mortgage ratio rarely rises above 0.5, we do not feel the estimated effect has strong economic implications. A sensible upper bound on the mortgage ratio of say, 0.4 (which exceeds the mortgage ratio for over 95% of households) implies an increase in the risky asset ratio of 0.004 relative to a household with a mortgage ratio of zero. This estimate is, however, robust to the various model specifications we consider in Table 2.

Investment Substitutes

In our core specification we focus on home ownership as a substitute for risky financial assets. Surprisingly, home ownership is associated with a sizeable positive impact on the risky asset ratio. After controlling for all other characteristics, including age and net worth, home owners have a risky asset ratio 0.09 higher than other households. The existing literature has generally found that home owners hold fewer risky financial assets, which is attributable to indivisibilities and illiquidity of real estate holdings.

In order to better understand the seemingly counter-intuitive nature of committed expenditure risk and homeownership, it is useful to consider the evolution of the mortgage market in Australia. Since the mid-1980s, home lending has been characterised by aggressive competition between lenders and substantial innovation in mortgage products offered. As a consequence, home owners have had access to quite cheap (mortgage-backed) credit that may be used for a variety of purposes. This would be expected to increase the risky asset ratio for homeowners. It creates the potential for measured committed expenditure, and home ownership status itself, to capture effects of access to cheap and easily accessed credit for other investment purposes, including equity investments. In empirical estimation, home-ownership status does not entirely pick up credit accessibility, since there is variation in mortgage products held. Furthermore, it is likely that measured committed expenditure is capturing unobserved preferences for investing in equities: home-owners with greater desire for equities will have higher committed expenditures than other home-owners because they

will increase borrowings against their houses to finance their equity investments. Thus, both of the variables would seem to be capturing credit availability effects rather than substitution effects or committed expenditure risk.

We introduce a number of variables for other potential investment substitutes in Models 3 and 4, including second (and subsequent) houses, business ownership and superannuation. Of all these investment substitutes, the only variable that is statistically significant is the dummy indicator that is equal to one for households that make voluntary contributions to superannuation. However, the coefficient estimate is positive, implying complementarity rather than substitution between non-mandatory superannuation and risky asset holdings. It appears that this variable is capturing a preference for greater equity holdings that is not captured by other variables. Our results on substitution effects run counter to the expectation that households with second homes and private businesses might substitute these investments for risky financial assets. For example, Heaton and Lucas (2000b) find a greater level of proprietary business income reduces risky asset holdings due to associated background risks.

Directly Observed Preferences

Our last category of covariates provides measures of time and risk preferences. The savings horizon variable ranges from zero to five, a higher value indicating a longer horizon. The coefficient implies a household with a planning horizon in excess of 10 years will have a risky asset ratio 0.09 $\left(0.018\times 5\right)$ greater than a household with a planning horizon of 'next week'.

The dummy indicator for risk aversion is statistically significant and of the expected sign. Households unwilling to take risks with financial investments have a predicted risky asset ratio 0.25 lower than other observationally similar households (that do not claim to have no spare cash for investments).

4.2 Employed households sub-sample

Labour market income risk is likely to be of greater relevance to portfolio decisions of employed households than portfolio decisions of other households. We therefore in Table 3 report results of analysis of the population sub-group comprising households in which the head is employed. This facilitates the inclusion of additional variables that are not defined, or not relevant, for non-employed households. In particular, we are able to add variables for casual employment status, self-employment status, sector of employment, tenure of current employment, subjective probability of retaining the current job, share of household income

earned by the household's highest earner, and satisfaction with job security, each of which potentially captures a different dimension of labour income risk.

Our approach in Table 3 is analogous to that in Table 2. Model 1 is our core specification, Model 2 excludes preference variables, Model 3 considers a range of additional labour income risk measures and potential investment substitutes, and Model 4 excludes realised labour income risk from Model 3. For all specifications, for the variables in common, estimates are qualitatively very similar in the employed sub-sample to those obtained for the full sample. There are, however, a few notable exceptions. First, residing in a major city is associated with a significantly higher risky asset ratio in the employed sample, whereas in the full sample no effect was evident. Second, while net worth has positive effects on the risky asset ratio in the employed sample, the quadratic net worth term takes the opposite sign to that obtained in the full sample, implying a decreasing (rather than increasing) rate of increase of the risky asset ratio as net worth increases. Third, the magnitudes of the effects associated with health status are somewhat larger in the employed sample. Indeed, a significant negative effect of 'okay health' compared with 'good health' is evident even in Model 1, which includes directly observed preferences. Finally, the coefficient on the home owner variable is almost halved to 0.057 from 0.093 for the full sample.

As in Table 2, Models 3 and 4 consider additional labour income risk measures, but the restriction to employed households facilitates consideration of a much larger number of factors. However, none of the added variables exerts a significant effect on the risky asset ratio. The point estimates are of the expected sign for *Household-multiple earners*, *Casual employee*, *Self-employed*, *Job security satisfaction* and *Job tenure*, but not for *Private sector*, *Probability don't retain job* and *Highest earner share*. In Model 4, where *realised labour income risk* is omitted, the coefficient on *Poor health* becomes significant at the 10% level, with a coefficient of -0.244. We might infer from this that households *ex ante* have some idea that they face labour income risk arising from poor health and as a result reduce their risky asset ratio.

Table 3: Determinants of the risky asset ratio – Employed households

	Model 1		Model 2		Model 3		Model 4	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
*Age (*15-24 *omitted)*								
25-34	0.161**	0.063	0.170**	0.064	0.164**	0.064	0.170**	0.064
35-44	0.257**	0.065	0.242**	0.066	0.255**	0.065	0.261**	0.065
45-54	0.229**	0.067	0.230**	0.068	0.220**	0.068	0.228**	0.067
55-59	0.228**	0.073	0.214**	0.074	0.217**	0.074	0.222**	0.074
60+	0.305**	0.074	0.263**	0.075	0.301**	0.076	0.303**	0.076
*Family status (*Single *omitted)*								
Sole parent	-0.041	0.049	-0.074	0.05	-0.044	0.051	-0.045	0.05
Couple	0.014	0.036	0.011	0.037	0.004	0.042	0.005	0.042
Couple with dep children	-0.001	0.035	-0.006	0.036	-0.015	0.04	-0.014	0.04
Number of dep children	-0.002	0.013	-0.005	0.014	-0.004	0.013	-0.003	0.013
Divorced	0.010	0.043	0.001	0.044	0.009	0.043	0.008	0.043
*Educational attainment (*Did not complete high school *omitted)*								
Degree+	0.068**	0.033	0.107**	0.034	0.069**	0.034	0.069**	0.034
Other PS qualification	0.050*	0.029	0.072**	0.03	0.052*	0.029	0.051*	0.029
Completed high school	0.097**	0.041	0.112**	0.041	0.101**	0.041	0.100**	0.041
ESB migrant	-0.055*	0.033	-0.048	0.033	-0.052	0.033	-0.053	0.033
NESB migrant	-0.121**	0.037	-0.121**	0.038	-0.118**	0.037	-0.117**	0.037
Poor English	-0.684**	0.281	-0.726**	0.296	-0.689**	0.28	-0.694**	0.279
City	0.056**	0.023	0.060**	0.023	0.052**	0.023	0.053**	0.023
Equivalised income	5.7e-4	9.2e-4	1.3e-3	9.5e-4	2.7e-4	9.3e-4	4.1e-4	9.3e-4
Equivalised income squared	-7.2e-7	4.2e-6	-2.5e-6	4.3e-6	-3.6e-8	4.2e-6	-7.9e-7	4.1e-6
Net worth	4.4e-4**	4.6e-5	5.3e-4**	4.6e-5	4.4e-4**	4.8e-5	4.4e-4**	4.8e-5
Net worth squared	-8.3e-8**	9.9e-9	-9.8e-8**	1.0e-10	-8.2e-8**	1.0e-8	-8.2e-8**	1.0e-8
Credit constraints								
Difficult to raise $2,000	-0.157**	0.039	-0.233**	0.038	-0.154**	0.039	-0.155**	0.039
No credit card	-0.144**	0.029	-0.176**	0.029	-0.143**	0.029	-0.143**	0.029
Don't pay off credit card	-0.068**	0.029	-0.107**	0.029	-0.067**	0.029	-0.067**	0.029
*Health (*Good health *omitted)*								
Okay health	-0.043**	0.022	-0.059**	0.022	-0.049**	0.022	-0.049**	0.022
Poor health	-0.228	0.147	-0.289*	0.149	-0.238	0.148	-0.244*	0.148
Labour income risk								
Realised labour income risk	-0.057**	0.025	-0.050**	0.025	-0.035	0.028		
Household - multiple earners					0.025	0.029	0.030	0.029
Casual employee					-0.047	0.036	-0.052	0.036
Self-employed					-0.028	0.037	-0.042	0.036
Private sector					0.013	0.027	0.011	0.027
Probability don't retain job					0.088	0.101	0.087	0.1
Highest earner share					0.025	0.043	0.033	0.043
Job security dissatisfaction					0.005	0.005	0.005	0.005
Job tenure					0.002	0.001	0.002	0.001
Committed expenditure								
Mortgage ratio	0.009**	0.004	0.009**	0.004	0.010**	0.004	0.010**	0.004
Rent ratio	0.004	0.008	0.006	0.008	0.004	0.008	0.004	0.008
Investment substitutes								
Home owner	0.057*	0.03	0.051*	0.03	0.048	0.03	0.050*	0.03
Own second house					-0.013	0.027	-0.012	0.027
Own a business					-0.028	0.032	-0.033	0.031
Super share of NW - accum					0.001	0.004	0.001	0.004
Super share of NW - defined					-0.031	0.058	-0.030	0.058
Voluntary super contributions					0.038	0.027	0.039	0.027
Directly observed preferences								
Saving horizon	0.024**	0.008			0.024**	0.008	0.024**	0.008
Risk averse	-0.237**	0.026			-0.237**	0.026	-0.236**	0.026
No cash	-0.216**	0.04			-0.215**	0.04	-0.216**	0.04
Constant	-0.334**	0.077	-0.412**	0.076	-0.374**	0.092	-0.405**	0.089
Log-likelihood	-2369.6		-2426.5		-2363.5		-2364.3	

Notes: Sample size: 3,512; Left-censored: 1845; Right-censored: 22. Tests of joint significance were conducted as per Table 2. We failed to reject the null at the 10% level for all variable groups in which no variable was individually significantly different from zero.

4.3 Retired households sub-sample

In Table 4 we present estimates for retired households only, motivated by the expectation that the determinants of portfolio composition are likely to differ from those of working households. Retired households face quite different circumstances to working households, but perhaps the most important reason for separately examining retired households is that retired persons (over 55 year of age) are permitted to make choices regarding their retirement savings that are not open to working households. This in itself is likely to lead to different behaviour with regards to portfolio choice.

Table 4: Determinants of the risky asset ratio – Retired households

	Model 1		Model 2		Model 3	
	Coef.	SE	Coef.	SE	Coef.	SE
*Age (*55-59 *omitted)*						
60-64	0.060	0.069	0.075	0.070	0.053	0.068
65-69	0.028	0.067	0.020	0.068	0.025	0.067
70+	-0.240**	0.063	-0.260**	0.064	-0.243**	0.063
*Family status (*Single *omitted)*						
Couple	-0.001	0.037	0.008	0.037	-0.001	0.037
Divorced	-0.046	0.056	-0.047	0.057	-0.040	0.056
*Educational attainment (*Did not complete high school *omitted)*						
Degree+	0.121**	0.061	0.133**	0.062	0.113*	0.061
Other PS qualification	0.038	0.039	0.060	0.040	0.035	0.039
Completed high school	0.056	0.070	0.052	0.071	0.041	0.070
ESB migrant	-0.070	0.048	-0.082*	0.049	-0.066	0.048
NESB migrant	-0.172**	0.056	-0.203**	0.057	-0.171**	0.056
Poor English	-0.013	0.132	0.007	0.133	-0.008	0.131
City	0.019	0.035	0.021	0.036	0.009	0.035
Equivalised income	0.022**	0.003	0.023**	0.003	0.022**	0.003
Equivalised income squared	-2.16e-4**	3.95e-5	-2.15 e-4**	4.00 e-5	-2.14 e-4**	3.92 e-5
Net worth	4.99 e-4**	7.96 e-5	5.90 e-4**	7.81 e-5	5.56 e-4**	8.26 e-5
Net worth squared	-9.23 e-8**	1.69 e-8	-1.09 e-7**	1.68 e-8	-9.71 e-8**	1.69 e-8
Credit constraints						
Difficult to raise $2,000	-0.186**	0.061	-0.226**	0.058	-0.187**	0.060
No credit card	-0.173**	0.038	-0.200**	0.038	-0.171**	0.037
Don't pay off credit card	-0.091	0.071	-0.105	0.072	-0.085	0.071
*Health (*Good health *omitted)*						
Okay health	0.072*	0.040	0.057	0.040	0.071*	0.040
Poor health	0.052	0.066	0.029	0.067	0.050	0.066
Committed expenditure						
Mortgage ratio	-0.070	0.347	-0.021	0.351	-0.027	0.345
Rent ratio	0.036**	0.012	0.036**	0.013	0.036**	0.012
Investment substitutes						
Home owner	0.114**	0.053	0.099*	0.053	0.105**	0.053
Own second house					-0.099*	0.057
Own a business					-0.230*	0.129
Directly observed preferences						
Saving horizon	-0.004	0.012			-0.006	0.012
Risk averse	-0.211**	0.041			-0.209**	0.041
No cash	-0.229**	0.062			-0.228**	0.062
Constant	-0.054	0.106	-0.213**	0.101	-0.042	0.105
Log-likelihood	-809.17		-823.25		-805.93	

Notes: Risky financial assets include superannuation holdings. Sample comprises households in which the head is retired and over 55 years of age. Sample size is 1,195 (543 left-censored and 4 right-censored).

The different regulatory treatment of superannuation for retired households also implies an alternative definition of the risky asset ratio is appropriate. Upon retirement, households have a range of options, such as taking lump sums or transferring these retirement savings into an *allocated pension*.[12] There are in fact few binding regulatory constraints on the use of superannuation for retired households over 55 years of age: it may be converted into any form desired, or indeed completely consumed at the owner's discretion. We therefore treat superannuation as a financial asset for the retired household sub-sample.

As in Tables 2 and 3, several specifications are reported. Model 1 is the core specification, Model 2 omits the directly observed preferences variables, while Model 3 adds to Model 1 additional variables for potential investment substitutes. As might be expected, a number of similarities with the results from the full and employed households samples are evident, but there are also some differences, and also some new insights that are not obvious from examining the other samples.

The risky asset ratio does not differ significantly among the 55-59, 60-64 and 65-69 age groups, but, all else equal, those aged over 70 years have substantially lower risky asset ratios. This may reflect lifecycle effects on optimal risky asset holdings, but it may also derive from cohort differences in accumulation of superannuation. Employer superannuation contributions first became compulsory in 1992, with a minimum contribution rate of 3% of earnings; the current minimum contribution rate of 9% was only introduced in 2002. Younger cohorts have correspondingly had greater exposure to the compulsory scheme during their working lives, and therefore higher average superannuation balances at retirement.

Significant differences by educational attainment are restricted to bachelor's degrees vis-à-vis all other qualification levels. In contrast to the findings in the other samples, poor English language ability is not associated with a significant negative effect on the risky asset ratio, though NESB status retains a significant negative coefficient. Credit constraints appear to be important to the risky asset ratio of retired persons, but – somewhat surprisingly – health status has little explanatory power. Indeed, estimates imply that those with intermediate-level health have the highest risky asset holdings, and those in the best health have the lowest risky

[12] An allocated pension is a structured investment product, available only to the retired, which offers regular pension payments with preferential tax treatments and the scope for the funds to be invested in a range of managed investment products (essentially mutual funds) with varying degrees of risk, at the discretion of the investor.

asset holdings. It would therefore seem that poor health is not an important determinant of risky asset holdings for retired households, a finding at odds with prior studies.

Consistent with findings for the other samples, and as expected, we find strong negative effects of risk aversion. The savings horizon variable is not, however, associated with significant effects, perhaps reflecting the lifecycle stage of sample members, many or most of whom will be dissaving rather than saving.

As in the other samples, home ownership has a positive impact on the risky asset ratio, acting to increase the ratio by a substantial 10 percentage points, and suggesting that even for retired households, homeownership allows retired households to diversify into risky financial assets. The two additional investment substitute variables included in Model 3 also exert significant effects on the risky asset ratio, but these effects are as would be expected of substitutes, acting to decrease the risky asset ratio – by 10 percentage points in the case of second-home ownership and by 23 percentage points in the case of business ownership. These substitution effects were not evident to any significant extent in the other samples. We also find committed expenditures in the form of rent payments are positively related to risky asset holdings for retired households. Unlike the positive coefficients evident for mortgage payments in the other samples, there is no obvious explanation for this relationship. Retired households may choose to rent in order to invest in risky financial assets, but if the underlying driver is a substitution of risky financial assets for home ownership, this effect ought be captured by the home-ownership dummy; and one would not expect the risky asset ratio to be increasing in the proportion of household income paid in rent.

5. Conclusions

We have studied the portfolio allocation decisions of Australian households, focusing on the ratio of risky to total financial assets in an effort to understand the determinants of household risky financial asset allocation decisions. Our empirical approach has been to exploit the rich dataset at our disposal by considering a number of the alternative background risks that have been studied in the empirical and theoretical literature, along with other factors such as credit constraints, observed risk preferences, investment substitutes, lifecycle stage, educational attainment and immigrant status. A key motivation for our approach has been the goal of identifying the relative importance of these alternative potential explanations of household portfolio allocation.

Our results imply roles for a number of factors. Background risks posed by labour income uncertainty are important and operate as expected. Background risks associated with poor health are also important but primarily for the sub-sample of employed households, suggesting more cautionary asset allocations by workers in poor health. We also find the committed expenditure background risks studied by Fratantoni (1998) have some explanatory power. However, these have an unexpected positive, albeit economically small, effect on the risky asset ratio. When we consider this committed expenditure and home-ownership together, we argue that despite the indivisibilities and conflict between consumption and investment associated with home ownership, households use the access to cheap credit provided by home ownership to raise their risky asset ratio.

As expected, we find strong negative effects of risk aversion and that as the investment planning horizon lengthens, households increase the risky asset ratio. We also find that self-funded retirees are more willing to hold risky assets, while credit constraints are found to have negative effects on the risky asset ratio.

Consistent with Bertaut (1998), and as alluded to in Guiso *et al* (2002), a number of the effects we find suggest that financial awareness or literacy is an important influence on risky asset holdings. The risky asset ratio is positively correlated with educational attainment and immigrant status – particularly NESB immigrant status – and poor English ability are both associated with negative impacts on the risky asset ratio. Immigrants are not as familiar with the Australian financial landscape and poor English makes it hard for them to acquire such knowledge. We also find a positive age profile for the risky asset ratio. Older households hold greater proportions of their financial portfolios as risky assets, possibly reflecting the growing body of knowledge and experience that comes with age; King and Leape (1987).

This picture of poor financial awareness or investment errors is consistent with the focus in Campbell (2006), where it is argued that non-participation in risky asset markets and poor diversification are a result of investment mistakes. As would be expected under this hypothesis, we find that these mistakes are more likely to be made by less-educated households and by those likely to have less knowledge of and experience in the Australian financial landscape. Conversely, our results on homeownership and committed expenditure suggest there are many financially sophisticated households that exploit mortgage markets and the collateral offered by their homes to diversify their portfolios into risky financial assets like shares and managed (mutual) funds.

The pivotal role played by financial literacy implies that stock exchanges, fund managers, investment companies and possibly even governments ought to promote financial awareness in the population if we are to see an expansion of risky financial asset holding. An alternative policy recommendation is that governments resolve this market failure by mandating risky asset holding. This has effectively been the case in Australia through compulsory employer-based superannuation contributions, ensuring all working households indirectly own risky financial assets. We found that these superannuation balances have no discernable impact on direct holdings of risky assets, implying that compulsory retirement savings have been effective in increasing overall (direct and indirect) risky asset holding. Of course, there are alternatives to compulsion, such as concessionary tax treatment of retirement savings. For example, as Bertaut and Starr-McCluer (2002) find, growth in indirect stock holdings similar to that experienced in Australia has been achieved in the US through the introduction of relatively flexible, employment-based, tax-deferred retirement savings accounts, without any mandatory component.

6. Appendix

Table A1: Description of variables

Age	Dummy variables for 8 age categories
Retirement status	
Self-funded retiree	Self-identify as retired and obtain at least half of income from non-government sources (dummy)
Other retiree	Self-identify as retired and obtain more than half of income from the government pension (dummy)
Family status	
Single	Household consists of a single person (omitted dummy)
Sole parent	Household consists of a sole parent family (dummy)
Couple	Household consists of a couple family without children (dummy)
Couple with children	Household consists of a couple family with children (dummy)
Number of dep children	Number of dependent children in the household. A child is defined to be dependent if under 16 years of age or if aged 16-24 years and a full-time student.
Divorced	Resides in a sole parent or single-person household and is divorced or separated (dummy)
Educational attainment	
Degree+	Highest educational qualification is a bachelor's degree or higher (dummy)
Other PS qualification	Highest educational qualification is any other post-school qualification (i.e., undergraduate diploma or certificate) (dummy)
Completed high school	Completed high school but holds no post-school qualifications (dummy)
Did not complete high school	Has not completed high school and holds no post-school qualifications (omitted dummy)
ESB migrant	Born in New Zealand, UK, Ireland, USA, Canada or South Africa (dummy)
NESB migrant	Born in another country outside Australia (dummy)
Poor English	First language is not English and self-assess ability to speak English as poor (dummy)
City	Reside in a major city. Derived from the Accessibility/Remoteness Index of Australia (ARIA) scores from the 2001 Census. See ABS (2001) Australian Standard Geographical Classification, Canberra (cat. no. 1216.0, pp36-37) (dummy)
Equivalised income	Household disposable income in the year from 1 July 2001 to 30 June 2002 adjusted for household composition using the modified OECD scale. Unit of measurement is one thousand dollars.
Net worth	Total value of household financial and non-financial assets minus total value of household debts. Unit of measurement is one thousand dollars.
Credit constraints	
Difficult to raise $2,000	Could not raise $2,000 for an emergency or would have to do something drastic, such as sell an important possession, to raise the money (dummy)
No credit card	Does not possess a credit card (dummy)
Don't pay off credit card	Has one or more credit cards and pays off the entire balance of all cards 'hardly ever or never', or 'not very often' (dummy)
Health	
Good health	Self-assessed general health is excellent or very good (omitted dummy)
Okay health	Self-assessed general health is good or fair (dummy)
Poor health	Self-assessed general health is poor (dummy)

Note: Personal characteristics relate to the household head (household reference person).

Labour income risk	
Realised labour income risk	Coefficient of variation of annual household labour income (adjusted for age and time trends) over the five years from 2001 to 2005. Age- and time-adjusted income y_t^a is obtained as: $y_t^a = y_t - (\hat{y}_t - \hat{y}_1)$ where y_t is actual labour income in year $t = 1, ..., 5$ and $\hat{y}_t = \hat{\beta}_0 + \hat{\beta}_1 age_t + \hat{\beta}_2 age_t^2 + \hat{\beta}_3 t$ is predicted labour income in year t.
Household - multiple earners	Household contains two or more persons with labour market earnings in the year from 1 July 2001 to 30 June 2002.
Household - no earners	Household contains no one who was in paid employment in the year from 1 July 2001 to 30 June 2002.
Casual employee	Employee with no entitlement to paid holiday or sick leave
Self-employed	Self-employed
Private sector	Employed in a private sector for-profit organisation
Probability don't retain job	Self-assessed probability of losing job in next 12 months multiplied by one minus self-assessed probability that, in the event of job loss, will find and accept a job at least as good as the current job. This variable is defined for employed persons only and is set to zero for employers and self-employed persons.
Highest earner share	Share of household labour income earned by the highest earner in the household. Defined only for households with at least one person employed.
Job security dissatisfaction	Dissatisfaction with job security, ranging from 0 (completely satisfied) to 10 (completely dissatisfied).
Job tenure	Continuous years of employment with current employer.
Committed expenditure	
Mortgage ratio	Annual total mortgage repayments as a proportion of annual household disposable income
Rent ratio	Annual rent payments on primary residence as a proportion of annual household disposable income.
Substitute investments	
Home owner	Own primary residence (whether paying off mortgage or not) (dummy)
Own second house	Own a house other than primary residence (dummy)
Own a business	Own a business (dummy)
Super share of NW - accum	Value of superannuation as a proportion of net worth for persons who are not retired and hold superannuation predominately in accumulation style accounts
Super share of NW - defined	Value of superannuation as a proportion of net worth for persons who are not retired and hold superannuation predominately in defined-benefit style accounts
Super share of NW - retired	Value of superannuation as a proportion of net worth for persons who are retired
Voluntary super contributions	Make non-mandatory contributions to a superannuation fund (either regularly or occasionally)
Directly observed preferences	
Saving horizon	Financial planning horizon, ranging from 0 (next week) to 5 (more than 10 years)
Risk averse	Not willing to take any financial risks with cash used for savings or investment (dummy)
No cash	Never has any spare cash for savings or investment (dummy)

Note: Personal characteristics relate to the household head (household reference person).

Table A2: Sample means of covariates

	All households	Employed households	Retired households
Age (years)	48.6	42.2	70.7
Self-funded retiree	0.089		0.369
Other retiree	0.152		0.631
Family status			
Single	0.290	0.228	0.449
Sole parent	0.098	0.085	
Couple	0.284	0.246	0.450
Couple with children	0.329	0.441	
Number of children	0.431	0.474	
Divorced	0.155	0.141	0.137
Educational attainment			
Degree+	0.210	0.266	0.084
Other PS qualification	0.358	0.381	0.312
Completed high school	0.104	0.118	0.062
Did not complete high school	0.327	0.235	0.542
ESB migrant	0.127	0.121	0.157
NESB migrant	0.117	0.104	0.138
Poor English	0.010	0.005	0.022
City	0.603	0.616	0.580
Equivalised income ($'000)	29.02	34.15	19.36
Net worth ($'000)	409.85	438.13	435.76
Credit constraints			
Difficult to raise $2,000	0.210	0.164	0.165
No credit card	0.341	0.251	0.484
Don't pay off credit card	0.183	0.224	0.074
Health			
Good	0.452	0.543	0.241
Okay	0.508	0.449	0.666
Poor	0.039	0.008	0.093
Labour income risk			
Realised labour income risk	0.592	0.438	
Household - multiple earners	0.359	0.530	
Household - no earners	0.292		
Casual employee		0.154	
Self-employed		0.140	
Private sector		0.734	
Probability don’t retain job		0.036	
Highest earner share		0.772	
Job security dissatisfaction		2.3	
Job tenure (years)		8.3	
Committed expenditure			
Mortgage ratio	0.106	0.146	0.007
Rent ratio	0.110	0.105	0.081
Investment substitutes			
Home owner	0.705	0.716	0.803
Own second house	0.167	0.204	0.099
Own a business	0.116	0.166	0.017
Super share of NW - accum	0.232	0.330	
Super share of NW - defined	0.037	0.053	
Super share of NW - retired	0.020		
Voluntary super contributions	0.143	0.216	
Directly observed preferences			
Saving horizon	2.0	2.2	1.9
Risk averse	0.356	0.304	0.527
No cash	0.188	0.149	0.185

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