Household asset portfolio diversification: Evidence from the Household, Income and Labour Dynamics in Australia (HILDA) Survey[†]

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Abstract

This paper examines the impact of demographic, socioeconomic and risk aversion factors on diversification in Australian household asset portfolios using Wave 6 of the HILDA Survey. Household assets are categorised as home and other property, superannuation, equity and cash investment, business assets, bank accounts, life insurance, trust funds and collectibles. The characteristics examined include family structure and composition, the source and level of income, age, gender and attitudes towards financial risk taking. The diversification measures comprise a naïve index, a Hirschman–Herfindahl concentration index, a Shannon entropy index, absolute and relative benchmark indexes and a market asset share index. Tobit models are used to identify the source and magnitude of the factors associated with diversification. The results indicate that Australian household portfolios have very low levels of asset diversification and that the factors analysed exert a major impact. Importantly, the behaviour observed in household portfolios appears to bear little relation to the central predictions of classic portfolio theory.

JEL classification C23, C25, D14, G11

Keywords household asset portfolios, diversification, mean-variance efficiency.

Introduction

In recent years, interest has grown in household finance—the financial decisions households make and the tools used to make these decisions. Reasons are not hard to find. In nearly all developed economies, including Australia, burgeoning household debt, the growth of superannuation (pension) funds alongside ageing populations, the escalating complexity of household financial decision-making and the diversity of financial products available, and the increasing professionalization of advisory services, has attracted the attention of policymakers, practitioners and professional bodies alike interested in household financial behaviour and its outcomes.

By analogy with corporate finance, household finance also asks how financial decisions are used to attain certain objectives. However, households have features that make the direct

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transfer of the tools of corporate finance to a household setting difficult. For instance, households must plan over long (but finite and uncertain) horizons, they have important non-traded assets (notably their own human capital), they hold mostly illiquid assets (especially housing), and they face constraints on their ability to borrow and to engage in short selling. Further, many household assets have consumption properties (like housing and vehicles), households may have strong desires for intergenerational transfer, and they are subject to complex taxation, high market entry costs, demanding information requirements, and transaction costs. As a result, households often make constrained decisions based on preferences shaped by their own behavioural circumstances. These particularly include, amongst others, loss aversion—the tendency to prefer avoiding losses to acquiring gains—and mental accounting—the division of assets into separate, non-transferable portions with different levels of utility that affect household consumption decisions and other behaviour. In many instances, these provide non-optimal solutions to their posited efforts to maximise wealth.

One area of particular interest is household asset portfolio diversification. This is clearly important because, among other things, financial advisors need to be aware of household risk preferences in order to customise advice and financial system regulators must be cognisant of household exposures in the event of adverse macroeconomic shocks. For example, in Australia there have been substantial changes in the composition of household portfolios over time. In particular, for much of the last decade there has been a substantial increase in the sector's relative holdings of market-linked financial assets, particularly equities and superannuation, thereby increasing household exposure to financial market volatility (RBA 2004; Heady *et al*. 2005). Concomitantly, there has been a decline in the relative shares of safe assets (like bank deposits) held by households. Accordingly, even if there is no change in returns and return volatility across time, rebalancing across assets will change household portfolio returns and risk, ultimately affecting household consumption decisions and welfare.

However, ever since Markowitz (1952), classic portfolio theory considers that investors select assets based solely on the mean and variance of portfolio returns. Unfortunately, in households the diversification process within and across assets is not straightforward, especially as each household's preferences change with its own demographic, socioeconomic and other circumstances (notwithstanding that portfolio theory originally concerned only financial assets). Accordingly, the central lessons of portfolio theory are generally inapplicable in a household context and we must resort to positive household finance—

knowledge about what the household actually does—to understand household behaviour. Empirically, this requires representative samples of high-quality household-level data on wealth and its components.

In a number of national contexts, there has already been examination of household asset portfolio diversification (more precisely, individual asset concentration) on the pretext that we need to control for the demographic and socioeconomic profile of households when analysing their portfolio decisions. For instance, in the US, Bertaut and Starr-McCluer (2000) and Campbell (2006) use the Federal Reserve's *Survey of Consumer Finances*. In France, Arrondel and Lebfevre (2001) employ the *French National Institute for Statistics and Economic Studies Survey* and in the Netherlands, Hochguertal et al. (1997) and Alessie et al. (2000) examine the *Dutch Collective Bank Study*. Similarly, Guiso and Japelli (2000) employ the Bank of Italy *Survey of Household Income and Wealth* and Banks and Smith (2000) consider the *Financial Research Survey* in the UK. Finally, in Germany, Borsch-Supan and Eymann (2000) analyse the *Income and Expenditure Survey* while Barasinka et al. (2008) use the *German Socioeconomic Panel*. Unfortunately, it is only recently in Australia that researchers interested in household portfolio diversification have had access to sufficiently detailed surveys of household financial behaviour. Fortunately, the Household, Income and Labour Dynamics in Australia (HILDA) Survey now provides data that is well suited to the analysis of the composition of household asset portfolios along with information on household demographic and socioeconomic characteristics.

The purpose of this paper is twofold. First, evaluate the diversification of Australian household asset portfolios using a variety of measures suited to the nature of the available survey data. This should provide a better understanding of Australian household risk preferences and their exposure to assets overall. Second, examine the demographic, socioeconomic and financial determinants of household asset portfolio diversification. This will allow a better understanding importance of various household characteristics in determining the composition and distribution of household asset portfolios. The paper itself is divided into four main areas. The first section explains the empirical methodology and data employed in the analysis. The second and third sections discuss the measurement of diversification and the specification of the explanatory variables, respectively. The fourth section presents the results. The paper ends with some concluding remarks and directions for future research.

Research method and data

The basic model advanced in this study is that the household environment, including the external environment, demographic and socioeconomic background and characteristics and financial experiences and attributes shape household financial decisions, including those concerning portfolio diversification. Economic, regulatory, cultural, and political factors shape the external environment facing households. The household's own demographic and socioeconomic background and personal also affect the decision-making process. There is also a role for households' financial experiences with particular products and services. And there are financial skills consumers can learn to assist decision-making. Clearly, modeling household asset portfolio diversification should take into account the different demographic, socioeconomic, and financial profiles of households.

The data used is from the Household, Income, and Labour Dynamics in Australia (HILDA) Survey (2009) [initiated and funded through the Australian Department of Families, Housing, Community Services, and Indigenous Affairs with the Melbourne Institute of Applied Economic and Social Research at the University of Melbourne providing survey design and management]. The HILDA Survey is a broad social and economic longitudinal survey commencing in 2001 with Wave 1 with Wave 7 (the most-recent survey) completed in 2008 and made available in 2009. While the longitudinal design means most questions are common across time, each wave has also included special modules focusing on particular areas of interest to Australian policymakers and researchers. The data in this study concerning household wealth is from Wave 6 of the survey conducted in 2006 and made available in 2008. The combined data file is composed of two sets of information. The first and larger set of information comprises information on household wealth and other characteristics and is mainly from the household questionnaire. The second smaller set of information on the person providing most of the information for the household questionnaire is from the person questionnaire.

Wave 6 of the HILDA Survey directed a series of questions on household wealth to the household member knowing most about the household's finances. The questions concerned their holding of various classes of assets and debt: these subsequently provide measures of financial and non-financial assets and debt and, ultimately, household net worth. Watson (2009) provides further details on the wealth module. The survey included the dollar value of 14 classes of assets at the finest level of enumeration; these correspond to the assets specified in this study with the exception that we combine joint, own, and children's bank accounts and

retiree and non-retiree superannuation at the household level. The 11 household assets are then: (i) bank accounts (BNK), (ii) home assets (HOM), (iii) other property assets (OTH), (iv) superannuation (SPR), (v) equity investments (EQI), (vi) cash investments (CSH), (vii) life insurance (LFE), (viii) trust funds (TST), (ix) business assets (BUS), (x) vehicles (VEH), and (xi) collectibles (COL). This taxonomy is similar to comparable overseas studies.

Table 1 provides selected descriptive statistics on the distributional properties of the 11 assets in the sample by asset holding and non-asset holding households. Importantly, while very few households hold no assets, relatively few hold more than several assets, and almost none hold all assets. This is consistent with the international evidence, including amongst others Haliassos et al. (2001) in Cyprus, Böorsch-Supan and Eymann (2002) in Germany, and Polkovnichenko (2005) and Campbell (2006) in the US. Across all households, the most substantial assets (means in brackets in thousands) are HOM ($296), OTH ($124) and SPR ($112) while the least important are LFE ($7), COL ($3) and CSH ($2).

In asset-holding households, the most important are OTH ($613), HOM ($454) and BUS ($423). Nevertheless, the distribution of assets for all and asset-holding households are both positively skewed—signifying the likelihood of more positive values—while the kurtosis is also large—thereby indicating leptokurtic distributions with many extreme observations. In terms of the proportion of asset-holding households, 97.2 percent of the sample households have assets in the form of BNK, 89.1 percent in VEH and 78.4 percent in SPR, but only 7.8 percent in LFE, 3.4 percent in TST and just 2.4 percent in CSH.

<TABLE 1 HERE>

The primary analytical technique is to specify measures of diversification calculated using these assets as dependent variables in regressions with household demographic, socioeconomic and financial characteristics as predictors. As shown below, the nature of the dependent variables (two-tailed censoring) indicates limited dependent variable techniques are appropriate. Accordingly, we specify Tobit models with a varying number of households included in the sample.

Measurement of diversification

Markowitz (1952) portfolio theory states that a portfolio is fully diversified if it has minimum risk (variance) at a given level of return, or equivalently, maximum return at a given level of risk. Unfortunately, the concept of mean–variance efficiency is unlikely to apply to household

asset portfolios. First, and as shown above, the return distribution of household assets, both financial and nonfinancial, is unlikely to be normal and therefore variance is an inappropriate measure of risk in an expected utility framework. Second, even though the Markowitz model is extremely parsimonious—requiring only the expected return, variance and covariance of each asset along with its share of wealth—we are unable to obtain even this basic level of detail using the data available. The only alternatives are heuristic measures of diversification constructed using the asset classes collected by survey. Here we follow the work on industry diversification in bank loan portfolios, as recently exemplified by Kamp *et al*. (2007), as both streams of research rely on insufficiently detailed data at the unit level.

Let $X_i^{m,t}$ be the nominal investment of household *m* at time *t* in asset *i* with *i* = 1, . . . , *n* where $x_i^{m,t}$ is the proportion of total wealth invested:

$$x_i^{m,t} = \frac{X_i^{m,t}}{\sum_{j=1}^{n} X_i^{m,t}} \tag{1}$$

Using these values, we calculate eight measures of diversification: three using information on the number or shares of wealth in household assets, two with reference to a benchmark portfolio, and one in terms of the risk profile of the chosen asset concentration. The first measure of diversification represents a naïvely-invested portfolio that only takes into account the number of assets held by the household (Barasinska *et al*., 2008). Note that 'naïve diversification' here only reflects the number of assets in the portfolio, not the $1/n$ diversification strategy sometimes used to compare the outcomes of a mean–variance efficient portfolio where the share of wealth invested in each asset is proportional to the number of assets available. The naïve measure of diversification (D_p) (for simplicity, we hereafter omit superscripts *m* and *t*) is:

$$D_p(x) = 1/n_i \tag{2}$$

where *n* is the number of asset classes held by the *i*th household and D_p lies in the interval [1/*n*,1]. Where the household holds all assets, perfect naïve diversification is then $1/n$ and perfect concentration is one. However, where households with no assets are included, D_p will lie in the interval [0,1]. This is potentially problematic as a household with no (or no declared) assets could appear better diversified than any asset-holding household would.

The second measure of diversification is a Hirschman–Herfindahl index concentration measure (D_h):

$$D_h(x) = \sum_{i=1}^{n} x_i^2 \tag{3}$$

This measure is also distributed in the interval [1/n,1] where perfect concentration is equal to 1 when all wealth is invested in a single asset and perfect diversification 1/n when wealth is invested equally across all assets. Where a household holds no assets, D_h = 0 and so this measure also lies in the interval [0,1]. Its main advantage is that it reflects the weights (shares of wealth) of the assets in the portfolio, not just the number of assets.

The third measure of diversification is a Shannon entropy index (D_s):

$$D_s(x) = -\sum_{i=1}^{n} x_i \bullet \ln\left(1/x_i\right) \tag{4}$$

where D_s is distributed in the interval [–ln(n),0] such that perfect concentration is equal to 0 when all wealth is held in a single asset and perfect diversification is expressed by –ln(n). The advantage of this measure of diversification over D_h is that it better reflects the distributional properties of the data. For example, as the size distribution of households becomes less uniform (more diverse), D_s approaches zero.

The next two measures of diversification quantify the distance between the household's asset portfolio x and a benchmark asset portfolio y. In this setting, diversification is maximised when the household's portfolio perfectly matches the asset shares in the benchmark portfolio. In this study, we use the sample means as the benchmark portfolio. The first of these relative measures, the sum of absolute differences (D_a) is:

$$D_a(x, y) = \frac{1}{2}\sum_{i=1}^{n} \left| x_i - y_i \right| \tag{5}$$

where y_i is the proportion of wealth held in the benchmark portfolio. We can then interpret D_a as being the proportion of the household's portfolio x that would have to rearranged to achieve the benchmark portfolio. Note that the distance measure is normalised to the interval [0, 1] with 0 indicating a portfolio identical to the (fully diversified) benchmark portfolio and 1 a portfolio requiring most adjustment to achieve the benchmark portfolio. The second measure D_r is the absolute relative difference:

$$D_r(x, y) = \frac{1}{n}\sum_{i=1}^{n}\frac{|x_i - y_i|}{x_i + y_i} \quad (6)$$

The key difference is that D_r includes relative differences and thereby takes account of the relative size of the assets when calculating the deviation. Unfortunately, one disadvantage is that some assets are not relevant (that is, $x_i = 0$) but still contribute $1/n$ to the distance measure. Once again, the measure is normalised to the interval [0, 1], with 0 (1) indicating a portfolio most similar (dissimilar) to the benchmark portfolio and its implied level of diversification.

The final measure of diversification concerns risk concentration. The benefit of this measure is that it reflects inherent risk, and therefore corrects for some of the limitations of the above measures, especially of the naïve measures of diversification. For example, two household portfolios may have identical values of D_p or D_h (i.e. the same number of assets and/or the same proportions of wealth in the same number of assets) but one may hold a relatively risky combination, say equity, while the other may be in relatively less risky owner-occupied property. We measure diversification (concentration) here by the proportion of household assets held in financial assets (BNK, SPR, EQI, CSH. LFE, TST). This measure is also distributed in the interval [0,1] where 0 is perfect diversification away from financial assets (i.e. a zero holding) and 1 is perfect concentration towards financial assets (i.e. a maximal holding).

Table 2 provides selected descriptive statistics of the diversification measures. All five measures are consistent in that increasing (decreasing) values are associated with more concentrated (diversified) portfolios. However, the upper and lower censoring values differ with D_p, D_a, D_r and D_m lying in the interval [0,1], D_h in the interval [0.091,1] and D_s in the interval [–2.397, 0]. As shown, the mean of the naïve measure of diversification is 0.280 (some 3.5 assets in the typical household portfolio), with 75 percent of the sample having a diversification measure of 0.200 or higher (five or fewer assets). A similar picture emerges for the Hirschman–Herfindal and Shannon entropy indexes of portfolio concentration.

<TABLE 2 HERE>

With D_a, the sum of the absolute differences between each household's portfolio and the benchmark portfolio, we can see that three-quarters of all household portfolios would need rearranging by at least 32 percent to align themselves with the benchmark portfolio. Taking into account the relative size of assets, the measure of absolute relative difference (D_r)

indicates that the adjustments needed for the same three-quarters of the most poorly-diversified portfolios is now 62 percent. Finally, D_m, the measure of concentration in market assets, shows that the lowest diversification (most diversified) quartile has less than 10.5 percent of its assets in financial market-related assets, though the highest diversification (most concentrated) quartile has at least 57.8 percent of its assets in market-related assets.

<TABLE 3 HERE>

As background for the subsequent analysis, we provide the diversification measures for deciles of the Australian Bureau of Statistics' Socio-Economic Index for Areas (SEIFA) for the households included in the sample. This suite of indexes ranks geographic areas across Australia in terms of their socioeconomic characteristics and results from a combination of indicators, broadly socioeconomic advantage, economic resources, and education and occupation. It is clear that as households move from the lower deciles (most disadvantaged) to the higher deciles (most advantaged) the values of D_p, D_h, D_s, D_a and D_r generally fall (asset diversification improves). In the case of D_m, the values generally increase as we move from the lowest to the highest deciles, indicating that less-disadvantaged households hold a greater proportion of their assets in market assets.

Specification of explanatory variables

The next set of information comprises the explanatory variables specified in the Tobit regression models. These relate to the demographic, socioeconomic and financial characteristics of the surveyed households. The coding and descriptive statistics for these variables are included in Table 4. Whilst there is no unequivocal rationale for predicting the direction and statistical significance of many of these independent variables, their inclusion is consistent with past studies of the determinants of the composition of household asset portfolios and the presumed interests of professional advisors, regulators, policymakers and other parties.

<TABLE 4 HERE>

The first set of six variables relate to the demographic characteristics of the household and the principal respondent. The first variable is the number of persons in the household (HSH) as an indicator of size. Generally, an increase in the size of the household suggests an increase in the level and diversity of human capital and the development of investment needs, interests and abilities not encountered in a smaller household. We hypothesise a negative coefficient

when portfolio diversification is regressed against household size indicating larger households hold more diversified portfolios. The second variable is the proportion of children in the household (PCH) (Hochguertal *et al*. 1997; Cobb-Clark and Hildebrand 2009). While children imply an increase in the need for many forms of asset investment (especially those with consumption properties), including home property, vehicles, life insurance, and trust funds, the need for human capital investment (children's education) and their high expenditure needs reduces the resources available for investment elsewhere. We hypothesise a positive coefficient indicating that households with a high proportion of children hold less-diversified portfolios.

The next two variables concern the sex (FEM) and age (AGE) of the principal household respondent. To start with, a typical hypothesis is that females may lack financial skills through education and experience (Hochguertal *et al*. 1997; Jianakoplos and Bernasek 1998; Worthington 2006, 2007, 2008). This would suggest that households with a female respondent might hold less-diversified portfolios and we hypothesise a positive coefficient for FEM. In terms of respondent age (AGE), the lifecycle hypothesis commonly used to support a hump-shaped accumulation of wealthy over an individual's lifetime has some applicability to diversification in that portfolios will increase in complexity and risk during the working years and simplify and become less risky with retirement (Andersson 2001; Banks and Smith 2002; McCarthy 2004; Cobb-Clark and Hildebrand 2009). At the same time, older households may better meet the needs of information-intensive assets, like own-business, collectibles and equity investment. Moreover, the housing owned by many older households may overcome the borrowing constraints facing younger households and a number of studies have already considered the interrelationships between housing and other areas of investment (Bruekner 1997; Frantantoni 1998; Arrondel and Lefebvre 2001; Flavin and Yamashita 2002; Cocco 2005). We hypothesise a negative coefficient indicating that older households have more diversified portfolios.

The final two demographic variables are dummy variables for couples with children (CPC) and lone parents with children (LPC) households. The omitted category comprises single person and multiple family households and couples and lone parents with other dependents and non-dependent children. To a certain extent, CPC provides a similar proxy to the proportion of children in a household except that it more accurately defines the household composition (Hochguertal *et al*. 1997). Generally, CPC households are typically younger working families actively engaged in building their asset portfolio, especially those assets

expected to deliver services over time (like housing and vehicles). In contrast, LPC households often suffer a disadvantage in the composition of their asset portfolios because of their less-diverse human capital, ongoing workforce constraints, and the impact of the factors sometimes responsible for their creation (especially separation and divorce). Single parent households are especially at risk from a lack of financial access and understanding (Worthington 2006). We hypothesise negative and positive coefficients for CPC and LPC, respectively.

The next set of six variables concern the socioeconomic characteristics of the household. First, gross annual income (GRI) is used as a proxy for the resources available for investment, and thereby the ability to overcome barriers to asset market entry, along with an indirect proxy for education. For example, Worthington (2006) has linked income with many aspects of financial access and understanding. The next four variables comprise the proportion of household income from wages and salaries (PWS), business (PBZ), investments (PIN), and private pensions and transfers (PPP). The omitted category is the proportions of income from public and foreign pensions and transfers. These variables all follow the argument that there is a strong relationship between the sources of household income (as proxies for financial abilities, knowledge and constraints) and the composition of their asset portfolios. For example, the largest component of household wealth is usually (non-tradable and unhedgeable) labour income. On one hand, this may lead households to invest more cautiously; on the other, the flexibility to increase labour supply may increase their willingness to engage in financial risks (Bodie et al. 1992; King and Leape 1998; Alessie et al. 2002; Campbell 2006). Similarly, Gentry and Hubbard (2004) argue that entrepreneurial (business) investors have extremely concentrated portfolios with most wealth held in the form of business assets. The final socioeconomic variable is the total assets of the household (AST). Typically, the argument is that the increase in assets is associated with increasingly diversified portfolios (Hochguertal *et al*. 1997; King and Leape 1998; Guiso and Japelli 2002; Banks and Smith 2002; McCarthy 2004). A negative coefficient is then hypothesised when the diversification measures are regressed against household assets.

The final set of four variables concern the self-declared level of risk aversion of the principal respondent for each household. Theory would suggest that investors with higher risk aversion would maintain more diversified portfolios to minimise the variance of returns (Barasinksa 2008). However, the evidence supporting this theoretical prediction has rarely been forthcoming, with a number of studies proposing alternatives potentially more applicable to

households. For example, King and Leape (1998) suggest that risk-averse individuals are more likely to limit their portfolios to relatively safe assets, like bank accounts and government bonds, and this necessarily implies less diversification. Conversely, Gomes and Michaelides (2005) argue that more risk-averse individuals will have relatively more diversified portfolios, but only because they tend to accumulate more wealth, and this links with an increase in the diversity of assets held. Alternatively, Campbell, Chan and Viceira (2003) conclude that the demand for some risky assets (stocks) is a positive though hump-shaped function of risk tolerance, such that while demand is strong at intermediate levels of risk tolerance it is negative for highly risk-averse or risk-seeking investors. This would suggest that diversification is also a hump-shaped function of risk aversion.

We use separate dummy variables (in increasing order of risk aversion) to indicate if the respondent is highly risk-seeking (HRS), moderately risk-seeking (MRS), and risk-avoiding (RAV). These correspond to responses in the survey that the respondent is willing to take above-average risks expecting above-average returns, takes substantial risks expecting substantial returns, and is unwilling to take financial risks, respectively. We also include a category for respondents that declare that they never have any spare cash (NSC) and are therefore unable to undertake financial risk decisions. The omitted category is respondents that are willing to take average risks to achieve average returns: note that we use risk seeking (risk avoiding) here to identify households with risk tolerances greater (lesser) than the sample average.

Following King and Leape (1998) and McCarthy (2004), our hypothesis is that only less risk-averse or risk-seeking households will move beyond a set of relatively common low-risk assets (such as bank deposits, home property, and vehicles) to higher stand-alone risk assets (like their own business, equity investment or collectibles). Accordingly, we expect the respective coefficients for risk-averse (RAV) and less risk-averse (MRS and HRS) households to be positive and negative (or of greater and lesser magnitude) than the reference category of a household of average risk-aversion. Accordingly, relative to an average level of risk-aversion, we hypothesise more (less) risk averse households will hold less (more) diversified portfolios

Empirical findings

Table 5 provides the estimated coefficients, standard errors and p-values of the parameters for the Tobit regressions. Also included is the log-likelihood ratio statistic as a test of the null

hypothesis that all slope coefficients are zero and Wald chi-squared statistics of the null hypotheses that the demographic (upper panel), socioeconomic (middle panel) and risk attitude (lower panel) coefficients are jointly insignificant. As shown, all of the models are highly significant, as are the joint coefficients, with the exception of risk attitudes in the model where D_m is the regressand.

<TABLE 4 HERE>

Consider first the model predicting diversification as measured by the number of assets in the household portfolio (columns 2, 3 and 4). The significantly negative estimated coefficients for HSH, AGE, CPC, PWS, PBZ, PIN, PPP and MRS indicate that larger and older households, couples with children, households drawing larger portions of their income from wages and salaries, business assets, investment and private pensions and transfers, and moderately risk-taking households tend to hold more diversified portfolios. However, households with a greater proportion of children (PCH), those with higher incomes (GRI) and assets (AST), and those stating they never have any spare cash for financial risk-taking (NSC) hold more concentrated portfolios, as indicated by the significant positive coefficients.

Further, the value of the constant (0.589) gives the expected level of household diversification across the population after controlling for the set of explanatory factors and stochastic error. Comparing this with the mean value of D_p from Table 2 (0.280) illustrates that the typical household asset portfolio is substantially more concentrated than simple descriptive statistics would at first suggest: 1.73 assets per portfolio in the base household as against the 3.57 assets indicated in Table 2. Based on the magnitudes of the coefficients, the major impacts on portfolio diversification as measured are the proportions of income from wages and salaries (PWS) and private pensions and transfers (PPP), while the least effect arises from gross income (GRI) and assets (AST).

Next, consider the model where the dependent variable is the Hirschman–Herfindal measure of diversification (columns 5, 6 and 7). This more accurately reflects the attempts at diversification by households as it accounts for the share of assets invested. In most cases, the signs and magnitudes of the estimated coefficients are consistent with the former model, with the exception of FEM, CPC, LPC and RAV. Taken together, these indicate that female and lone parent with children households and those unwilling to take financial risks hold less-diversified (more concentrated portfolios) while couples with children no longer significantly impact upon household diversification. The changes in the levels of significance are very

similar to the model where the Shannon entropy index of diversification (Ds) serves as the dependent variable (columns 8, 9, and 10). Once again, the mean levels of Dh and Ds (0.578 and -0.760) are substantially lower (more diversified) than their expected value from the Tobit models (0.837 and -0.184) (more concentrated), yet again illustrating the major impact demographic, socioeconomic and risk attitude factors have on the observed level of diversification (about 31 percent in both cases)

Columns 11, 12, and 13 provide the estimated coefficients, standard errors and level of significance for the model where the absolute deviation from the benchmark portfolio is the dependent variable. As shown, the typical household asset portfolio requires an adjustment of 88.8 percent in order to attain the benchmark portfolio. However, less adjustment is required in overall percentage terms for large households (HSH), older households (AGE), couples with children, those with higher income (GRI) and those sourcing higher proportions of theiur incomes from wages and salaries (PWS), business interests (PBZ), investments (PIN) and private pensions and transfers (PPP). Likewise, more adjustment is required for households with a greater proportion of children (PCH), those with more assets (AST), and highly risk-seeking (HRS) and risk-avoiding (RAV) households. Interestingly, the magnitude of GRI AST are still positive, though very small, suggesting that higher income and wealthier households hold marginally more concentrated portfolios. The regression where the relative difference in benchmark diversification is the dependent variable (columns 14, 15 and 16) has similar signs and magnitudes, but given the expected level of diversification indicated by the constant (0.924) is higher (than 0.888), implies that even greater changes are required to achieve the benchmark portfolio when asset size is taken into account.

The final model in Table 4 is when the share of market assets is the dependent variable. In general, the signs and levels of significance of the estimated coefficients differ quite markedly from the earlier models. In the sample, the typical household will hold 61.3 percent of its assets in market assets. However, the share is higher for higher incomes (GRI) and assets (AST) and with greater portions of their income from investments (PIN) and private pensions and transfers (PPP) and lower for larger (HSH) and older (AGE) households or households comprising couples (CPC) and lone parents (LPC) with children. Very interestingly, risk attitudes have no affect, individually or jointly, on the holding of market-related assets, unlike the other five measures of diversification. Moreover, the typical household after controlling for demographic, socioeconomic and risk attitude factors and stochastic error is substantially more concentrated in market assets than the mean household is. This suggests that aggregate

sector wide measures substantially underestimate the exposure of the typical Australian household to market risk.

Concluding remarks and directions for future research

The present study uses Tobit models to investigate the impact of demographic, socioeconomic and financial characteristics on new measures of Australian household asset portfolio diversification. To start with, we have shown that portfolio diversification varies strongly according to demographic and socioeconomic characteristics and risk attitudes. All other things being equal, larger households, older households, households composed of couples and children, and households drawing larger portions of their income from wages and salaries, business interests, investments and private pensions and transfers have more diversified portfolios. Moderately risk-taking households also tend to hold more diversified portfolios. However, households with a greater proportion of children and lone parent households tend to have more concentrated portfolios, along with risk-avoiding households and those with insufficient spare cash. Wealthier and higher income households also hold less-diversified portfolios, but the effect is very small.

One major finding is that the demographic, socioeconomic and risk attitude factors that so persuasively impact upon our heuristic measures of diversification bear little relation to the factors influencing the proportion of assets held in market assets (bank accounts, superannuation, equity and cash investments, life insurance and trust funds). This would suggest that the need (or requirement) to hold substantial portions of household wealth in financial assets offsets or counters the efforts of households seeking risk-minimisation through diversification. The most conspicuous contributor, at least in the HILDA survey, is superannuation and, to a lesser extent, equity investment. Fortunately, in most Australian households large non-financial holdings in home property balance (at least in terms of implied diversification) the impact of superannuation as the largest financial asset; however, this does not apply equally to all households (especially younger households).

As the first study of household asset portfolio diversification of this type in Australia, a number of future directions for research naturally arise. To start with, there is the possibility of matching the cross-section in this study with the earlier HILDA Wave 2 as it also includes a module on household wealth. This would provide estimates that are more robust and some indication of changes in these factors over time, though the time span (2002–2006) is very short. A second extension would be to examine more closely the life-cycle hypothesis in

Australian household assets, debt and net wealth, perhaps also using panel data. This would complement the large body of work in this area drawn from international experience and currently lacking in Australia. Finally, a relatively simple extension would be to re-examine the departures from benchmark diversification in the context of a mean-variance efficient portfolio. For example, we could use information on asset returns and risk from outside the HILDA Survey (say, indicative equity and property indices, indicator deposit rates, and asset depreciation schedules) to construct an optimal portfolio and use this to evaluate the relative diversification of Australian household asset portfolios.

References

Alessie, R. Hochguertel, S. and Van Soest, A. (2002), Household portfolios in the Netherlands, in L. Guiso, M. Haliassos, and T. Jappelli (eds.) *Household Portfolios*, Cambridge: MIT Press.

Anderrson, B. (2001) Portfolio allocation over the life cycle: Evidence from Swedish household data, *Uppsala University Department of Economics Working Paper*, No. 4. Available at http://www.nek.uu.se/pdf/2001wp4.pdf

Arrondel, L. and Lefebvre, B. (2001) Behavior of household portfolios in France: The role of housing, *Review of Income and Wealth*, 47(4), 489–514.

Banks, J. and Smith, S. (2002) UK household portfolios, in L. Guiso, M. Haliassos, and T. Jappelli (eds.) *Household Portfolios*, Cambridge: MIT Press.

Barasinska, N. Schäfer, D. and Stephan, A. (2008) Financial risk aversion and household asset diversification, *SOEP Papers on Multidisciplinary Panel Data Research*, No. 117. Available at http://www.diw.de/soeppapers

Bertaut, C. and Starr-McCluer, M. (2002), Household portfolios in the United States, in L. Guiso, M. Haliassos, and T. Jappelli (eds.) *Household Portfolios*, Cambridge: MIT Press.

Bodie, Z., Merton, R.C., and Samuelson, W.F. (1992) Labor supply flexibility and portfolio choice in a life cycle model, *Journal of Economic Dynamics and Control*, 16, 427–449.

Böorsch-Supan, A. and Eymann, A. (2002) Household portfolios in Germany, in L. Guiso, M. Haliassos, and T. Jappelli (eds.) *Household Portfolios*, Cambridge: MIT Press.

Brueckner, J.K. (1997) Consumption and investment motives and the portfolio choices of homeowners, *Journal of Real Estate Finance and Economics*, 15, 159–180.

Campbell, J.Y. (2006) Household finance, *Journal of Finance*, 61(4), 1553–1604.

Cobb-Clark, D.A. and Hildebrand, V.A. (2009) The asset portfolios of native-born and foreign-born Australian households, *Economic Record*, 85(268), 46–59.

Cocco, J.F. (2005) Portfolio choice in the presence of housing, *Review of Financial Studies*, 18, 535–567.

Flavin, M. and Yamashita, T. (2002) Owner-occupied housing and the composition of the household portfolio, *American Economic Review*, 92, 345–62.

Fratantoni, M. C. (1998) Homeownership and investment in risky assets, Journal of Urban Economics. 44, 27–42.

Gentry, William, and Glenn Hubbard, 2004, Entrepreneurship and household saving, *Advances in Economic Analysis and Policy*, 4(1), 1053–1053.

Guiso, L. and Jappelli, T. (2002), Household portfolios in Italy, in L. Guiso, M. Haliassos, and T. Jappelli (eds.) *Household Portfolios*, Cambridge: MIT Press.

Haliassos, M. Hassapis, C. Karagrigoriou, A. Kyriacou, G. Syrichas, G and Michael, M.C. (2001) Assets of Cyprus households: Lessons from the first Cyprus Survey of Consumer Finances, *University of Cyprus Working Papers in Economics*, No. 0205. Available at http://papers.econ.ucy.ac.cy/RePEc/papers/0205.pdf

Haliassos, M., and Bertaut, C. C. (1995) Why do so few hold stocks? *Economic Journal*, 105, 1110–1129.

Heady, B., Marks, G. and Wooden, M. (2005), The structure and distribution of household wealth in Australia, *Australian Economic Review*, 38, 159–75.

Heaton, J., and Lucas, D. (2000) Portfolio choice in the presence of background risk, *Economic Journal*, 110, 1–26.

Household, Income and Labour Dynamics in Australia (HILDA) Survey (2009) Available at http://www.melbourneinstitute.com/hilda

Hochguertel, S., Alessie, R. and Van Soest, A. (1997) Saving accounts versus stocks and bonds in household portfolio allocation, *Scandinavian Journal of Economics*, 99(1), 81–97.

Jianakoplos, N. A., and Bernasek, A. (1998) Are women more risk averse? *American Economic Review*, 36, 620–630.

Kamp, A, Pfingsten, A., Memmel, C. and Behr, A., (2007) Diversification and the Banks' Risk-Return-Characteristics - Evidence from Loan Portfolios of German Banks, EFA 2006 Zurich Meetings Paper. Available at SSRN: http://ssrn.com/abstract=906448

King, M. and Leape, J. (1998), Wealth and portfolio composition: Theory and evidence, *Journal of Public Economics*, 69, 155–193.

Markowitz, H. (1952) Portfolio selection, *Journal of Finance*, 7(1), 77–91.

McCarthy, D. (2004) Household portfolio allocation: A review of the literature. Paper presented at the *ESRI International Forum*, Tokyo.

Pålsson, A-M. (1996) Does the degree of relative risk aversion vary with household characteristics? *Journal of Economic Psychology*, 17, 771–787.

Pelizzon, L. and Weber, G. (2008) Are household portfolios efficient? An analysis conditional on housing, *Journal of Financial and Quantitative Analysis*, 43(2), 401–432

Polkovnichenko, V. (2005) Household portfolio diversification: A case for rank-dependent preferences, *Review of Financial Studies*, 18(4), 1468–1502.

Reserve Bank of Australia (2004) The composition and distribution of household assets and liabilities: Evidence from the 2002 HILDA Survey, *Reserve Bank of Australia Bulletin*, April, 1–11.

Watson, N. (ed) (2009) HILDA User Manual – Release 7, Melbourne Institute of Applied Economic and Social Research, University of Melbourne.

Worthington, A.C. (2008) Knowledge and perceptions of superannuation in Australia, *Journal of Consumer Policy*, 31(3), 349–368.

Worthington, A.C. (2006) Predicting financial literacy in Australia, *Financial Services Review*, 15(1), 59–79.

Worthington, A.C. (2007) Personal bank account access and awareness: An analysis of the technological and informational constraints of Australian consumers, *International Journal of Consumer Studies*, 31(5), 443–452.

TABLE 1. Household asset statistics

	All households					Asset-holding households					
	Number	Mean	Std. deviation	Skewness	Kurtosis	Number	Mean	Std. deviation	Skewness	Kurtosis	Proportion
BNK	7058	27.924	78.650	7.998	84.985	6862	28.721	79.622	7.900	82.845	0.972
HOM	7058	296.639	414.946	6.217	68.499	4607	454.456	438.254	7.124	73.897	0.653
OTH	7058	124.847	623.665	14.158	235.135	1437	613.203	1269.569	7.048	53.583	0.204
SPR	7058	112.092	235.822	5.674	45.988	5537	142.883	257.858	5.195	38.115	0.784
EQI	7058	51.006	270.072	11.064	143.320	2659	135.390	426.877	6.844	53.669	0.377
CSH	7058	2.410	33.414	21.798	526.758	166	102.477	193.486	3.148	9.416	0.024
LFE	7058	7.940	63.539	13.168	195.872	551	101.701	205.545	3.540	12.709	0.078
TST	7058	11.277	136.503	17.241	319.092	243	12.861	95.965	8.321	69.764	0.034
BUS	7058	52.954	333.761	10.210	120.491	883	423.268	856.958	3.457	12.695	0.125
VEH	7058	22.238	37.266	8.561	118.318	6289	24.957	38.610	8.452	112.752	0.891
COL	7058	3.440	28.287	23.302	649.396	987	24.598	72.151	9.161	96.564	0.140

Notes: All dollar figures in thousands. BNK – bank accounts, HOM – home assets, OTH – other property assets, SPR – superannuation, UQI – equity investments, CSH – cash investments, LFE – life insurance, TST – trust funds, BUS – business assets, VEH – vehicles, and COL – collectibles. Asset-holding households are conditional on non-zero asset holding. All skewness and kurtosis statistics are significant at the .01 level. Proportion is the share of asset holding households among all households.

TABLE 2. Diversification measure statistics

Statistic	D_p	D_h	D_s	D_a	D_r	D_m
Mean	0.280	0.578	-0.760	0.457	0.697	0.367
Std. deviation	0.163	0.213	0.387	0.189	0.108	0.316
25^{th} percentile	0.200	0.412	-1.037	0.322	0.621	0.105
50^{th} percentile	0.250	0.532	-0.788	0.420	0.694	0.263
75^{th} percentile	0.333	0.734	-0.496	0.551	0.781	0.578

Notes: D_p – naïve measure of diversification, D_h – Hirschman-Herfindahl index of concentration, D_s - Shannon entropy index of diversification, D_a - absolute differences in benchmark diversification, D_r – relative differences in benchmark diversification, D_m – proportion of market assets in portfolio

TABLE 3 Diversification measures by population index

Index	Deciles	D_p	D_h	D_s	D_a	D_r	D_m
SEIFA 2001 Relative socio-economic advantage	Lowest decile	0.358	0.646	–0.599	0.523	0.751	0.393
	2nd decile	0.308	0.617	–0.687	0.483	0.717	0.349
	3rd decile	0.295	0.606	–0.705	0.473	0.711	0.338
	4th decile	0.293	0.587	–0.747	0.468	0.706	0.357
	5th decile	0.267	0.576	–0.770	0.445	0.692	0.343
	6th decile	0.272	0.572	–0.776	0.434	0.689	0.355
	7th decile	0.256	0.552	–0.810	0.436	0.682	0.354
	8th decile	0.257	0.565	–0.792	0.437	0.682	0.362
	9th decile	0.250	0.534	–0.847	0.422	0.670	0.393
	Highest decile	0.244	0.518	–0.875	0.437	0.669	0.422
SEIFA 2001 Economic resources	Lowest decile	0.350	0.636	–0.620	0.523	0.745	0.391
	2nd decile	0.301	0.615	–0.692	0.485	0.715	0.345
	3rd decile	0.304	0.609	–0.703	0.476	0.713	0.341
	4th decile	0.284	0.587	–0.745	0.456	0.704	0.355
	5th decile	0.283	0.572	–0.769	0.459	0.698	0.372
	6th decile	0.259	0.562	–0.796	0.430	0.682	0.351
	7th decile	0.259	0.564	–0.793	0.433	0.684	0.352
	8th decile	0.252	0.554	–0.813	0.426	0.675	0.357
	9th decile	0.254	0.529	–0.854	0.424	0.675	0.410
	Highest decile	0.239	0.528	–0.859	0.433	0.666	0.400
SEIFA 2001 Education and occupation	Lowest decile	0.334	0.634	–0.631	0.499	0.737	0.359
	2nd decile	0.311	0.614	–0.698	0.482	0.716	0.347
	3rd decile	0.294	0.595	–0.722	0.469	0.712	0.361
	4th decile	0.291	0.592	–0.732	0.462	0.706	0.368
	5th decile	0.286	0.589	–0.742	0.464	0.701	0.338
	6th decile	0.268	0.578	–0.761	0.448	0.693	0.334
	7th decile	0.250	0.554	–0.808	0.424	0.675	0.353
	8th decile	0.266	0.559	–0.804	0.437	0.680	0.380
	9th decile	0.251	0.547	–0.825	0.425	0.674	0.366
	Highest decile	0.254	0.523	–0.862	0.452	0.678	0.452

TABLE 4. Explanatory variable definitions and statistics

Variable	Definition	Mean	Std. deviation
HSH	Number of persons in household	2.448	1.407
PCH	Proportion of children in household, number of children < 15 years ÷ number of persons in household	0.128	0.215
FEM	1 if female responding to most questions in household; 0 otherwise	0.490	0.500
AGE	Age in years at 30 June 2006 of person responding to most questions in household	47.955	17.689
CPC	Couples with children aged < 15 years; 0 otherwise	0.224	0.417
LPC	Lone parents with children aged < 15 years; 0 otherwise	0.056	0.229
GRI	Gross income in $ thousands at 30 June 2006	72.399	68.710
PWS	Proportion of wage and salary income, gross wages and salary ($) ÷ gross income ($)	0.575	0.488
PBZ	Proportion of business income, business income ($) ÷ gross income ($)	0.058	0.422
PIN	Proportion of investment income investment income ($) ÷ gross income ($)	0.061	0.201
PPP	Proportion of private pensions and transfers, private pensions and transfers ($) ÷ gross income ($)	0.045	0.148
AST	Total assets in $ thousands at 30 June 2006	709.700	1267.586
HRS	1 if takes substantial risks expecting substantial returns; 0 otherwise	0.014	0.119
MRS	1 if takes above-average risks expecting above-average returns; 0 otherwise	0.056	0.230
RAV	1 if not willing to take financial risks; 0 otherwise	0.341	0.474
NSC	1 if never has any spare cash; 0 otherwise	0.156	0.363

TABLE 4 Parameter estimates and statistics

	D_p			D_h			D_s			D_a			D_r			D_m		
Variable	Coef.	Std. error	p-value	Coef.	Std. error	p-value	Coef.	Std. error	p-value	Coef.	Std. error	p-value	Coef.	Std. error	p-value	Coef.	Std. error	p-value
CONS.	0.589	0.015	<0.001	0.837	0.016	<0.001	–0.184	0.027	<0.001	0.888	0.013	0.001	0.924	142.900	<0.001	0.613	0.025	<0.001
HSH	–0.024	0.002	<0.001	–0.022	0.002	<0.001	–0.051	0.004	<0.001	–0.028	0.002	0.001	–0.016	–12.382	<0.001	–0.026	0.004	<0.001
PCH	0.064	0.018	<0.001	0.067	0.029	0.022	0.177	0.051	<0.001	0.075	0.026	0.004	0.059	4.173	<0.001	0.048	0.046	0.303
FEM	0.004	0.003	0.188	0.009	0.005	0.059	0.015	0.008	0.059	0.003	0.004	0.388	0.001	0.031	0.975	–0.003	0.007	0.727
AGE	–0.002	0.001	<0.001	–0.001	0.001	<0.001	–0.002	0.001	0.001	–0.004	0.001	<0.001	–0.002	–24.907	<0.001	–0.004	0.001	<0.001
CPC	–0.031	0.008	<0.001	0.002	0.013	0.903	–0.022	0.023	0.326	–0.047	0.011	<0.001	–0.030	–4.687	<0.001	–0.097	0.021	<0.001
LPC	0.006	0.011	0.574	0.031	0.018	0.080	0.020	0.030	0.514	–0.002	0.016	0.889	–0.013	–1.611	0.107	–0.048	0.029	0.093
GRI	0.001	0.001	0.086	–0.003	0.001	<0.001	–0.007	0.001	<0.001	–0.002	0.001	0.001	–0.002	–8.441	<0.001	0.002	0.001	0.003
PWS	–0.210	0.010	<0.001	–0.215	0.011	<0.001	–0.423	0.018	<0.001	–0.219	0.009	0.001	–0.114	–24.599	<0.001	0.008	0.015	0.598
PBZ	–0.183	0.012	<0.001	–0.205	0.014	<0.001	–0.412	0.024	<0.001	–0.166	0.011	0.001	–0.103	–17.152	<0.001	0.009	0.028	0.733
PIN	–0.205	0.020	<0.001	–0.296	0.028	<0.001	–0.584	0.053	<0.001	–0.122	0.019	0.001	–0.107	–8.026	<0.001	0.136	0.027	<0.001
PPP	–0.236	0.011	<0.001	–0.289	0.016	<0.001	–0.556	0.029	<0.001	–0.260	0.014	0.001	–0.144	–17.974	<0.001	0.169	0.026	<0.001
AST	0.001	0.001	<0.001	0.001	0.001	<0.001	0.001	0.001	<0.001	0.001	0.001	0.053	0.001	–5.311	<0.001	0.001	0.001	<0.001
HRS	–0.010	0.012	0.432	–0.004	0.019	0.818	–0.027	0.038	0.483	0.031	0.018	0.075	0.001	0.135	0.893	–0.023	0.030	0.442
MRS	–0.019	0.005	<0.001	–0.025	0.009	0.007	–0.055	0.018	0.002	0.011	0.009	0.213	–0.012	–2.407	0.016	0.006	0.015	0.710
RAV	0.004	0.004	0.315	0.021	0.005	<0.001	0.041	0.009	<0.001	0.010	0.004	0.022	0.015	6.444	<0.001	0.001	0.008	0.942
NSC	0.034	0.006	<0.001	0.073	0.008	<0.001	0.157	0.012	<0.001	0.042	0.006	0.001	0.039	12.703	<0.001	0.003	0.012	0.813
*ln*LR	2961.840	–	<0.001	2519.130	–	<0.001	3471.521	–	<0.001	2709.929	–	<0.001	3706.141	–	<0.001	556.422	–	<0.001
χ2 D	584.965	–	<0.001	145.877	–	<0.001	275.694	–	<0.001	1280.486	–	<0.001	1051.894	–	<0.001	360.968	–	<0.001
χ2 SE	2091.015	–	<0.001	1644.214	–	<0.001	2372.652	–	<0.001	1605.986	–	<0.001	2345.110	–	<0.001	131.775	–	<0.001
χ2 RA	59.856	–	<0.001	131.823	–	<0.001	210.667	–	<0.001	55.374	–	<0.001	187.151	–	<0.001	0.7816	–	0.9409

Notes; Dependent variable in top row. All values rounded to three decimal places. Left censoring and right censoring in Tobit models is [0,1], [0,1], [–2.39.0], [0,1], [0,1] and [0,1], respectively. All standard errors are Huber/White covariance consistent standard errors. LnLR is log-likelihood ratio F-test of the null hypothesis that all slope coefficients are zero. χ2 D,SE and RA are Wald tests of the null hypothesis that the coefficients for all demographic (HSH, PSCH, FEM, AGE, CPC, LPC), socioeconomic (GRI, PWS, PBZ, PIN, PPP, AST) and risk attitude (HRS, MRS, RAV, NSC) are jointly zero, respectively.