The Gender Gap in Household Bargaining Power: A Revealed-Preference Approach*

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Abstract

When members of the same household have different risk preferences, whose preference matters more for investment decisions and why? We propose an intrahousehold model that aggregates individual preferences at the household level as a result of bargaining. We structurally estimate the model, analyze the determinants of bargaining power, and find a significant gender gap. The gap is partially explained by gender differences in individual characteristics such as income and employment, but it is also driven by gender effects. These patterns hold broadly across Australia, Germany, and the US. We further link the distribution of bargaining power to perceived gender norms in the cross-section of households.

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1 Introduction

When analyzing portfolio decisions, most studies start with the household as the primitive unit of analysis (Gomes et al. 2021). In a typical model, a household is an imagined individual solving the optimal portfolio problem with a well-defined set of goals and constraints. In the empirical analysis, it is common to treat a household by averaging across its members or to use the characteristics of the household's head to represent the entire household. Such treatments simplify the modeling of the decision-making process, but they also embed a fundamental disconnect between individuals and households: decisions of a household often involve multiple members, each of which could be playing a different role or have a different say. This idea of intrahousehold bargaining has been studied previously in the domains of consumption and time-use decisions (e.g., Chiappori and Mazzocco 2017), but less has been uncovered in the domain of portfolio choice. For example, risk preference is a key determinant of portfolio choice, and it has been observed that members of the same household often have different risk preferences. When such disagreement occurs, what determines one's bargaining power? Within the household, is there a gender gap in bargaining power? If so, what drives it?

A budding literature begins to tackle these questions.[1] One approach links variation in individual characteristics to household outcomes to establish the relevance of these characteristics (e.g., Addoum 2017; Olafsson and Thornquist 2018; Ke 2021). This approach requires plausible instruments and usually does not allow for a quantitative comparison among multiple characteristics. A second approach directly relies on survey responses to measure bargaining power (e.g., Friedberg and Webb 2006; Yilmazer and Lich 2015; Zaccaria and Guiso 2020). A popular proxy is based on the so-called "final say" question, which asks who has the ultimate responsibility of making financial decisions for the household and acts as the "financial head." However, responsibility does not imply power, especially when coordination is effective and the decision-maker fully takes into account others' preferences. When separately surveyed, members of the same household often give different answers, suggesting nontrivial noise and disagreement about the allocation of

[1] Gomes et al. (2021) review existing approaches and recent advancements in intrahousehold analysis. They also mention an additional approach to intrahousehold problems that incorporates changes to the family structure—arising from divorce, the arrival of children, or the death of a spouse—into a life cycle model of portfolio choice (e.g., Love 2010). This approach, however, does not directly model the bargaining process among household members and is therefore not included in our discussion.

responsibility (Barsky et al. 1997; Mazzocco 2004). Furthermore, a common concern about the use of survey responses still lingers: is what people say consistent with what they do (Bertrand and Mullainathan 2001)?

In this paper, we propose a revealed-preference approach for analyzing bargaining power in intrahousehold portfolio decisions. This approach rests on the premise that those with more bargaining power are more able to incorporate their own risk preferences into the household's overall portfolio choice. Therefore, when individual risk preferences are observable, household-level portfolio choice reveals whose preference matter more. This departs from the aforementioned survey-based approach by examining what people actually *do* rather than what they *say*. Moreover, by explicitly modeling the household's decision process and estimating the determinants of bargaining power, we simultaneously study multiple channels and quantify each channel's relative contribution.

We start with a tractable intrahousehold model of portfolio choice. In our model, spouses—a husband and a wife—differ in risk preferences and other individual characteristics and make portfolio decisions for the entire household in two steps.[2] In the first step, they cooperatively decide on a household risk preference, modeled as a weighted average of their respective risk preferences. The weight represents each individual's bargaining power and is determined by spousal differences in individual characteristics and a gender effect. In the second step, the household makes portfolio decisions based on this household-level risk aversion as if it were a single individual, with additional considerations suggested in the literature such as participation cost. The household then decides whether to participate in the stock market (the extensive margin) and by how much (the intensive margin), in the spirit of the Merton model (Merton 1969, 1971). While we are only concerned with bargaining over risk preference in this paper, the model can be easily extended to accommodate bargaining over beliefs or other types of preferences.[3]

We structurally estimate the model using data from Australia, Germany, and the US. Our main analysis is based on the Household, Income, and Labour Dynamics in Australia (HILDA) Survey, a nationally representative survey of Australia. The HILDA Survey asks respondents to provide

[2]Since we are interested in identifying the gender gap in bargaining power, we are only concerned with heterosexual couples throughout the paper.

[3]For instance, when one member is optimistic about future market returns, but the other is pessimistic, it may involve bargaining to resolve belief disagreement. This can be done, for example, if one could manage to collect detailed expectation data on stock market returns at the individual level.

detailed information about household asset allocation. More importantly, it includes detailed individual characteristics such as risk aversion, making it an ideal dataset to implement our method. The model is then estimated using maximum likelihood, with stock market participation and risky asset holdings as the two outcome variables.

Our estimation results show substantial heterogeneity across households in the intrahousehold allocation of bargaining power. This heterogeneity, in turn, can be attributed to spousal differences in individual characteristics. Employment, earning, and cognitive ability are important determinants of bargaining power. Other factors, such as age and education, matter as well, but to a lesser extent. Interestingly, noncognitive attributes such as personality traits also matter in the bargaining process. For example, consistent with prior literature on personality and labor outcomes (Flinn et al. 2018), less agreeable and more extraverted individuals have more bargaining power.

We next examine the allocation of bargaining power between husband and wife. In the average household, the weight placed on the husband's risk preference is about 0.59, while the weight placed on the wife's is 0.41. Therefore, household asset allocation reflects the husband's risk preference 0.18—or 44% in relative terms—more than the wife's. We decompose this gender gap into two components, one driven by spousal differences in individual characteristics and the other by the gender effect. Individual characteristics such as employment and age tilt bargaining power toward the husband, as the husband is typically older and more likely to have a job. However, observable characteristics combined can only account for about half the gap, leaving the other half accounted for by the gender effect. It has been widely documented that certain characteristics such as employment and earning are "gendered," in that they themselves embed gender stereotypes and discrimination against women (e.g., Bertrand et al. 2015). Because the gender gaps in these characteristics generally further tilt the bargaining power towards men, the estimates from our exercise can be perceived as a lower bound of the total gender effect in intrahousehold bargaining.

Our subsequent analysis examines the sources of the gender effect documented above. The HILDA Survey includes a question asking participants to identify who has the "final say" about financial decisions in the household. As discussed above, previous studies have directly used it as a proxy for bargaining power whereby the financial head has full (100%) bargaining power. We follow Ke (2021) and view it as an indicator of patriarchal social norms. We find that the above-documented gender effect is primarily driven by husband-headed households. In an average

husband-headed household, the husband retains an additional bargaining weight of 0.27 to 0.29 beyond what is implied by his observable characteristics, an effect that has been persistent over time. In contrast, in wife-headed households, while wives retain more bargaining power than their spouses, the magnitude of the additional weight is much smaller. This analysis also allows us to compare our revealed-preference approach to the survey-based approach. Qualitatively, the two approaches are consistent in two aspects. First, the husband's bargaining power monotonically increases from wife-headed to shared-responsibility households to husband-headed households. Second, the average bargaining weight of the husband in a shared-responsibility household is 0.53, close to having an equal say. However, quantitatively, in both wife-headed and husband-headed households, financial heads incorporate the risk preferences of their spouses in a nontrivial way, suggesting that focusing only on the financial head may be an oversimplification.

We further construct a more direct measure of perceived gender norms and link it to bargaining power in the cross-section of households. The HILDA Survey includes three questions to elicit each individual's perception of gender norms. The topics range from attitudes toward traditional gender roles to the division of housework and childcare duties, and both the husband and wife need to answer these questions separately. We find that households with progressive attitudes toward gender norms are more likely to elect the wife as the financial head, thereby empowering women with more decision power in financial decisions. Interestingly, these effects apply to the perception of both the wife and the husband, suggesting that it is important to bring awareness to both women and men when promoting more egalitarian intrahousehold dynamics.

A division of labor may exist in intrahousehold decision-making: perhaps spouses with less bargaining power in the domain of portfolio choice are compensated by having greater bargaining power in other domains such as consumption and child-rearing decisions (Becker 1985; Becker and Murphy 1992). However, when testing the correlation between financial decisions and other labor and consumption decisions, we do not find any supportive evidence. In many households, investment and consumption decisions are made by the same individual. We also discuss the welfare implications of our findings. The dataset does not contain information on portfolio returns and therefore does not allow for a comparison of performance across households. However, we argue that the gender gap suggests a welfare loss for wives in expected utility, since their preferences are incorporated to a less extent into household decisions than husbands' preferences.

We apply this framework using data from two other national panels: the German Socio-Economic Panel (GSOEP) Survey and the US Health and Retirement Study (HRS). In both settings, we find even stronger gender gaps. For instance, in the average German household, the weight placed on the husband's risk preference is about 0.68, while the weight placed on the wife's is 0.32. More strikingly, observable gender differences such as wage and employment status can only explain around a quarter of the gap, leaving the rest explained by gender effects. This greater gender gap in Germany is consistent with its more traditional attitude towards gender (Ke 2018).

This paper proposes a new framework for understanding the bargaining process within a household. In particular, the structural approach we propose complements the existing reduced-form approaches that rely on exogenous variation in individual characteristics or on survey-based proxies of bargaining power. Rather than treating the household as a single decision unit, we adopt the collective bargaining model developed by Chiappori and Others (1988) and Chiappori (1992) and model the household's risk preference as a result of bargaining. While the collective bargaining model usually concerns consumption and labor supply (e.g., Chiappori and Others 1988; Browning et al. 1994), our model concerns asset allocation, the domain in which risk preferences are a key consideration and a natural starting point of intrahousehold analysis. Moreover, the model can be extended to model bargaining over beliefs or other types of preferences.

Second, we contribute to the literature on gender differences in financial decisions. Earlier studies have revealed the existence of a gender gap in domains such as trading behavior and performance (Barber and Odean 2001), housing returns (Goldsmith-Pinkham and Shue 2020), and stock market participation and other financial decisions (Addoum 2017; Olafsson and Thornquist 2018; Ke 2021; Zaccaria and Guiso 2020; Kim 2021). We contribute to this literature by backing out the bargaining weights between husband and wife in making investment decisions and showing a substantial gender gap.

Third, our paper quantitatively evaluates the relative importance of different factors in determining bargaining power. While existing papers have studied consumption and labor supply decisions (e.g., Chiappori 1992; Bourguignon et al. 2009; Attanasio and Lechene 2014; Pollak 2011, 2005; Flinn et al. 2018), we are primarily concerned with financial decisions. We find that factors such as income and employment status are the most important determinants of bargaining power, whereas other factors matter to a lesser extent. In this regard, the closest paper to ours is Bertocchi

et al. (2014), which also studies the determinants of bargaining power but simply uses the financial head of the household as the proxy for it.

Fourth, we find supportive evidence that traditional gender norms constrain women's power in intrahousehold decisions. The two papers closest to ours are Ke (2021) and Zaccaria and Guiso (2020). Ke (2021) studies how men and women of similar financial sophistication affect their household's stock market participation decisions differently. Zaccaria and Guiso (2020) use household headship to proxy for gender norms and find that egalitarian gender norms lead to higher stock market participation and better financial returns. Apart from the aforementioned methodological differences, our paper differs in two other aspects. First, as discussed above, our identification of bargaining power relies on the revealed preference on the household portfolio choice. Second, our measures of gender norms are directly based on survey responses rather than on proxies based on household headship.

The paper proceeds as follows. Section 2 describes the data and shows some stylized facts. Section 3 presents the model and estimation implementation. Sections 4 and 5 report and discuss results from the estimation and counterfactual experiments. Section 6 conducts similar analyses for German and US households. Section 7 concludes.

2 Data and Stylized Facts

2.1 HILDA Survey

Our main data set is the Household Income and Labour Dynamics in Australia (HILDA) Survey, which is nationally representative and has been conducted every year since 2001. Our choice of data is primarily driven by the rich set of variables available at both the individual and household levels. Below, in Section 2.3, we review household-level surveys conducted in other countries and argue that the HILDA Survey is most suitable for analyzing intrahousehold decision-making.

For each household, all adult household members (15 years old and older) first attend a face-to-face interview and then complete a self-administered questionnaire in private. The interview and questionnaire cover a wide range of topics concerning economic and subjective well-being, labor market dynamics, and family dynamics. Each wave includes a different questionnaire module and

asks questions related to different aspects of the household. Because different sets of information are collected in different waves, we construct our main sample based on four waves—waves 6, 10, 14, and 18—all of which collect information about demographics, financial head, and asset allocation, but not for personality traits. Therefore, we rely on the four preceding waves for information on personality traits. Cognitive ability is only collected in waves 12 and 16. Therefore, we assume that cognitive ability is persistent at the individual level and use the average value of waves 12 and 16 for the four waves. Table 1 shows how we merge information from different waves to arrive at the main data set.

We focus on heterosexual married couples with a wife and a husband.[4] In the raw sample, we have 17,320 household-wave observations across the four waves. We then drop observations with missing information. We further exclude households in which financial decisions are made by someone not in the household and households in which both spouses claim to be the financial head of the household. This leaves us with a final sample of 8,708 household-wave observations with completed information, representing 3,951 unique households.[5]

2.2 Summary statistics

Table 2 shows the summary statistics for our main sample. We start with household characteristics. Stock participation is a dummy variable that indicates whether a household directly holds any equities, including individual stocks and mutual funds.[6] The overall participation rate in the stock market is 48%, which is higher than those in many other developed countries (see Badarinza et al. 2016 for a recent international comparison). The median household income is AU$105,000. The median total wealth and financial wealth are AU$979,000 and AU$243,000, respectively, suggesting good coverage of relatively affluent families.[7] The average value of equities holding is

[4]By construction, the gender gap exists only for households where the spouses are of different genders. Same-sex marriage was legalized in Australia in 2017. While we do not have sufficient data to analyze same-sex couples, we expect that gender dynamics would not apply in the same way in a non-heteronormative relationship.

[5]In the Online Appendix, Section A.1 discusses the filters in detail. In Section D of the Online Appendix, Table A.1 compares the raw and the baseline samples.

[6]We do not consider equities held in retirement accounts in this analysis for two reasons. First, investment decisions in retirement accounts are infrequent and more passive. Second, the HILDA Survey does not report how retirement accounts are invested.

[7]Financial wealth (the HILDA Survey variable HWFINI) includes equity, cash investments, trusts, bank accounts, insurance, and superannuation. We define total wealth as the sum of financial and non-financial wealth (the HILDA Survey variable HWNFII).

AU$74,000, while the median level is zero. The distributions of income, total wealth, financial wealth, and equities value, as expected, are positively-skewed. On average, a household has fewer than one child.

For individual characteristics, most of the demographic variables, such as age and education, cover a wide spectrum, consistent with the HILDA Survey's national coverage. A more interesting set of statistics concerns the comparison between husbands and wives. Overall, in an average household, the husband is 2.4 years older, is 8% more likely to be employed, makes AU$29,000 more every year, and has a similar level of education to the wife. It is worth noting that these differences themselves can also be gendered: for example, the difference in labor income may reflect patriarchal social norms which lower women's pay even for the same job (Akerlof and Kranton 2000; Fortin 2005; Bertrand et al. 2015).

The HILDA Survey also collects information on each spouse's risk preference, cognitive ability, personality traits, and the identity of the household financial head. Below, we will explain how we code these variables.

Risk preference. In the HILDA Survey, risk aversion is measured in the same way as in the Survey of Consumer Finances (SCF). Each household member answers the following question in the self-completion questionnaire: which of the following statements comes closest to describing the amount of financial risk that *you* are willing to take with *your* spare cash (that is, cash used for savings or investment.)? The answer options are (1) I take substantial financial risks expecting to earn substantial returns; (2) I take above-average financial risks expecting to earn above-average returns; (3) I take average financial risks expecting average returns; and (4) I am not willing to take any financial risks.[8] These four options are then numbered from one to four, with a higher number indicating a greater level of risk aversion. This self-assessment question is a widely used proxy for risk aversion, especially in the domain of financial decision-making. Although the measure does not capture the full spectrum of risk tolerance, it has good consistency over time and is correlated with other measures of risk aversion elicited using hypothetical gambles and from portfolio choices (Grable and Lytton, 2001; Hanna and Lindamood, 2004). As Table 2 shows, the average risk aversion is 3.18 for husbands and 3.42 for wives, suggesting that wives, on average, are more

[8]There is a fifth option: I never have any spare cash. We exclude individuals who choose this last option, because it is unclear how to classify these individuals.

risk-averse than husbands.

One potential concern is that answers to this question may themselves reflect an outcome of bargaining. While the question's phrasing explicitly elicits one's own risk attitude, we cannot fully rule out the possibility that the reported risk attitude may partially capture the risk attitude of one's spouse. For example, Serra-Garcia (2021) shows that spouses' risk preferences become more alike over time after marriage. To address this concern, we introduce measurement errors in the risk measurement equation to capture potential biases between the "reported" and "true" risk attitude. We will further allow measurement errors to be correlated between husband and wife within the same household.

Cognitive ability. The survey conducts three tests to measure cognitive ability: (1) the "backward digits span" (BDS) test; (2) a 25-item version of the National Adult Reading Test (NART); and (3) the "symbol-digit modalities" (SDM) test.[9] We construct a single measure by first standardizing the results of each test and then taking the mean. In our sample, wives have a higher cognitive ability, scoring 0.11 higher than husbands.

Personality traits. The HILDA Survey collects information about the Big Five personality traits: openness to experience, conscientiousness, extraversion, agreeableness, and emotional stability.[10] Each trait is measured on a scale from 1 to 7.[11] Overall, as shown in Table 2, husbands are less extraverted, less agreeable, less conscientious, and more open to experiences than their wives.

Financial head of the household. The HILDA Survey also collects information on the financial head of the household. In a self-completion questionnaire, each spouse answers who makes the decisions about savings, investment, and borrowing in their household. Participants are given the following options: themselves, their spouses, shared equally between spouses, or other people. We exclude households whose financial decisions are made by other people and those in which both spouses claim themselves to be the only financial head of the household.

[9] See Section A.2 of the Online Appendix for more details.

[10] For overviews of the Big Five, see Costa Jr and McCrae (1990); McCrae and John (1992); John and Srivastava (1999)

[11] More details are included in Section A.3 of the Online Appendix.

This question is similar to the question about "final say" used in other surveys (e.g., HRS), which asks the following question: "When it comes to major family decisions, who has the final say, you or your husband (wife)?" The literature has used this variable for two purposes. First, it has been used as a proxy for bargaining power (e.g., Friedberg and Webb 2006; Yilmazer and Lich 2015; Zaccaria and Guiso 2020). Second, it has been used as a measure of gender norms, with husband-headed families being interpreted as having more patriarchal gender norms (Ke 2021). In this paper, we follow the second approach and use household headship to proxy for traditional gender norms.

Based on the answers to the "financial head" question, we first classify all households into three types: "husband-headed," in which both spouses report the husband makes financial decisions; "jointly headed," in which both husband and wife report that financial decisions are "shared equally" between the spouses; and "wife-headed," in which both spouses report the wife makes financial decisions. In some cases, spouses give slightly different answers to the same question, giving rise to two other types: "husband-shared," in which one spouse reports "husband" and the other reports "shared equally," and "wife-shared," in which one spouse reports "wife" and the other reports "shared equally."[12]

Figure 1 plots the distribution of household types by year. Depending on the specific wave, 57% to 60% of households report that spouses equally share in the responsibility of making financial decisions. If responsibilities are not shared equally, it is more likely that the husband acts as the financial head: 26% to 29% of the households report the husband as the financial head, while only 13 % to 17% report the wife. Across the four waves, the fraction of each household structure remains rather steady. There is a slight trend toward wife-headed and wife-shared households, but the magnitude is relatively small.

2.3 Comparison with other data sets

The most comparable data set for U.S. households is the Panel Study of Income Dynamics (PSID). The PSID collects demographics, employment, income, wealth, and other information on a nationally representative panel of households and reports individual-level information. However, al-

[12] In rather rare cases (1.3% of the sample), the husband and wife give opposite answers; we drop these responses in subsequent analyses.

though the PSID collects individual-level risk aversion, it is only available for the household head, not for the other household members. This limitation makes it impossible to aggregate risk preferences from the individual level to the household level. A second candidate data set is the HRS, which provides comprehensive information on households' asset allocations and the risk preferences of all household members. However, the HRS restricts its sample by exclusively surveying people over the age of 50 only. While the focus on a particular demographic group is inherently interesting, the conclusions drawn from a restrictive sample will also face issues of generalizability. A third widely used data set is the U.S. Survey of Consumer Finances (SCF). However, the SCF does not survey each household member's characteristics in a given household, which again makes it unsuitable for our study.

Similar nationally representative data sets are available for other countries, but different data limitations make these data sets not ideal for our study. For example, in the Korean Labor and Income Panel Study (KLIPS), risk preference is measured using hypothetical lottery questions, but only 9.4% of individuals deviate from the safest choice, making the measure rather underpowered. The information in the German Socio-Economic Panel (GSOEP) is very detailed but does not include information about financial heads. In the British Household Panel Survey (BHPS), households only report their asset holdings in dummy variables, which makes the main measure of asset holdings rather crude and potentially underpowered. China Household Finance Survey (CHFS) is similar to the PSID in that only the financial head's risk aversion is collected. Given these considerations, we cannot replicate our full analysis in any of these datasets. However, it is still feasible to repeat the main part of our estimation using two data sets: HRS for the US and GSOEP for Germany. We will describe these exercises later in Section 6.

2.4 Stylized facts

2.4.1 Heterogeneous risk preferences within households

In our model, we will assume that spouses bargain by aggregating their risk preferences. A key premise for bargaining over risk aversion is that members of the same household have different levels of risk aversion. To confirm this, Table 3 shows the distribution of husband-wife-paired risk aversions. The diagonal terms represent the cases in which the husband and the wife have the same

risk aversion, and the off-diagonal terms represent cases in which the two spouses have different risk preferences. Overall, two robust patterns emerge. First, consistent with the prior literature (e.g., Dohmen et al. 2012), we find assortative mating on risk preferences: more than 50% of the couples have the same risk preference. It is unclear whether sorting happens before marriage or spouses become more alike after marriage. Second, in around 43% of households, spouses have different levels of risk aversion. This pattern confirms our hypothesis that a significant proportion of spouses need to bargain over their risk preferences when making financial decisions.

2.4.2 Risk preference and stock market participation

To illustrate the quantitative importance of risk preference to stock market participation, we run a simple linear probability model by regressing the dummy of stock market participation on various household characteristics. Column (1) in Table 4 concerns the regression in which only measures of risk aversion are included as the explanatory variables. Indeed, both spouses' risk aversions show up negative and significant, suggesting that risk aversion is a key determinant of stock market participation. Column (2) adds additional controls and shows that the relationship between risk aversion and risky shares remains robust after controlling for a variety of individual characteristics. Columns (3) and (4) repeat the analysis for single households and show a similar pattern.[13]

2.4.3 Financial head of the household

Table 5 reports household characteristics by sorting households into three different types: husband-headed, jointly headed, and wife-headed; we omit the two other household types for simplicity. As mentioned before, some existing papers use the identity of the financial head as a proxy for bargaining power. We view this approach as plausible; below, we will provide some supportive evidence of this approach. However, in this paper, we use this variable as a measure of household types and instead use portfolio choice to back out bargaining power.

We start by comparing average household characteristics. At the individual level, members of husband-headed households are slightly older, more educated, less likely to be employed (primarily driven by the wife), earn a higher income, and are less risk-averse in general. At the household

[13]Estimates from a logit regression model (not reported) reveal a similar pattern to that obtained from the linear probability model.

level, they are more likely to participate in the stock market, hold more equity, and are wealthier in their overall financial assets.

A more interesting comparison concerns the difference between husbands and wives in their individual characteristics. We find that, generally, when a spouse is better off in education, employment, income, risk-taking capacity, and cognitive ability, this person is more likely to become a financial head. Indeed, in an average husband-headed household, the husband is generally better off in these dimensions, and vice versa in an average wife-headed household.

3 Model

3.1 Baseline model

3.1.1 Assets

The economy has two assets: a risk-free asset with a constant interest return r_f and a risky asset (stock) with return $r_f + \widetilde{x}$, where $\widetilde{x}$ represents the equity premium and follows a normal distribution $N(r_x, \sigma_x^2)$. For simplicity, we assume that r_x is homogeneous across households and abstract away from heterogeneous expectations.[14] Household i has total wealth w. Consider a static portfolio allocation between risky asset holding a and risk-free asset holding $w - a$, where a represents the household's choice variable.

Given the empirically low stock participation rate, a common method for matching this moment is to impose a participation cost, which can be either a lump-sum cost or per-period fee (e.g., Vissing-Jørgensen 2002; Gomes and Michaelides 2005; Alan 2006). We follow this method and assume a one-time lump-sum cost of C_i for each household participating in the stock market. Subscript i indicates that C_i is heterogeneous across households. While the prior literature has often interpreted this cost as the physical effort of opening a brokerage account or the mental effort of learning about financial markets, our interpretation is more flexible. As we will discuss later, we use the cost as an absorbing term that captures any factor affecting stock market participation

[14] We cannot use household-level expectations data in our portfolio choice problem since the survey data (HILDA, GSOEP, and HRS) do not include information about stock market return expectations. Instead, we rely on the existing literature to pre-set the mean (r_x) and standard deviation (σ_x) of the premium distribution in our estimation.

other than risk aversion.

3.1.2 Utility function

The mean-variance utility function of household i is specified as

$$U_i(a) = \max_a \underbrace{w(1+r_f)}_{\text{Risk-free return}} + \left(\underbrace{ar_x - C_i}_{\text{Mean}} - \underbrace{\frac{1}{2}\gamma_i a^2 \sigma_x^2}_{\text{Variance}} \right) I(a>0), \tag{1}$$

where $I(a>0)$ is a dummy variable indicating whether the household invests in the risky asset, and γ_i represents the household's risk aversion. The solution is given by

$$a = \begin{cases} 0 & \gamma_i > \frac{r_x^2}{2\sigma_x^2 C_i} \\ \frac{r_x}{\gamma_i \sigma_x^2} & \gamma_i \leq \frac{r_x^2}{2\sigma_x^2 C_i} \end{cases}. \tag{2}$$

Section B of the Online Appendix shows the proof. In equation (2), there are two sources of household heterogeneity: household risk aversion γ_i and participation cost C_i. Both a higher risk aversion and a higher participation cost would lead to a lower participation rate and, conditional on participation, a lower fraction of wealth invested in the risky assets.

Next, we specify participation cost C_i. Because we view it as an absorbing term, we adopt a rather flexible specification as a linear combination of various household-level characteristics:

$$\begin{aligned} C_i = {} & c_0 + c_1 \log(\text{earning})_i + c_2 \log^2(\text{earning})_i + c_3 \log(\text{wealth})_i + c_4 \log^2(\text{wealth})_i + c_5 \text{age}_i \\ & + c_6 \text{age}_i^2 + c_7 \text{education}_i + c_8 \text{cognition}_i + c_9 \text{child}_i + c_{10} \text{year}_{2010} + c_{11} \text{year}_{2014} + c_{12} \text{year}_{2018}, \end{aligned} \tag{3}$$

where earning, wealth, and child represent household earnings, household net wealth, and the number of children, respectively. The literature suggests that this set of characteristics influence stock market participation decisions (Campbell, 2006). At this point, because we are primarily concerned with household-level characteristics, we use the average value between the two spouses for age, education, and cognitive ability; later, differences in individual characteristics between spouses will enter the bargaining equation. We include quadratic earnings, wealth, and age terms to account for nonlinear effects. We also include three year dummies, using year 2006 as the

reference group. It is worth noting that the inclusion of wealth in the participation cost function breaks the wealth neutrality commonly implied by a mean-variation utility. Therefore, although household wealth does not directly show up in the portfolio solution, it still indirectly affects stock market participation through C_i. In our estimation, heterogeneous participation cost C_i is not a fitted value but an endogenous object estimated jointly with other model parameters (see Section 3.2 for more detail).

3.1.3 Risk aversion and bargaining power

Next, we specify how household risk aversion γ_i is aggregated from individual preferences; for simplicity, we now drop subscript i.[15] We focus on heterosexual marriage in which a household consists of a husband (h) and a wife (w). We assume that couples are fully committed to staying in their marriage and do not consider the case of divorce. We assume the *reciprocal* of household risk aversion, $\frac{1}{\gamma}$, is a weighted average of the *reciprocals* of the two spouses' risk aversions, denoted by $\frac{1}{\gamma^h}$ and $\frac{1}{\gamma^w}$, respectively:

$$\frac{1}{\gamma} = \frac{\beta^h(\cdot)}{\gamma^h} + \frac{\beta^w(\cdot)}{\gamma^w}, \tag{4}$$

where the weight parameters β^h and β^w can be interpreted as the bargaining power of the husband and of the wife, and $\beta^h + \beta^w = 1$. With this formulation, we are assuming that greater bargaining power means a greater ability to incorporate one's own risk preference into the household financial decision.

We make two remarks based on our functional form choices. First, under the mean-variance utility, portfolio decisions follow a cut-off rule and simplify the subsequent estimation. As we show later, though simple, this utility function turns out to fit the data rather well. Second, in equation (4), risk aggregation uses the reciprocal of individual risk aversion rather than risk aversion itself. Under the conditions detailed in Section B of the Online Appendix, this gives an equivalent expression as in the classical collective bargaining model in which the household utility function is a weighted average of the individual's utility (Manser and Brown 1980; McElroy and Horney

[15] In theory, household members may also differ in their time preference or expected returns as well, and they will need to bargain in these dimensions as well. A full exploration, however, needs to extend our static model to a dynamic setup. To the best of our knowledge, such a model (dynamic intrahousehold decisions in the financial domain) has not yet been developed in the literature and could be an interesting avenue for future work.

1981; Chiappori 1988, 1992).[16] Therefore, in our model, aggregating individual risk preferences are equivalent to aggregating individual utility functions. Therefore, β^h and β^w in equation (4) carry the same interpretation as the Pareto weights in a collective bargaining model.

3.1.4 Determinants of bargaining power

Finally, we specify the determinants of bargaining power. In period t, $\beta^h(\cdot)$ is determined by both the observed characteristics of the two spouses and a gender effect. Specifically, $\beta^h(\cdot)$ takes the following form:

$$\beta^h(X_t^h, X_t^w, H_t) = \frac{\exp\left(\widetilde{\beta}\left(X_t^h, X_t^w, H_t\right)\right)}{\exp\left(\widetilde{\beta}\left(X_t^h, X_t^w, H_t\right)\right) + 1}, \tag{5}$$

where

$$\widetilde{\beta}\left(X_t^h, X_t^w, H_t\right) = \left(X_t^h - X_t^w\right)\delta_x + \sum_{j=1}^{5} \delta_{jt}^H I(H_t = j) + \mu + \varepsilon_t, \tag{6}$$

X_t^h and X_t^w represent the observed characteristics of the husband and wife in period t, respectively, and H_t denotes the household structure at time t. Logistic transformation is commonly used to map the unrestricted $\widetilde{\beta}(\cdot)$ onto the unit interval, thereby bounding bargaining power between zero and one. The first term, $\left(X_t^h - X_t^w\right)\delta_x$, captures the contribution of the observed differences between husband and wife to bargaining power. Here, we assume the effects are gender-neutral. Instead, gender asymmetry is absorbed by the gender effect terms, $\sum_{j=1}^{5} \delta_{jt}^H I(H_t = j)$, where $I(H_t = j)$ indicates the five types of household structure based on the identity of the financial head. The inclusion of subscript t means that gender effects can differ across periods in our model. The next term, μ, captures unobserved household heterogeneity, which is assumed to be fixed for the same household over multiple periods; we will discuss the distributional assumptions we make about μ in the next section. Lastly, ε_t captures a temporary preference shock and follows a normal distribution $N\left(0, \sigma_\varepsilon^2\right)$.

[16] The key condition is that the total participation cost C_i is a weighted average of individuals' participation costs, where the weights are the same as the bargaining power coefficients, β^h and β^w. Without this condition, we lose the equivalent expression, but the model's estimation remains valid.

3.2 Econometric specification and maximum likelihood function

We now introduce some parametric assumptions in order to estimate the model. To simplify the exposition, we continue suppressing subscript i and will bring it back later when introducing the likelihood function.

3.2.1 Observable individual and household characteristics

We use Ω_t to represent the observed characteristics in period t:

$$\Omega_t = \left(\overline{\gamma}_t^h, \overline{\gamma}_t^w, X_t^h, X_t^w, H_t\right),$$

where $\left\{\overline{\gamma}_t^h, \overline{\gamma}_t^w\right\}$ are the risk aversion measures reported in the survey; $\left\{X_t^h, X_t^w\right\}$ represent the set of individual characteristics of the husband and the wife; and H_t denotes the household structure based on the identity of the financial head.

Our survey-based measures of risk aversion, $\{\overline{\gamma}_t^h, \overline{\gamma}_t^w\}$, are categorical variables. Directly using discrete variables may be noisy and induce measurement errors, leading to attenuation biases and inconsistent coefficient estimates (e.g., Beauchamp et al. 2017). Therefore, we introduce measurement errors, $\{\xi_t^h, \xi_t^w\}$, to map the survey-based risk aversion to the true risk aversion, $\{\gamma_t^h, \gamma_t^w\}$:

$$\begin{aligned} \log \gamma_t^h &= \zeta_0 + \zeta_1^h \log \overline{\gamma}_t^h + \xi_t^h \\ \log \gamma_t^w &= \zeta_0 + \zeta_1^w \log \overline{\gamma}_t^w + \xi_t^w \end{aligned}, \tag{7}$$

where coefficients $\{\zeta_1^h, \zeta_1^w\}$ are gender-specific. This means the same answers may reflect different risk preferences depending on gender. The intercept, ζ_0, is assumed to be common, but making ζ_0 gender-specific does not change our main results. We assume $\xi_t = \{\xi_t^h, \xi_t^w\}$ follows a joint normal distribution, specified by

$$\xi_t = \begin{pmatrix} \xi_t^h \\ \xi_t^w \end{pmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & \rho_\xi \\ \rho_\xi & 1 \end{bmatrix} \sigma_\xi^2\right),$$

where ρ_ξ represents the correlation between spouses' measurement errors. This parameter is used to capture the potential correlation between spouses' reported risk attitudes. The lognormal func-

tional form is a common choice in the literature and ensures that the risk preference is non-negative and is computationally simple.[17] In addition, since the empirical distribution of risk aversion is highly skewed to the right, the lognormal assumption allows the model to better capture the distributions in the right tail (e.g., Kimball et al. 2008).

3.2.2 Outcome variables

Next, we specify the outcome variables. We focus on both the extensive and intensive margins of stock market participation. We use d_t to indicate whether a household has a positive holding in equities, and $\overline{a}_t$ measures the reported holdings in equities (in AU$). To account for measurement errors, we assume $\overline{a}_t$ is also a noisy measure of the true asset value a

$$\log \overline{a}_t = \log a + \varepsilon_t^a, \tag{8}$$

where ε_t^a is a residual term and follows a normal distribution $N(0, \sigma_a^2)$.

The last parametric assumption we need to make is about the distribution of μ in equation (6), which captures the persistent unobserved heterogeneity of each household. Following Heckman and Singer (1984), we model μ as a random effect using the nonparametric mass points approach.[18] In particular, we assume that μ is drawn from a discretized distribution of K mass points $\mu \in \{\mu_1, \mu_2, ..., \mu_K\}$ and use notation $p = \{p_1, p_2, ..., p_K\}$ as the associated probability weights.[19] In practice, we assume four types, i.e., $K = 4$. We also restrict its mean value to be 0 to separately identify μ and δ_{jt}^H.

3.2.3 Likelihood function

We now discuss the construction of the likelihood function. We start with a type-k household with observable characteristics Ω_t in a given period t. In the model, the decision of whether to partici-

[17] For example, the mean and variance of γ can be calculated analytically using its moment-generating function.

[18] An alternative approach is to model μ as a fixed effect. However, the inclusion of fixed effects increases the set of parameters by thousands, substantially reducing the degrees of freedom. In addition, this can produce inconsistent estimates when the model is nonlinear.

[19] Alternatively, we can impose a specific distribution for μ, for example, a mixture of several normal distributions. However, econometric evidence suggests that our current approach performs better. Using Monte Carlo simulation, Mroz (1999) shows the discrete type assumption performs as well as the normal assumption when the true distribution is normal. When the true distribution is not normal, however, the discrete type method performs better in terms of precision and bias.

pate in the stock market is fully pinned down by $(\Omega_t, \varepsilon_t, \xi_t, \mu_k)$. Therefore, we can write the model implied decision as $\tilde{d}(\Omega_t, \varepsilon_t, \xi_t, \mu_k)$. Furthermore, for a household that is invested in the stock market, the probabilistic distribution of risky asset holdings is fully determined by $(\Omega_t, \varepsilon_t, \xi_t, \mu_k)$ and the distributional assumptions we make about the error term ε_t^a.[20] Therefore, for a type-k household with observable characteristics Ω_t, we can write the likelihood function as the joint probability of making the discrete choice d_t and the continuous choice $\overline{a}_t$:

$$l_{kt} = \int_{\xi_t} \int_{\varepsilon_t} 1\left(\tilde{d} = d_t | \Omega_t, \varepsilon_t, \xi_t, \mu_k\right) P_a(\tilde{a} = \overline{a}_t | \Omega_t, \varepsilon_t, \xi_t, \mu_k)^{1(d_t=1)} d\varepsilon_t d\xi_t,$$

where $1(\tilde{d} = d_t)$ indicates whether the model implied decision $\tilde{d}$ matches with the observed decision d_t, and $P_a(\tilde{a} = \overline{a}_t)$ denotes the probability that the model implied amount of asset holding $\tilde{a}$ matches with the observed amount of risky asset a_t. This term enters the likelihood function when the household does participate in the stock market, i.e., $1(d_t = 1) = 1$. Since we do not know the values of ε_t and ξ_t for each household, our MLE takes this into account by integrating out both error terms.

Next we bring back subscript i to specify the overall likelihood function:

$$L = \prod_i \left[\sum_{k=1}^{K} p_k \Pi_{t \in \{2006,2010,2014,2018\}} l_{kt}^i \right] \tag{9}$$

where i indexes each household. To calculate the overall likelihood, we first take the product of the likelihood function over multiple periods for the same type-k household i. Then, we sum over the K types of household heterogeneity (μ_k, where $k = 1, 2, ..., K$). Finally, we integrate all households to arrive at the total probability function. Standard errors are computed using the BHHH algorithm (Berndt et al. 1974).

[20] Specifically, $(\Omega_t, \varepsilon_t, \xi_t, \mu_k)$ implies a theoretical level of risky holding a. In our model, there is also a measurement error ε_t^a. Therefore, the probability of holding risky asset $\tilde{a}$ is $P_a(\tilde{a}|\Omega_t, \varepsilon_t, \xi_t, \mu_k) = P_a(\tilde{a}|a) = \phi\left(\frac{\varepsilon_t^a}{\sigma_a}\right) = \phi\left(\frac{\log\tilde{a} - \log a}{\sigma_a}\right)$, where ε_t^a is the measurement error in the asset equation (8), and a is the true asset value implied in equation (2).

3.3 Identification

In this section, we discuss how each parameter is identified in the model. In our model, individual characteristics can enter the likelihood function, specified in equation (9), through two channels: stock market participation cost C and household risk preference γ. When explaining the intuition of the identification, we are first concerned with C and γ and, assuming that C and γ have been identified, we then proceed to the other parameters. In practice, however, C and γ are jointly estimated with other model parameters in one step through an MLE procedure.

Suppose that we have a sufficiently large group of households that are homogeneous in their characteristics Ω (except for γ), which leads to identical participation cost C, but are different in their risk preferences γ. According to equation (2), among those invested in the stock market, γ can be identified from the household's holding of risky assets: in equation (2), among households with $\gamma \leq \frac{r_x^2}{2\sigma_x^2 C_i}$, a one-to-one mapping exists between the amount of risky holding a and the household risk aversion γ. Moreover, for the marginal households whose risk aversion is $\gamma = \frac{r_x^2}{2\sigma_x^2 C_i}$, their risky holding equals $a = \frac{2C}{r_x}$, which means that C can be backed out from the households with the minimum risky holding within the group. Once $\{C, \gamma\}$ are identified for the subset of households participating in the stock market, coefficients $c = \{c_i\}_{i=0}^{12}$ can be recovered based on the cost function, specified in equation (3), and coefficients $\delta = \{\delta_x, \{\delta_{jt}^H\}_{j=1}^5\}$ can be recovered based on the bargaining weight function, specified in equations (5) and (6). Similarly, parameters $\zeta = \{\zeta_0, \zeta_1^h, \zeta_1^w\}$ in the risk preference measurement equation (7) can be recovered by comparing the risk preference γ inferred from the model and the risk preference $\bar{\gamma}$ reported in the survey data. More detailed proofs can be found in Section C of the Online Appendix.

After showing how identification works in the ideal case when the sample size is sufficiently large, we provide further evidence on the properties of the MLE estimator in our finite sample. Indeed, crucial to our identification is the sensitivity of the likelihood function to changes in parameter values. Below, we empirically test the identification sensitivity by varying each parameter around its estimate while keeping other parameters unchanged. The changes in likelihood values are shown in Appendix Figure A.1 (when varying the coefficients in the participation cost equation) and Appendix Figure A.2 (when varying the coefficients in the bargaining equation). Both figures confirm a noticeable decrease in log-likelihood as we move away from estimates for all

parameters. Optimization is implemented by a global solver (particle swarm optimizer). We also experiment with starting the algorithm from various initial values, and the estimated parameters always result in the same estimates.

4 Estimation Results

4.1 Model estimates

Table 6 and 7 report the estimation results in the bargaining equation 6. Table 6 reports the estimates for the spousal differences in observed characteristics. Column (1) reports the coefficients, and Column (2) reports the standard errors. In Column (3), we calculate the percentage change in bargaining weight in response to a one-standard-deviation change in a given characteristic. Employment, earning, and cognitive ability stand out as the most important determinants of bargaining power. All coefficients are positive, and a one-standard-deviation change in employment, earnings, and cognitive ability increases the bargaining weight by 6.49%, 11.64%, and 6.06%, respectively. Therefore, much of the cross-sectional variation in the allocation of intrahousehold bargaining power is driven by these three characteristics. Age and education also positively affect bargaining power, but with a smaller magnitude. Notably, personality traits also matter: higher scores in conscientiousness and openness lead to more bargaining power, while higher scores in extraversion, stability, and agreeableness lead to less bargaining power (Flinn et al. 2018; Jiang et al. 2022).

Table 7 reports the estimates for the gender effects. Each coefficient represents one of the five household types—"husband-headed," "husband-shared," "jointly headed," "wife-shared," and "wife-headed"—in each of the four waves. In any given year, coefficients exhibit a monotonically increasing pattern from wife-headed to jointly headed to husband-headed households. Therefore, financial heads have disproportionally large bargaining power in household portfolio decisions. However, without a proper simulation exercise, it is difficult to interpret the coefficients' contribution to bargaining power. We will perform this exercise later in Section 4.4.

Table 8 reports the estimates for the rest of the model.[21] The left panel reports all the coef-

[21] Table A.5 in the Online Appendix reports the estimates for unobserved types, μ, in the bargaining equation (6), which is used to capture the household heterogeneity that is not captured by observed characteristics. The estimates indicate that households are more likely to be Types I and II, not the other two types.

ficients from equation (3), which specifies the stock market participation cost. The coefficients for the log of household earnings and the squared term are both negative, suggesting that higher earnings are associated with a lower participation cost. In comparison, the coefficients for the log of net wealth and the squared term are both positive. These coefficients are consistent with the regression coefficients in Table 4, which shows that stock market participation is positively correlated with income and negatively correlated with wealth.[22] Meanwhile, the effects of age and cognitive ability on participation cost are both negative, indicating that stock market participation decisions are easier for households with more experienced and intelligent members. Having more children increases participation costs, possibly because of constraints in the allocation of time. Figure 2 plots the distribution of participation costs, which display substantial heterogeneity across households. The average participation cost is around AU$300, consistent with estimates from the previous literature.[23]

The upper-right panel of Table 8 reports the coefficients associated with the risk attitude measurement equation. To further understand the "true" risk preferences generated from the risk measure equation, we plot the distribution of risk aversion in Figure 3. The distribution of the husband's risk aversion has a lower median and is more positively skewed than the distribution of the wife's risk aversion. This finding is consistent with existing evidence in the literature.[24] The lower-right panel of Table 8 reports the other parameters. The residual term in the bargaining equation has a standard deviation of 0.641. The standard deviation of the measurement error term for the log asset is 2.111.

[22]Similarly, in Campbell (2006), stock market participation is positively correlated with income and only weakly correlated with wealth. In some specifications, the fraction of risky shares in the household portfolio is, in fact, negatively correlated with wealth; see Table I of Campbell (2006). We suspect that for some wealthier investors, their portfolio allocation switches from public equities to real estate and private equities.

[23]For example, Vissing-Jorgensen (2003) finds that a per-period cost of $55 in 2003 prices is enough to explain 50% of non-participation using the Panel Study of Income Dynamics (PSID). However, our model differs from that of Vissing-Jorgensen (2003) in specifying participation cost as a one-time lump-sum cost. Moreover, the households surveyed by the PSID have less wealth on average: for example, around 21% of the households have no financial wealth at all.

[24]For example, Powell and Ansic (1997) provide experimental evidence of gender differences in risk behavior in financial decision-making, and Barsky et al. (1997) show survey-based evidence.

4.2 The model's goodness of fit

In this section, we compare the conditional moments from the model simulation and those from the real data to examine whether the model does a good job of fitting the data. In particular, we examine the two metrics the model is designed to match: a dummy for stock market participation and the level of risky asset holdings. We calculate both variables for each household, average them by household head types and risk preferences, and compare the average values across different groups. Table 9 reports the results: the first two columns concern stock market participation, and the last two concern the level of risky asset holdings for the subgroup of households invested in the stock market. Overall, the model fit is good: in the upper panel, moments from the model simulation and real data are close to each other, with a monotonic pattern across the five household types preserved; in the lower two panels, the simulated patterns are close to the patterns implied by the data. Figure 4 further plots the distribution implied by the model (in red line) against its empirical distribution (in blue histogram) for households holding positive risky assets. Overall, the model does a good job of capturing the empirical distribution of risky asset holdings.

4.3 Gender asymmetry and its sources

Next, we quantify the distribution of bargaining power between husband and wife through a series of simulation exercises. In each exercise, we shut down part of the model and focus on the mechanism we are interested in. We then simulate both the distribution of bargaining power and the two key moments of financial decisions. The benchmark case is when spouses have an equal say, with a 50-50 split in the distribution of bargaining power. This means setting $\beta = 0.5$ for all households, and the first line of Table 10 presents the results. In this benchmark case, the stock market participation rate is 42.9%, substantially lower than the actual number (48%). Similarly, the holdings of risky assets are also lower than the actual moment.

The next line presents our full heterogeneity case, including both gender effects and spousal differences in observable characteristics. We find a large gender gap: in an average household, the husband's bargaining power is 59%, whereas the wife's is 41%. This suggests an 18 percentage points gap in bargaining power; in relative terms, this suggests that husbands, on average, have 44% greater bargaining power than wives. The fact that husbands have more bargaining power,

combined with them having lower risk aversion on average, implies a stock market participation rate higher than the benchmark case. Indeed, the simulated stock participation rate has increased to 49.5%, close to the actual number (48%).

The next two lines present the two cases in which we consider only gender effects and only spousal differences in observable characteristics. Overall, both channels matter, with each channel alone generating a 12 percentage points (56% vs. 44%) and 10 percentage points (55% vs. 45%) gap in bargaining power, respectively. Therefore, observable differences do not fully explain the gender gap: although the typically higher income and better employment status of husbands can partially justify their greater bargaining power, about half of the gap remains unexplained and can be traced to gender effects. Our subsequent analysis speaks to the sources of this gender effect.

The rest of Table 10 reports the explanatory power of each variable alone.[25] Because of the potentially significant covariance between variables, the sum of all individual effects would not equate to the total effect. Income and employment appear to be the main contributors to the cross-sectional variations in the distribution of bargaining power. In our sample, wives are less likely to have a job and earn substantially less than their husbands, resulting in them having less say in financial matters. These differences could also be gendered: for example, a traditional family structure would involve the husband as the "breadwinner" and the wife as the "homemaker"; even when both work, the husband tends to earn more than the wife on average. Therefore, gender inequality in labor market status can, in turn, lead to a gender gap in bargaining power, thereby constraining women's say in financial decisions. Wives have a higher cognitive ability, and their personality traits, especially their higher level of extraversion, contribute positively to bargaining power. Overall, however, the net effect of observed characteristics is dominated by income and employment and leans toward husbands, resulting in more bargaining power for husbands in financial matters.

In our model, we take the spousal differences in individual characteristics as given and attribute all the gender effects to the fixed effects. Some other papers may adopt a relatively broader concept and attribute the observed gender difference in characteristics as additional sources of gender effect

[25] Household unobserved heterogeneity μ, in principle, could also have an impact on the gender gap in bargaining power. However, since we have restricted $E[\mu] = 0$, this channel does not affect the average gender gap in the population by construction. Our decomposition exercise confirms this result. We, therefore, ignore the impact of μ in our following analysis.

as well (Bertrand et al. 2015). In reality, spousal differences are also likely to capture a gender effect, which we do not model. In this regard, our estimated gender effect can serve as a lower bound for the gender gap in bargaining power.

4.4 Bargaining power across household head types

Figure 5a plots, for each household type in any given wave, the average bargaining power of a husband. Because of the monotonic trend of average bargaining power across different household types, we omit husband-shared and wife-shared without losing significant information.[26] Consistent with the patterns revealed by the coefficients, a husband's bargaining power increases substantially from wife-headed to jointly headed to husband-headed households. The magnitude is large: in an average husband-headed household, the husband's bargaining power is around 89%; in an average wife-headed household, the husband's bargaining power ranges from 28% to 44%, depending on the year. Figures 5b and 5c further decompose bargaining power into two sources: gender effects and observable spousal differences. While both can explain some heterogeneity in bargaining power across household types, gender effects play a major role.

The patterns plotted in Figure 5 have two main implications. First, they directly compare our revealed-preference approach to a survey-based approach. The latter approach makes the implicit assumption that the financial head is the *de facto* decision-maker of the household endowed with full or disproportionally high bargaining power (e.g., Friedberg and Webb 2006; Johnston et al. 2016). Qualitatively, our findings are consistent with this approach: a husband's average bargaining power monotonically increases from wife-headed households to jointly headed households to husband-headed households. In addition, bargaining power in jointly headed households is close to an even distribution among the two spouses. Quantitatively, however, in both wife-headed and husband-headed households, financial heads incorporate—at least partially—the risk preferences of their spouses. Second, the decomposition further suggests that both observable differences and gender effects are important determinants of bargaining power in households. For a husband-headed household, the husband's greater bargaining power may arise because of his

[26] In particular, the average bargaining weight for the husband-shared group is between the husband-headed group and the jointly headed group, while the average bargaining weight for the wife-shared group is between the wife-headed group and the jointly headed group.

better economic status than his spouse's, but it could also arise because of a greater gender effect. Our structural model quantitatively compares the relative importance of these two channels and demonstrates that the gender effect is a much more important channel than observable differences in explaining heterogeneity in bargaining power across household types.

It is important to note that the choice of the financial head is clearly an endogenous outcome. In our current specification, we treat the financial head as a household characteristic without specifying the underlying process that determines it. While a full consideration of this issue is beyond the scope of this paper, below in Section 5.1, we show that an important consideration is gender norms. When perceived gender norms become more egalitarian, the household is more likely to have the wife as the financial head, resulting in the wife having more bargaining power in portfolio choice.

5 Discussion

5.1 Sources of the gender effect

We investigate the possible mechanisms underlying the gender effect. The literature has shown that traditional gender norms—for example, the perception that finance is a men's business—constrain women's say and participation in portfolio decisions (Ke 2018; Zaccaria and Guiso 2020). In our setting, this means that in a household with more traditional gender norms, the household's portfolio choice would disproportionally reflect the husband's risk preference, not the wife's.

To test this hypothesis, we directly measure perceived gender norms for each household. As detailed in Section A.5 of the Online Appendix, the HILDA Survey asks three specific questions about attitudes toward gender norms to both the husband and the wife. The three questions are intended to elicit participants' attitudes about the division of labor ("it is better for everyone involved if the man earns money and the woman takes care of the home and children"), the share of housework in the family ("if both partners in a couple work, they should share equally in the housework and care of children"), and the mother's role ("whatever career a woman may have, her most important role in life is still that of being a mother"). Answers to each question are measured

on a seven-point Likert scale from 1 (strongly disagree) to 7 (strongly agree).[27] We recode all variables so that a higher value represents a more traditional view of gender norms.

We first regress simulated bargaining weights of husbands (β_t^h) on household-level proxies of gender norms and report the regression results in Table 11. Column (1) represents the baseline specification, while Column (2) adds additional controls of individual characteristics, including age, income, employment, education, cognitive ability, and personality traits. Consistent with the view that traditional gender norms limit women's bargaining power, we find that, in households associated with more traditional gender norms, the husband tends to have greater bargaining power. It is worth noting that effects are not limited to the husband's perception: when the wife agrees with a more traditional view of gender norms, it also increases the husband's bargaining power. From a policy point of view, this means that it is important to bring awareness to both women and men when promoting more egalitarian intrahousehold dynamics.

Another way to see the effect of perceived gender norms is through the results in Column (3), which regresses the husband-headed dummy variable on perceived gender norms. Recall that in Section 4.4, we showed that the gender effect towards men is the strongest among husband-headed households. Column (3) shows that, consistent with the role of gender norms in shaping intrahousehold bargaining power, households with more egalitarian views of gender norms are less likely to select the husband as the household head, resulting in women having more say in financial decisions.

5.2 Division of labor

We have shown that, when making financial decisions, husbands have disproportionally high bargaining power compared with their wives, and we argue that an important driver of this gender gap is traditional gender norms. Traditional gender norms would then imply husbands have high bargaining power in other domains of household decisions besides financial decisions. An alternative explanation for the observed gender gap is Becker's theory on the division of labor: men specialize in certain domains (such as decisions on financial matters), whereas women specialize in other domains (such as daily shopping decisions) (Becker 1985; Becker and Murphy 1992; Pollak 2011;

[27] These three questions are widely used in surveys to elicit participants' attitudes on gender norms and stereotypes, for example, in the World Values Survey.

Chiappori and Lewbel 2015). In other words, wives' less bargaining power in financial matters may be compensated by having more bargaining power elsewhere. Indeed, if utility is ultimately derived from consumption and women have more say in consumption, the gender gap we have documented may be less relevant from a welfare point of view.

To test this hypothesis, we utilize another feature of the HILDA Survey. Besides questions about the financial head of the household, the survey also asks about household decision-making across six other domains: (1) managing day-to-day spending and paying bills; (2) making large household purchases (e.g., cars and major appliances); (3) the number of hours spent in paid work; (4) the number of hours partner/spouse spent in paid work; (5) the way children are raised; and (6) social life and leisure activities. Therefore, we can use these survey-based measures of bargaining power to examine the possible divisions of labor across different domains of economic decisions.

Table 12 shows the correlation between the responses to the "savings, investment and borrowing" domain and the responses to all other domains. The "savings, investment and borrowing" domain is strongly positively correlated with the former two domains of "spending and bills" and "large household purchases." Therefore, it does not appear that women's low bargaining power in portfolio decisions is compensated by having more bargaining power in consumption decisions. The correlation between the "savings, investment and borrowing" domain and the other four domains is considerably weaker, indicating investment decisions are orthogonal to decisions on labor supply, child-rearing, and time allocation. Overall, the correlation among decisions in different domains suggests that the division of labor is a less plausible theory in our story.

5.3 Welfare implications

In our model, utility is defined over wealth. The documented gender gap implies that wives, on average, lose to their husbands in terms of expected utility. Notice that even if wives earn higher ex-post returns due to the higher risk their partners may have, it is still an ex-ante welfare loss for them because they have to bear more risk than their own risk preference implies. It is also possible that the greater bargaining power of husbands is justified if they have more skills and are better traders. The empirical evidence, however, is rather thin. If anything, it has been documented that men trade more than women and underperform due to excessive trading (e.g., Barber and Odean

2001).

One alternative rationalization of the gender gap is based on the notion that utility is eventually derived from consumption. If consumption decisions are separated from investment decisions and wives do not lose out to husbands in consumption decisions, then the gender gap we document has less of a welfare consequence. However, based on survey evidence, Table 12 clearly suggests that investment and consumption decisions are highly correlated and usually made by the same person. Therefore, although we do not show this directly, we conjecture that the gender gap in investment decisions may also extend to consumption decisions.

6 Evidence from Germany and the US

6.1 Germany

For Germany, our analysis uses the German Socio-Economic Panel (GSOEP) survey, a longitudinal survey that is nationally representative and has been conducted annually since 1984. To make this exercise comparable to the previous exercise using HILDA, we select households from the years 2002, 2007, and 2012, all of which collect information about demographics and asset allocation.[28] These variables are then merged with other variables, including risk aversion, personality traits, and cognitive ability, which are available only from other waves.[29] The filters we used are detailed in Section E.1 of the Online Appendix. The final sample has 6,342 household-wave observations, representing 3,812 unique households.

Although GSOEP has a similar design to HILDA, a few significant differences are worth noting. First, in GSOEP, information on household stock market participation only pertains to whether or not the household participates (the extensive margin) and does not include the amount of equity investment (the intensive margin). As a result, we revise our model accordingly so that the

[28] While demographic information is collected every year, asset information is collected every five years. Following Gröbel and Ihle (2018), the total household wealth has eight components: owner-occupied property, other properties (both including debts), financial assets, building loan contracts, private insurance, business assets, tangible assets, and consumer debts. Stock market participation is constructed as a dummy variable based on the following question: "Did you or another member of the household own any of the other securities (e.g., stocks, funds, bonds) last year?"

[29] Measures of risk aversion are collected from the most adjacent waves, namely the years 2004, 2009, and 2014. Similarly, personality traits are from the years 2009, 2012, 2013, and 2017. Cognitive ability is from the years 2006, 2012, and 2016. For both personality traits and cognitive ability, we take the average values across waves by implicitly assuming that both measures are persistent at the individual level.

likelihood function does not depend on choices on the intensive margin. Second, the measure of risk preference has a different metric. In GSOEP, individuals report their willingness to take risks in financial matters using an eleven-point scale, with zero indicating complete unwillingness to take risks and ten indicating complete willingness to take risks.[30] Third, GSOEP does not have information on the final decision-maker within the household, and we degenerate the gender effect to be an intercept term for each wave in our model. We perform a maximum likelihood estimation using a likelihood function similar to equation (9). Estimated parameters and goodness of model fit are reported in Appendix E.2. We then use the estimated model to quantify the distribution of bargaining power between husband and wife by conducting a simulation exercise similar to the one performed in Subsection 4.3.

Table 13 reports the results, where we find a greater gender gap in bargaining power in Germany. For the average household, the husband's bargaining weight is 59% in Australia but 68% in Germany. Our decomposition exercise further shows that the greater gender gap in Germany is due to more pronounced gender effects, not due to differences in individual characteristics between husband and wife. Indeed, in both countries, gender differences in observable characteristics such as wages and employment status have a similar effect on the gender gap in bargaining power.

6.2 The US

For the US, we use data from the Health and Retirement Study (HRS), a nationally representative longitudinal survey of households of age 50 and above. Similar to GSOEP, the HRS collects data on wealth, income, asset allocation, and other demographic variables. In addition, the HRS elicits risk aversion measures using a question of hypothetical income-gamble questions. Specifically, respondents are asked a series of questions about whether they would be willing to accept equal-probability gambles that would either increase or decrease their income. We follow Kimball et al. (2008) to impute risk aversion measures.[31] Because the risk-aversion question is only asked in earlier waves, our analysis only uses three waves: the years 2002, 2004, and 2006. The filters we use are detailed in Section F.1 of the Online Appendix. The final sample has 7,014 household-wave

[30] There are also similar risk attitude questions in other contexts, including car driving, financial matters, leisure and sports, career, and health. For the purpose of our analysis, we only use the question regarding financial matters.

[31] Kimball et al. (2008) develop a method that could eliminate measurement error and consistently measure risk aversion for all respondents over survey waves between 1992 and 2002.

observations, representing 2,664 unique households.[32]

A few differences are worth noting in the analysis of the HRS data. First, since the HRS only follows people over the age of 50, this sample is not directly comparable to earlier samples in Australia and Germany. Second, the risk aversion measure is imputed from responses to income gambles rather than the subjective assessment of risk-taking attitude in financial decisions. Third, the HRS has collected information related to cognitive function across waves. Since 2006, the HRS has also collected information on personality traits. However, if we were to include information on cognition and personality traits, we would lose two-thirds of the sample. So we decide not to include them in the sample. Finally, the HRS only asks who is the final decision-maker within the household in its initial wave in year 1992, which is much earlier than the period we focus on. As a result, we exclude this variable from our estimation.

We perform a maximum likelihood estimation and report our estimated parameters and goodness of model fit in Appendix F.2. We then use the estimated model to quantify the distribution of bargaining power between husband and wife and report the results in Table 13. For an average household, the husband's bargaining weight is 61%, greater than the weight in Australia (59%) but smaller than the weight in Germany (68%).

Comparing across Australia, Germany, and the US, Table 13 shows that the gender effect is most pronounced in Germany, consistent with Germany having the most traditional gender norms out of the three countries (Ke 2018). Although the US has the most egalitarian gender norms, the HRS sample over-samples the older population, which may explain the larger gender effect than Australia. Therefore, the gender effects we estimate are roughly consistent with country-specific gender norms.

7 Conclusion

In this paper, we develop a household portfolio choice model allowing for a dissection of the intrahousehold bargaining process. The model recognizes the fact that each spouse in a couple may

[32]The total household wealth has nine components: primary residence; real estate (not the primary residence); vehicles; business; stocks, mutual funds, and investment trusts; checking, savings, or money market accounts; CD, government savings bonds, and T-bills; bonds and bond funds; all other savings. Stock market participation is constructed as a dummy variable based on the following question: "Do you [or your (husband/wife/partner)] have any shares of stock or stock mutual funds?"

have a different amount of influence over the household's financial decisions and aims to uncover how this process works. We structurally estimate the model using longitudinal surveys from three countries: Australia, the US, and Germany. We find substantial gender gaps in bargaining power in all three countries.

We find that the average Australian household incorporates 59% of the husband's preference but only 41% of the wife's, implying an 18 percentage points gap in bargaining power. Half of this gender gap is driven by observable characteristics, such as income and employment, while the other half of it can be traced back to a gender effect. Cross-sectionally, the gender effect is stronger in husband-headed households and weaker in households with more progressive views of gender norms. In the other two countries, the average bargaining power for husbands is 68% in Germany and 61% in the US.

There are several limitations to note about the current paper. First, our portfolio choice model is static, and future models can be extended to a dynamic model. This type of extension can also allow for bargaining over time preference. Second, bargaining in our model happens over risk preferences, but in theory, household members can bargain along other dimensions such as expectations. Third, we assume full commitment in our model, and future work can allow for limited commitment to examine other determinants of bargaining power once spouses can be threatened with divorce.

References

Addoum, J. M. (2017). Household portfolio choice and retirement. *Review of Economics and Statistics*, 99(5):870–883.

Akerlof, G. A. and Kranton, R. E. (2000). Economics and identity. *The quarterly journal of economics*, 115(3):715–753.

Alan, S. (2006). Entry costs and stock market participation over the life cycle. *Review of Economic Dynamics*, 9(4):588–611.

Attanasio, O. P. and Lechene, V. (2014). Efficient responses to targeted cash transfers. *Journal of Political Economy*, 122(1):178–222.

Badarinza, C., Campbell, J. Y., and Ramadorai, T. (2016). International Comparative Household Finance. *Annual Review of Economics*, 8:111–144.

Barber, B. M. and Odean, T. (2001). Boys will be boys: Gender, overconfidence, and common stock investment. *Quarterly Journal of Economics*, 116(1):261–292.

Barsky, R. B., Juster, F. T., Kimball, M. S., and Shapiro, M. D. (1997). Preference Parameters and Behavioral Heterogeneity: An Experimental Approach in the Health and Retirement Study. *Quarterly Journal of Economics*, 112(2):537–579.

Beauchamp, J. P., Cesarini, D., and Johannesson, M. (2017). The psychometric and empirical properties of measures of risk preferences. *Journal of Risk and Uncertainty*, 54(3):203–237.

Becker, G. S. (1985). Human capital, effort, and the sexual division of labor. *Journal of labor economics*, 3(1, Part 2):S33–S58.

Becker, G. S. and Murphy, K. M. (1992). The division of labor, coordination costs, and knowledge. *The Quarterly journal of economics*, 107(4):1137–1160.

Berndt, E. R., Hall, B. H., Hall, R. E., and Hausman, J. A. (1974). Estimation and inference in nonlinear structural models. In *Annals of Economic and Social Measurement, Volume 3, number 4*, pages 653–665. NBER.

Bertocchi, G., Brunetti, M., and Torricelli, C. (2014). Who holds the purse strings within the household? The determinants of intra-family decision making. *Journal of Economic Behavior and Organization*, 101:65–86.

Bertrand, M., Kamenica, E., and Pan, J. (2015). Gender identity and relative income within households. *Quarterly Journal of Economics*, 130(2):571–614.

Bertrand, M. and Mullainathan, S. (2001). Do people mean what they say? Implications for subjective survey data. *American Economic Review*, 91(2):67–72.

Borghans, L., Duckworth, A. L., Heckman, J. J., and ter Weel, B. (2008). The economics and psychology of personality traits. *Journal of Human Resources*, 43(4):972–1059.

Bourguignon, F., Browning, M., and Chiappori, P.-A. (2009). Efficient intra-household allocations and distribution factors: Implications and identification. *Review of Economic Studies*, 76(2):503–528.

Breunig, C., Huck, S., Schmidt, T., and Weizsäcker, G. (2021). The Standard Portfolio Choice Problem in Germany. *The Economic Journal*.

Browning, M., Bourguignon, F., Chiappori, P.-A., and Lechene, V. (1994). Income and outcomes: A structural model of intrahousehold allocation. *Journal of Political Economy*, 102(6):1067–1096.

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

Chiappori, P.-A. (1988). Nash-bargained households decisions: a comment. *International Economic Review*, 29(4):791–796.

Chiappori, P.-A. (1992). Collective labor supply and welfare. *Journal of Political Economy*, 100(3):437–467.

Chiappori, P.-A. and Lewbel, A. (2015). Gary Becker's a theory of the allocation of time. *Economic Journal*, 125(583):410–442.

Chiappori, P.-A. and Mazzocco, M. (2017). Static and intertemporal household decisions. *Journal of Economic Literature*, 55(3):985–1045.

Chiappori, P.-A. and Others (1988). Rational household labor supply. *Econometrica*, 56(1):63–90.

Costa Jr, P. T. and McCrae, R. R. (1990). Personality disorders and the five-factor model of personality. *Journal of Personality Disorders*, 4(4):362–371.

Dohmen, T., Falk, A., Huffman, D., and Sunde, U. (2012). The intergenerational transmission of risk and trust attitudes. *Review of Economic Studies*, 79(2):645–677.

Flinn, C. J., Todd, P. E., and Zhang, W. (2018). Personality traits, intra-household allocation and the gender wage gap. *European Economic Review*, 109:191–220.

Fortin, N. M. (2005). Gender role attitudes and the labour-market outcomes of women across oecd countries. *oxford review of Economic Policy*, 21(3):416–438.

Friedberg, L. and Webb, A. (2006). Determinants and Consequences of Bargaining Power in Households. *Working Paper*.

Goldsmith-Pinkham, P. and Shue, K. (2020). The gender gap in housing returns. Technical report, National Bureau of Economic Research.

Gomes, F., Haliassos, M., and Ramadorai, T. (2021). Household finance. *Journal of Economic Literature*, 59(3):919–1000.

Gomes, F. and Michaelides, A. (2005). Optimal life-cycle asset allocation: Understanding the empirical evidence. *Journal of Finance*, 60(2):869–904.

Grable, J. E. and Lytton, R. H. (2001). Assessing the concurrent validity of the SCF risk tolerance question. *Journal of Financial Counseling and Planning*, 12(2):43.

Gröbel, S. and Ihle, D. (2018). Saving Behavior and Housing Wealth Evidence from German Micro Data. *Jahrbücher für Nationalökonomie und Statistik*, 238(6):501–539.

Hanna, S. D. and Lindamood, S. (2004). An improved measure of risk aversion. *Journal of Financial Counseling and Planning*, 15(2):27–45.

Heckman, J. and Singer, B. (1984). A method for minimizing the impact of distributional assumptions in econometric models for duration data. *Econometrica*, pages 271–320.

Jiang, Z., Peng, C., and Yan, H. (2022). Personality Differences and Investment Decision-Making. *Working paper*.

John, O. P. and Srivastava, S. (1999). The big five trait taxonomy: History, measurement, and theoretical perspectives. *Handbook of Personality: Theory and Research*, 2:102–138.

Johnston, D. W., Kassenboehmer, S. C., and Shields, M. A. (2016). Financial decision-making in the household: Exploring the importance of survey respondent, health, cognitive ability and personality. *Journal of Economic Behavior and Organization*, 132:42–61.

Ke, D. (2018). Cross-country differences in household stock market participation: The role of gender norms. In *AEA Papers and Proceedings*, volume 108, pages 159–162.

Ke, D. (2021). Who Wears the Pants? Gender Identity Norms and Intra-Household Financial Decision Making. *Journal of Finance*, 76(3):1389–1425.

Kim, O. (2021). Credit and the family: The economic consequences of closing the credit gap of us couples. *Working paper*.

Kimball, M. S., Sahm, C. R., and Shapiro, M. D. (2008). Imputing Risk Tolerance From Survey Responses. *Journal of the American Statistical Association*, 103(483):1028–1038.

Losoncz, I. (2009). Personality traits in Hilda. *Australian Social Policy No. 8*, page 169.

Love, D. A. (2010). The effects of marital status and children on savings and portfolio choice. *Review of Financial Studies*, 23(1):385–432.

Manser, M. and Brown, M. (1980). Marriage and household decision-making: A bargaining analysis. *International Economic Review*, pages 31–44.

Mazzocco, M. (2004). Saving, risk sharing, and preferences for risk. *American Economic Review*, 94(4):1169–1182.

McCrae, R. R. and John, O. P. (1992). An introduction to the five-factor model and its applications. *Journal of Personality*, 60(2):175–215.

McElroy, M. B. and Horney, M. J. (1981). Nash-bargained household decisions: Toward a generalization of the theory of demand. *International Economic Review*, pages 333–349.

Merton, R. C. (1969). Lifetime portfolio selection under uncertainty: The continuous-time case. *The Review of Economics and Statistics*, pages 247–257.

Merton, R. C. (1971). Optimum consumption and portfolio rules in a continuous-time model. *Journal of Economic Theory*, 3(4):373–413.

Mroz, T. A. (1999). Discrete factor approximations in simultaneous equation models: Estimating the impact of a dummy endogenous variable on a continuous outcome. *Journal of Econometrics*, 92(2):233–274.

Olafsson, A. and Thornquist, T. (2018). Bargaining over Risk: The Impact of Decision Power on Household Portfolios. *Working Paper*.

Pojanavatee, S. (2013). *An analysis of Australian mutual fund performance and market relationships*. PhD thesis, Curtin University.

Pollak, R. A. (2005). Bargaining power in marriage: Earnings, wage rates and household production. Technical report, National Bureau of Economic Research.

Pollak, R. A. (2011). Allocating time: Individuals' technologies, household technology, perfect substitutes, and specialization. Technical report, National Bureau of Economic Research.

Powell, M. and Ansic, D. (1997). Gender differences in risk behaviour in financial decision-making: An experimental analysis. *Journal of Economic Psychology*, 18(6):605–628.

Serra-Garcia, M. (2021). Risk Attitudes and Conflict in the Household. *Working paper*.

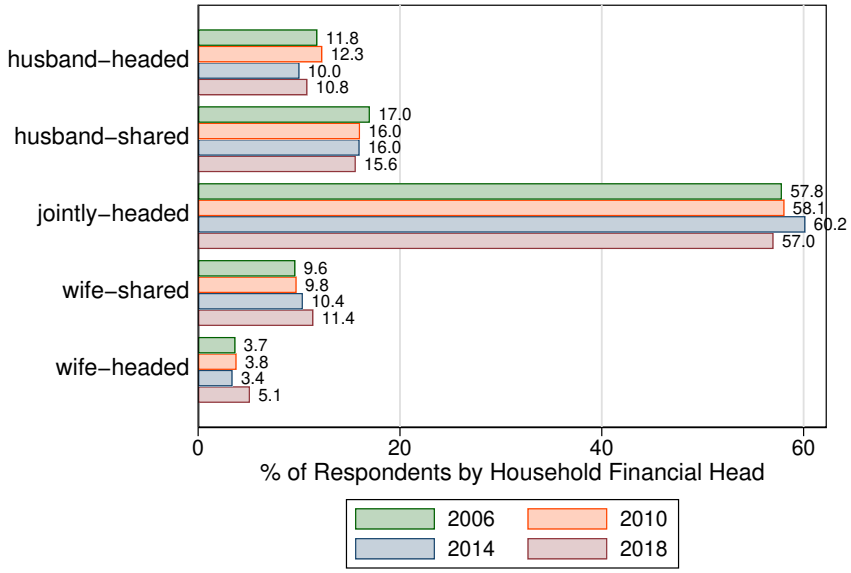
Vissing-Jørgensen, A. (2002). Limited asset market participation and the elasticity of intertemporal substitution. *Journal of Political Economy*, 110(4):825–853.

Vissing-Jorgensen, A. (2003). Perspectives on behavioral finance: Does" irrationality" disappear with wealth? Evidence from expectations and actions. *NBER Macroeconomics Annual*, 18:139–194.

Yilmazer, T. and Lich, S. (2015). Portfolio choice and risk attitudes: a household bargaining approach. *Review of Economics of the Household*, 13(2):219–241.

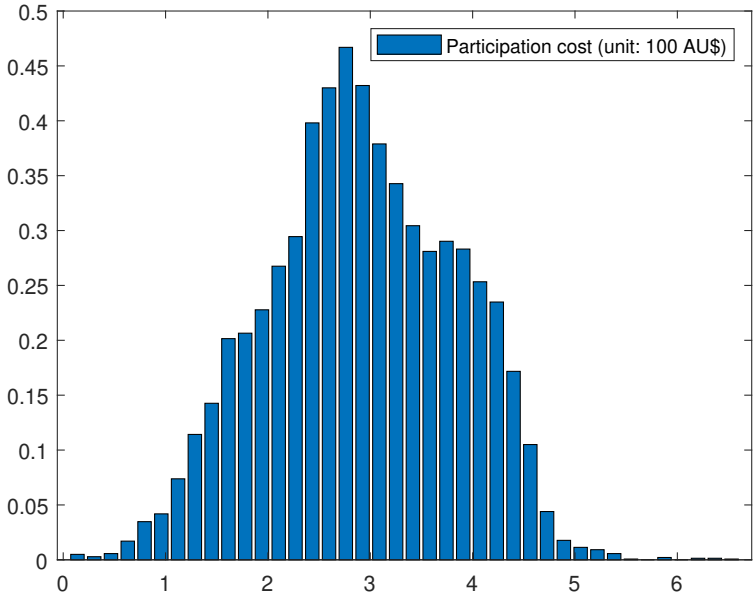
Zaccaria, L. and Guiso, L. (2020). From Patriarchy to Partnership: Gender Equality and Household Finance. *Available at SSRN 3652376*.

Figure 1: Distribution of the financial head of the household by years



Note: This figure shows the distribution of five household types by four different years (2006, 2010, 2014, 2018). The five types of households are "husband-headed," in which both spouses report the husband makes financial decisions; "jointly headed," in which both husband and wife report that financial decisions are shared equally between the spouses; "wife-headed," in which both spouses report the wife makes financial decisions; "husband-shared," in which one spouse reports "husband" and the other reports "shared equally"; and "wife-shared," in which one spouse reports "wife" and the other reports "shared equally."

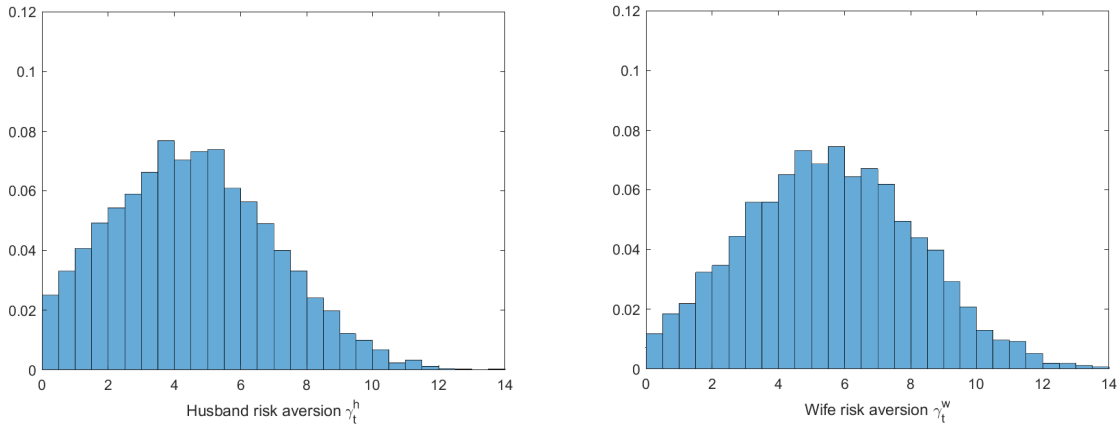
Figure 2: Distribution of participation cost (unit: 1000 AU$)



Note: The figure shows the histogram of participation costs for each household. The x-axis represents the participation costs (unit: AU$1000). The y-axis represents density. The participation costs are defined in equation (3).

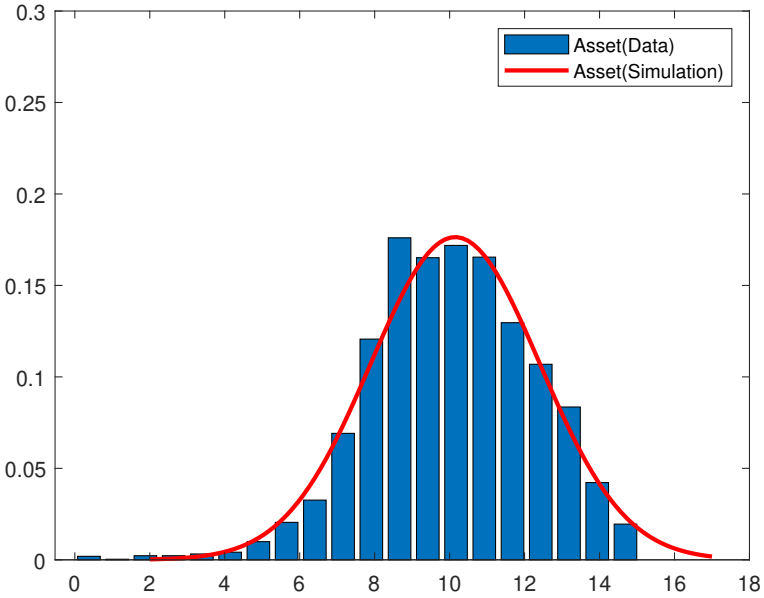
Figure 3: Distribution of risk aversion

(a) Husband risk aversion, γ_t^h (b) Wife risk aversion, γ_t^w



Note: This figure plots the distribution of the estimated risk aversion for both husbands (left panel) and wives (right panel) as a histogram. The x-axis represents the value of risk aversion. It is nonnegative, and a larger value means greater risk aversion. The y-axis represents density.

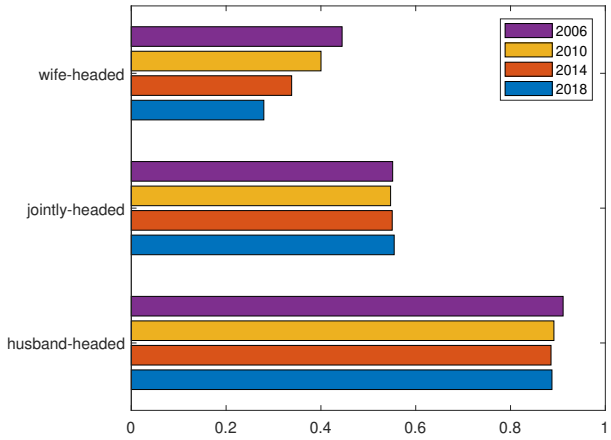
Figure 4: Distribution of the risky asset, $\log(a)$



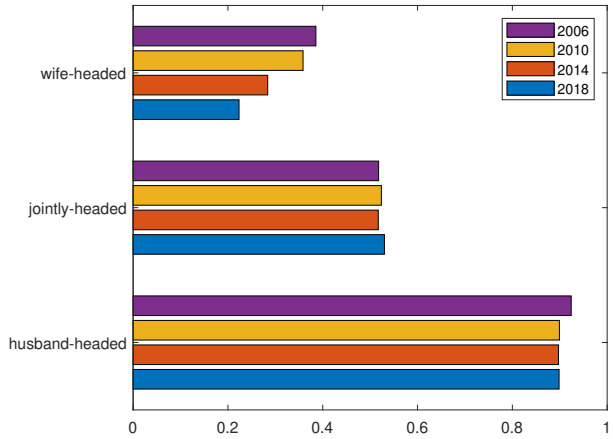
Note: This figure plots the distribution implied by the model (in red line) against the empirical distribution (in blue histogram). The x-axis represents the log value of the risky asset. The y-axis represents density. The asset value is top-coded in the HILDA Survey data by substituting the average value for all cases equal to or exceeding a given threshold. This approach explains the abnormally high value at the right end of the histogram distribution.

Figure 5: Husband's bargaining power, by financial head structure

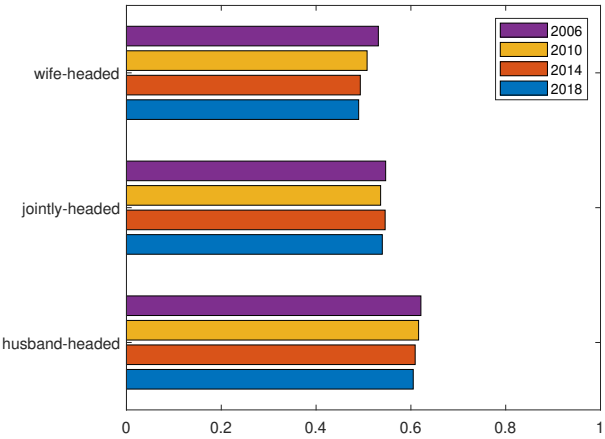
(a) Both gender effects and observed characteristics



(b) Gender effects only



(c) Observed characteristics only



Note: The figure plots the average bargaining power a husband has across household head types. "Husband-headed" represents the group in which both spouses report the husband makes financial decisions; "jointly headed" represents the group in which both husband and wife report that financial decisions are "shared equally" between spouses; and "wife-headed" represents the group in which both spouses report the wife makes financial decisions. Figure 5a plots, for each household type in any given wave, the average bargaining power a husband has in the baseline model. Figure 5b reports the simulated average husband bargaining weight when we retain gender effects, and Figure 5c reports the simulated average husband bargaining weight when we retain the heterogeneity from the observed characteristics.

Table 1: Variable availability in each wave of the HILDA Survey

Variables	Wave number			
Asset allocation information	6	10	14	18
Demographics	6	10	14	18
Financial head of the household	6	10	14	18
Personality traits	5	9	13	17
Risk aversion	6	10	14	18
Cognitive ability	12, 16	12, 16	12, 16	12, 16

Note: This table reports the wave numbers for each set of variables we use in the empirical analysis. Our main sample is constructed based on four waves: 6, 10, 14, and 18. Each row reports the waves that the particular variable is collected from. For cognitive ability, we use the average value from waves 12 and 16.

Table 2: Summary statistics

	Mean	SD	P25	P50	P75	Husband	Wife	Diff
Household characteristics								
Stock participation	0.48	0.50	0	0	1			
Household earnings (AU$1,000)	120	107	53	105	160			
Total wealth (AU$1,000)	1,423	1,562	565	979	1,704			
Financial asset (AU$1,000)	504	804	100	243	572			
Equity (AU$1,000)	74	299	0	0	20			
Number of children	0.84	1.10	0	0	2			
Individual characteristics								
Age	49.38	15.02	37	49	61	50.57	48.20	2.36***
Education	13.04	2.55	12	12	15	13.09	12.99	0.10**
Employment	0.64	0.48	0	1	1	0.69	0.60	0.08***
Earnings (AU$1,000)	48	59	0	37	74	62	33	29***
Risk aversion	3.30	0.67	3	3	4	3.18	3.42	-0.24***
Cognitive ability	0.10	0.67	-0.33	0.12	0.58	0.05	0.16	-0.11***
Extraversion	4.42	1.09	3.67	4.50	5.17	4.29	4.55	-0.26***
Agreeableness	5.43	0.86	5.00	5.50	6.00	5.19	5.66	-0.47***
Conscientiousness	5.27	0.97	4.67	5.33	6.00	5.17	5.36	-0.19***
Stability	5.28	1.03	4.50	5.33	6.00	5.27	5.28	-0.02
Openness	4.21	1.00	3.50	4.17	4.83	4.27	4.15	0.12***

Note: This table reports summary statistics of our main sample. Stock participation is a dummy variable that indicates whether a household directly holds any equities. Both age and education are measured in years. Employment is a dummy variable indicating whether or not an individual is currently employed. Risk aversion is measured using an integer from 1 to 4, with a higher number indicating more risk aversion. Cognitive ability is measured by the average of the standardized scores of three tests (see Section A.2 of the Online Appendix for more details). Extraversion, Agreeableness, Conscientiousness, Stability, and Openness are based on 36 personality questions, the values of which range from 1 to 7 (see Section A.3 of the Online Appendix for more details). US$1 $\approx$ AU$1.2. Levels of significance are denoted as follows: * if $p < 0.10$; ** if $p < 0.05$; *** if $p < 0.01$.

Table 3: Percentage of households by the risk preference of each spouse

		Wife				
		1	2	3	4	Total
Husband	1	0.1	0.4	0.8	0.7	2.0
	2	0.2	1.8	6.4	3.0	11.4
	3	0.3	2.1	30.6	20.5	53.5
	4	0.2	0.5	8.3	24.1	33.1
	Total	0.8	4.9	46.1	48.2	100.0

Note: This table shows the distribution of husband-wife-paired risk aversions. Risk aversion is measured using an integer from 1 to 4, where a higher number indicates a higher level of risk aversion. Each cell reports the fraction of households with a given pair of risk preferences. The off-diagonal terms represent the cases in which the husband and the wife have different risk preferences.

Table 4: OLS regression of the stock market participation rate on risk preferences

	Couples		Singles	
	(1)	(2)	(3)	(4)
Risk aversion	-0.109***	-0.078***	-0.132***	-0.103***
	(0.008)	(0.008)	(0.014)	(0.013)
Risk aversion (wife)	-0.129***	-0.092***		
	(0.009)	(0.009)		
Age/10		-0.078*		-0.029
		(0.045)		(0.024)
Age/10, squared		0.008**		0.007**
		(0.004)		(0.003)
Age/10 (wife)		0.023		
		(0.045)		
Age/10 (wife), squared		0.003		
		(0.004)		
Education		0.006***		0.014***
		(0.002)		(0.003)
Education (wife)		-0.000		
		(0.002)		
No. children in HH		-0.002		-0.011
		(0.005)		(0.008)
Log HH earning		0.043***		0.029***
		(0.007)		(0.009)
Log HH earning, squared		-0.001**		-0.002**
		(0.001)		(0.001)
Log net wealth		-0.065*		-0.114***
		(0.036)		(0.013)
Log net wealth, squared		0.006***		0.009***
		(0.001)		(0.001)
2010		-0.061***		-0.029
		(0.016)		(0.022)
2014		-0.156***		-0.060***
		(0.015)		(0.020)
2018		-0.196***		-0.079***
		(0.015)		(0.020)
Female			0.037	-0.123*
			(0.084)	(0.073)
Female_RiskAversion			-0.022	0.027
			(0.023)	(0.020)
Constant	1.269***	0.458**	0.726***	0.555***
	(0.033)	(0.228)	(0.050)	(0.090)
Observations	8600	8600	3213	3213
R^2	0.066	0.203	0.061	0.251

Note: This table analyzes the impact of risk aversion on stock market participation. This regression excludes households with negative net wealth. As a result, the number of observations drop from 8,708 to 8,600. The dependent variable is a dummy equal to one if the household directly holds any equities. *Risk aversion* is measured using an integer from 1 to 4, with a higher number indicating more risk aversion. *No. children in HH* is the number of children in the household. Columns (1) and (2) concern the regressions on married couple households. Columns (3) and (4) repeat the analysis for single households. In these two columns, *Female* is a dummy equal to one if the individual is a female. *Female_RiskAversion* is an interaction term between Female and measures of risk aversion. Robust standard errors are in parentheses. Levels of significance are denoted as follows: * if $p < 0.10$; ** if $p < 0.05$; *** if $p < 0.01$.

Table 5: Household characteristics by financial head

	Husband-headed				Jointly headed				Wife-headed			
	All	Husband	Wife	Diff.	All	Husband	Wife	Diff.	All	Husband	Wife	Diff.
Individual characteristics												
Age	50.12	51.42	48.81	2.60***	49.94	51.10	48.79	2.31***	48.28	49.59	46.97	2.63*
Education	13.66	14.04	13.29	0.75***	12.89	12.92	12.86	0.06	12.75	12.30	13.21	-0.91***
Employment	0.58	0.68	0.49	0.19***	0.64	0.68	0.61	0.07***	0.63	0.65	0.61	0.03
Earnings (AU$1,000)	53	82	25	57***	45	58	33	25***	44	47	42	5
Risk aversion	3.09	2.84	3.35	-0.52***	3.34	3.25	3.44	-0.19***	3.35	3.37	3.32	0.05
Cognitive ability	0.20	0.26	0.14	0.12***	0.06	-0.01	0.13	-0.15***	0.13	-0.05	0.30	-0.35***
Extraversion	4.30	4.16	4.45	-0.29***	4.43	4.33	4.53	-0.20***	4.50	4.37	4.62	-0.25**
Agreeableness	5.36	5.04	5.69	-0.65***	5.46	5.24	5.68	-0.44***	5.35	5.12	5.57	-0.44***
Conscientious.	5.26	5.32	5.20	0.12**	5.30	5.19	5.41	-0.22***	5.10	4.77	5.42	-0.65***
Stability	5.18	5.25	5.11	0.14**	5.33	5.31	5.34	-0.03	5.18	5.10	5.27	-0.17*
Openness	4.28	4.39	4.18	0.21***	4.18	4.24	4.13	0.11***	4.27	4.24	4.30	-0.06
Household characteristics												
Stock participation	0.64				0.45				0.42			
HH earnings (AU$1,000)	145				110				110			
Total wealth (AU$1,000)	2,144				1,284				1,300			
Financial asset (AU$1,000)	883				442				426			
Equity (AU$1,000)	204				46				101			
No. children in HH	0.97				0.79				0.89			

Note: This table reports household characteristics by the three types of financial heads of the household. The financial head of the household is measured based on the answers to the question of who makes the decisions about the savings, investment and borrowing in the household. The three types of households shown here are "husband-headed," in which both spouses report the husband makes financial decisions; "jointly headed," in which both husband and wife report that financial decisions are shared equally between spouses; and "wife-headed," in which both spouses report the wife makes financial decisions. US$1 $\approx$ AU$1.2. Levels of significance are denoted as follows: * if $p < 0.10$; ** if $p < 0.05$; *** if $p < 0.01$.

Table 6: Model estimates for spousal differences in observed characteristics in the bargaining equation

Characteristic	Value	SE	$\Delta\beta$
	(1)	(2)	(3)
$Age/10$	0.263	0.126	0.33%
Education	0.416	0.076	3.05%
Employment	0.452	0.073	6.49%
Earning	0.080	0.009	11.64%
Cognitive ability	0.160	0.020	6.06%
Extraversion	-0.155	0.016	-8.88%
Agreeableness	-0.120	0.015	-6.26%
Conscientiousness	0.053	0.010	2.80%
Stability	-0.049	0.010	-2.35%
Openness	0.046	0.010	2.22%

Note: This table reports the estimates for the spousal difference in observed characteristics in the bargaining equation. Each characteristic is defined as the value difference between the paired husband and wife. Column 1 reports the coefficients, and column 2 reports the standard errors. Column 3 shows, for each characteristic, the change in bargaining weight from the baseline level (50%) when that characteristic increases by one-standard-deviation.

Table 7: Model estimates for gender effects in the bargaining equation

	Period t			
	2006	2010	2014	2018
husband-headed	2.500	2.189	2.167	2.181
	(0.057)	(0.009)	(0.033)	(0.060)
husband-shared	0.803	0.508	0.517	0.610
	(0.059)	(0.048)	(0.024)	(0.000)
jointly headed	0.071	0.095	0.069	0.121
	(0.026)	(0.552)	(2.646)	(3.540)
wife-shared	-0.035	-0.174	-0.665	-0.630
	(1.789)	(2.742)	(0.380)	(0.229)
wife-headed	-0.466	-0.582	-0.925	-1.246
	(0.202)	(0.617)	(0.841)	(0.869)

Note: This table reports the estimates for gender effects in the bargaining equation. Each coefficient represents one of the five household types based on the identity of the financial head in each of the four waves (2006, 2010, 2014, 2018). The financial head of the household is measured based on the answers to the question regarding who makes the decisions about the savings, investment and borrowing in the household. The five types of households are "husband-headed," in which both spouses report the husband makes such decisions; "jointly headed," in which both husband and wife report that such decisions are shared equally between spouses; "wife-headed," in which both spouses report the wife makes such decisions; "husband-shared," in which one spouse reports "husband" and the other reports "shared equally"; and "wife-shared," in which one spouse reports "wife" and the other reports "shared equally."

Table 8: Model estimates for the rest of the parameters in the bargaining equation

Parameter	Value	SE	Parameter	Value	SE
Participation cost (AU$100)			*Risk measure equation*		
c_0(Intercept)	4.761	0.109	σ_ξ	2.623	0.057
c_1(log HH earning)	-0.020	0.003	ρ_ξ	-0.975	0.009
c_2(log HH earning, squared)	-1.069	0.055	ζ_0	0.735	0.033
c_3(log net wealth)	0.014	0.003	ζ_1^h	3.098	0.060
c_4(log net wealth, squared)	0.000	0.000	ζ_1^f	3.893	0.059
c_5(Age/10)	-0.017	0.002			
c_6(Age/10, squared)	0.000	0.000	*General parameters*		
c_7(Education)	0.023	0.004	σ_ε	0.641	0.048
c_8(Cognition)	-0.196	0.023	σ_a	2.111	0.024
c_9(No. children in HH)	0.153	0.020	r_x	0.060	-
c_{10}(2010)	0.387	0.062	σ_x	0.135	-
c_{11}(2014)	1.281	0.084			
c_{12}(2018)	14.953	0.869			

Note: This table reports estimates for the rest of the parameters in the bargaining equation. The left panel reports all the coefficients from the participation cost function. The upper-right panel reports the coefficients associated with the risk attitude measurement equation. The lower-right panel reports the other parameters: σ_ε is the standard deviation of the residual term in the bargaining equation; σ_a is the standard deviation of the measurement error term for the log asset; and r_x and σ_x are the mean and variance of the risk premium. Values of r_x and σ_x are preset following Pojanavatee (2013).

Table 9: Marginal distributions of portfolio choices

	Stock market participation		Risky asset (log value)	
	Sim	Data	Sim	Data
By the financial head of the household				
Husband-headed	0.653	0.648	10.60	11.03
Husband-shared	0.533	0.540	10.19	10.24
Jointly headed	0.463	0.449	10.04	9.74
Wife-shared	0.431	0.424	10.02	9.53
Wife-headed	0.462	0.424	10.15	9.92
By husband's risk preference				
Risk-taking	0.569	0.560	10.28	10.24
Risk-averse	0.336	0.325	9.71	9.17
By wife's risk preference				
Risk-taking	0.605	0.591	10.35	10.31
Risk-averse	0.370	0.365	9.81	9.48

Note: This table compares the conditional moments from the model simulation with those from the real data. The first two columns concern stock market participation, and the last two concern the level of risky asset holdings. We simulate bargaining weights and financial decisions for each household. In the upper panel, we average these outcomes by the household head types. In the middle panel, we average the metrics by the husband's risk preference. "Risk-taking" includes the households in which husbands report their values of risk aversion to be between 1 to 3. "'Risk-averse" includes the households in which husbands report their risk aversion as 4. In the bottom panel, we average the metrics by the wife's risk preference. "Risk-taking" includes the households in which wives report their values of risk aversion to be between 1 to 3. "'Risk-averse" includes the households in which wives report their risk aversion as 4.

Table 10: Source of bargaining power heterogeneity

	Bargaining weight (β_t^H)		Stock	Risky asset
	Mean	SD	participation	(log values)
	(1)	(2)	(3)	(4)
Equal weight ($\beta = 0.5$)	0.500	0.000	0.429	9.96
All heterogeneity	0.587	0.275	0.495	10.15
Gender effects (δ_{jt}^H)	0.561	0.147	0.448	10.02
All observed variables (δ_x)	0.552	0.174	0.455	10.00
Age	0.523	0.042	0.432	9.96
Education	0.515	0.358	0.526	10.43
Employment	0.541	0.256	0.491	10.64
Earning	0.550	0.218	0.469	10.09
Cognitive ability	0.481	0.130	0.440	9.98
Extraversion	0.467	0.193	0.445	10.01
Agreeableness	0.485	0.036	0.428	9.96
Conscientiousness	0.490	0.073	0.429	9.96
Stability	0.501	0.064	0.430	9.96
Openness	0.495	0.050	0.431	9.96

Note: This table quantifies the importance of various components of the model in explaining the distribution of bargaining power between husband and wife. Our method is as follows: we change one particular component each time in the bargaining equation and simulate the bargaining weight and financial decisions (stock market participation and the level of risky asset holdings) for each household. Columns 1 and 2 report the mean and standard deviation of the simulated bargaining weights. Columns 3 and 4 report the average stock market participation and average risky asset holdings. The first line presents the benchmark case, in which spouses have an equal say about financial decisions with the bargaining power of $\beta = 0.5$ in our model. The next line presents the full heterogeneity case in which we consider both gender effects and spousal differences in observable characteristics. The next two lines present the cases in which we consider only gender effects and only spousal differences in observable characteristics. The rest of the table reports the importance of each variable one by one.

Table 11: Gender norms and bargaining weights

	Bargaining weight of husbands with gender effect only		Husband-headed
	(1)	(2)	(3)
	Only gender norms	With controls	With controls
Division of labor (husband)	0.001	0.004**	0.006***
	(0.002)	(0.002)	(0.002)
Share housework (husband)	0.010***	0.006***	0.009***
	(0.003)	(0.002)	(0.002)
Mother's role (husband)	-0.003	0.001	0.010***
	(0.002)	(0.002)	(0.003)
Division of labor (wife)	0.010***	0.005***	-0.001
	(0.002)	(0.002)	(0.003)
Share housework (wife)	-0.005*	-0.001	0.002
	(0.003)	(0.002)	(0.002)
Mother's role (wife)	0.006***	0.001	0.007***
	(0.002)	(0.002)	(0.002)
Observations	7,741	7,741	7,741

Note: This table analyzes the impact of gender norms on bargaining weights. Attitudes about gender norms are measured by three questions that elicit participants' attitudes toward the division of labor, the share of housework in the family, and the mother's role. Answers to each question are measured on a seven-point Likert scale from 1 (strongly disagree) to 7 (strongly agree). We recode all variables so that a higher value represents a more traditional view of gender norms (see Section A.5 of the Online Appendix for more details). The dependent variable in columns 1 and 2 is the simulated bargaining weight when we only allow the gender effect in the bargaining equation, which is the same as the one shown in Figure 5a. Column 1 is a simple OLS regression of this simulated bargaining weight of husbands on both husbands' and wives' gender norm questions. Column 2 has extra controls, including age, income, employment, education, cognitive ability, and personality traits. Column 3 regresses the dummy variable indicating a husband-headed household on perceived gender norms. Robust standard errors are in parentheses. Levels of significance are denoted as follows: * if $p < 0.10$; ** if $p < 0.05$; *** if $p < 0.01$.

Table 12: Correlation between responses to household investment decisions and other household decisions

	Correlation
Domains	Savings, investment and borrowing
(1) Managing day-to-day spending and paying bills	0.53
(2) Making large household purchases	0.52
(3) The number of hours spent in paid work	0.23
(4) The number of hours partner/spouse spent in paid work	0.12
(5) The way children are raised	0.04
(6) Social life and leisure activities.	0.04

Note: This table investigates the correlation between household investment decisions and other household decisions. In addition to asking about household decision-making in "Savings, investment and borrowing," the HILDA Survey also asks about household decision-making along six other domains: (1) managing day-to-day spending and paying bills; (2) making large household purchases (e.g., cars and major appliances); (3) the number of hours spent in paid work; (4) the number of hours partner/spouse spent in paid work; (5) the way children are raised; (6) social life and leisure activities. Respondents are given the following options: themselves, their spouses, shared equally between spouses, or other people. In each domain, we classify all households into five types: "husband-headed," in which both spouses report the husband makes such decisions; "jointly headed," in which both husband and wife report that such decisions are "shared equally" between the spouses; "wife-headed," in which both spouses report the wife makes such decisions; "husband-shared," in which one spouse reports "husband" and the other reports "shared equally"; "wife-shared," in which one spouse reports "wife" and the other reports "shared equally."

Table 13: Comparison of bargaining power heterogeneity between Australia, Germany, and the US

	Australia		Germany		US	
	Bargaining weight (β_t^H)	Stock participation	Bargaining weight (β_t^H)	Stock participation	Bargaining weight (β_t^H)	Stock participation
Equal weight ($\beta = 0.5$)	0.500	0.429	0.500	0.206	0.500	0.352
All heterogeneity	0.587	0.495	0.682	0.279	0.609	0.384
Gender effects (δ_{jt}^H)	0.561	0.448	0.731	0.216	0.622	0.356
All observed variables (δ_x)	0.552	0.455	0.549	0.238	0.582	0.358

Note: This table quantifies the distribution of bargaining power between husband and wife in Australia, Germany, and the US. Our method is as follows: we change one particular component each time in the bargaining equation and simulate the bargaining weight and financial decisions (stock market participation and the level of risky asset holdings) for each household. Columns 1 and 2 report the average bargaining weights and stock market participation rate in Australia. Columns 3 and 4 report the average bargaining weights and market participation rate in Germany. Columns 5 and 6 report the average bargaining weights and market participation rate in the US. The first line presents the benchmark case, in which spouses have an equal say about financial decisions with the bargaining power of $\beta = 0.5$ in our model. The next line presents the full heterogeneous case in which we consider both gender effects and spousal differences in observable characteristics in our baseline full-fledged model. The next two lines present the cases in which we consider only gender effects and only spousal differences in observable characteristics.

For Online Publication

Online Appendix for "The Gender Gap in Household Bargaining Power: A Revealed-Preference Approach"

A Additional details about the HILDA Survey

A.1 Sample construction

Across waves 6, 10, 14, and 18 in the raw sample of married-couple households, we have 17,320 household-wave observations.[33] We follow the below steps and drop observations that do not meet certain criteria:

- We drop households with information missing on risk preference and education; doing so leaves us with a total of 15,277 observations.
- The HILDA Survey measures risk preference by asking individuals the amount of financial risk they are willing to take on with their spare cash. We exclude individuals who answer that they never have spare cash, because we are unclear about how to classify them. This restriction leaves us with 12,406 observations.
- We keep households that make financial decisions between the couple; doing so reduces the number of observations to 11,401.
- We drop households in which both spouses claim to be the financial head of the household, reducing the number of observations to 11,254.
- We restrict our sample to households for which we have information on the personality traits of both partners. This restriction leaves us with 10,071 observations.

[33] At the beginning of the HILDA Survey, 7,682 households were surveyed in the first wave, and another 2,153 households were surveyed in 2011. Waves 6, 10, 14, and 18 have a total of 32,746 household-wave observations, of which 17,320 are married couples.

- We further drop households with information missing on cognitive ability. Our final sample has 8,708 observations.

Table A.1 shows the summary statistics for the raw sample and for our baseline sample.

A.2 Cognitive ability

The survey conducted three tests to measure cognitive ability: (1) the "backward digits span" (BDS) test, (2) a 25-item version of the National Adult Reading Test (NART), and (3) the "symbol-digit modalities" (SDM) test. The BDS test is a traditional subcomponent of intelligence tests and measures working memory span. The interviewer reads out a string of digits that the respondent has to repeat in reverse order. NART is a short version of the National Adult Reading Test that measures premorbid intelligence. Respondents have to read out loud and correctly pronounce 25 irregularly spelled words. The SDM test asks respondents to match symbols to numbers according to a printed key. The test was originally developed to detect cerebral dysfunction but is now a recognized test for divided attention, visual scanning, and motor speed. To derive a summary measure for cognitive ability, we first construct a one-dimensional measure for each of these three tests. Then we standardize these three one-dimensional measures. Finally, we take the mean to construct a single measure of cognitive ability.

A.3 Personality traits

Personality trait measures aim to capture "patterns of thought, feelings and behavior" that correspond to "individual differences in how people actually think, feel and act" (Borghans et al., 2008). The personality trait measurements in this paper are based on the Five-Factor ("Big Five") Personality Inventory, which classifies personality traits along five dimensions: openness to experience, conscientiousness, extraversion, agreeableness, and emotional stability. "Big Five" information in the HILDA Survey is constructed using responses to 36 personality questions. Participants were asked how well each personality adjective describes them, and their answers were measured on a seven-point Likert scale. The lowest number, 1, denotes a totally opposite description, and the highest number, 7, denotes a perfect description. According to Losoncz (2009), only 28 of 36 items load well into their corresponding components when performing factor analysis. The other

eight items are discarded because of either their low loading values or their ambiguity in defining several traits.[34] Our construction of the "Big Five" follows the procedure provided by Losoncz (2009).

A.4 Transition rates of financial heads of the household between waves

Table A.2 presents a transition matrix for the financial heads of the household between waves. Jointly headed households are the most stable households between waves. More than 80% of jointly headed households report the same choice in the following wave compared to about 70% for husband-headed households, about 50% for wife-headed households, and about 40% for husband-shared and wife-shared households.

A.5 Attitudes about gender norms

The survey measures attitudes about gender norms against the following three statements: (1) It is better for everyone involved if the man earns money and the woman takes care of the home and children (*division of labor*). (2) If both partners in a couple work, they should share equally in the housework and care of children (*share housework*). (3) Whatever career a woman may have, her most important role in life is still that of being a mother (*mother's role*). Answers to each question are measured on a seven-point Likert scale from 1 (strongly disagree) to 7 (strongly agree). We recode all variables so that a higher value represents a more traditional view of gender norms. Table A.3 shows changes in measures of gender norms between waves. Husbands have stronger attitudes about traditional gender roles in the division of labor and the share housework, while wives have stronger attitudes about the mother's role. In general, attitudes toward gender norms trend toward becoming less traditional across most of these measures.

We run a simple linear probability model of the financial heads of the household on these three gender norms measures. Table A.4 reports the estimates. We find that both husbands' and wives' attitudes about gender norms matter for financial heads of the household. Households with more traditional attitudes toward gender norms are more likely to select the husband as the financial

[34] To check each item's loading performance, one can calculate the loading value after doing an oblimin rotation. The loading values of eight abandoned items were either lower than 0.45 or did not load more than 1.25 times higher on the expected factor than any other factor.

head, while households with more progressive attitudes about gender norms are more likely to select the wife as the financial head. Among three gender norms measures, the "division of labor" question from the wife and the "share housework" question from the husband are the most informative questions when predicting husband-headed households, while the "share housework" question from the wife is the single most informative question when predicting wife-headed households.

B CARA and mean-variance utility

Assuming a household has constant absolute risk aversion (CARA) utility with the risk aversion parameter, γ_i, the portfolio choice is

$$V_i = \max_a EU_i(a) = \max_a E\left\{-\exp\left\{-\gamma_i\left[w\left(1+r_f\right)+\left(a\tilde{x}-C_i\right)I\left(a>0\right)\right]\right\}\right\},$$

where a is the amount of asset the household chooses to invest in the stock market, and $I(a>0)$ is a dummy variable indicating whether the household invests in the risky asset. Assume the risky return follows a normal distribution, $\tilde{x} \sim N(r_x, \sigma_x^2)$, then the utility is lognormally distributed when the stock asset $a > 0$. Therefore, the portfolio choice problem is equivalent to

$$\begin{aligned}&\min_a \log E\left\{\exp\left\{-\gamma_i\left[w\left(1+r_f\right)+\left(a\tilde{x}-C_i\right)I\left(a>0\right)\right]\right\}\right\}\\ =&\min_a\left\{-\gamma_i\left[w\left(1+r_f\right)+\left(ar_x-C_i-\tfrac{1}{2}\gamma_i a^2\sigma_x^2\right)I\left(a>0\right)\right]\right\}.\end{aligned}$$

Then, we can rewrite the portfolio allocation problem using the mean-variance utility as

$$U_i(a) = \max_a w(1+r_f) + \left(ar_x - C_i - \frac{1}{2}\gamma_i a^2\sigma_x^2\right)I(a>0).$$

Next, we want to prove that the utility function has a collective bargaining expression:

$$V_i = \beta^h V^h + \beta^w V^w, \beta^h + \beta^w = 1.$$

If the utility function of each spouse, $j \in \{h, w\}$, is also mean-variance,

$$U^j(a_j) = \max_{a_j} w_j(1+r_f) + \left(a_j r_x - C_j - \frac{1}{2}\gamma^j a_j^2 \sigma_x^2\right) I(a_j > 0), j \in \{h, w\},$$

where

$$\begin{aligned} C_h \gamma^h &= C_w \gamma^w \\ \tfrac{1}{\gamma_i} &= \tfrac{\beta^h}{\gamma^h} + \tfrac{\beta^w}{\gamma^w}. \end{aligned} \tag{10}$$

We solve the optimization problem for each household member j and get the indirect utility function V^j as

$$V^j = \begin{cases} w_j\left(1+r_f\right) & \gamma^j > \frac{r_x^2}{2\sigma_x^2 C_j} \\ w_j\left(1+r_f\right) + \frac{r_x^2}{2\gamma^j \sigma_x^2} - C_j & \gamma^j \leq \frac{r_x^2}{2\sigma_x^2 C_j}. \end{cases}$$

Given condition $C_h\gamma^h = C_w\gamma^w$, the individual investment decisions of both spouses are the same. If we further assume the household's participation cost is the weighted average of the household members' participation cost,

$$C_i = \beta^h C_h + \beta^w C_w,$$

then the cutoff value of the household's investment decision would be the same as the cutoff values of both individuals' investment decisions,

$$\gamma_i C_i = \gamma^h C_h = \gamma^w C_w,$$

and the indirect utility of the household also can be expressed as the weighted average of the indirect utility of both individuals,

$$V_i = \beta^h V^h + \beta^w V^w.$$

C More details about identification argument

Let us begin by considering the identification of (C, γ) from a group of households who are homogeneous in their characteristics Ω but different in their risk preference $\{\gamma^h, \gamma^w\}$. Among those invested in the stock market, equation (2) suggests a one-to-one mapping from their risky asset

holding a and the household risk aversion γ, i.e., $\gamma = \frac{r_x}{a\sigma_x^2}$. Therefore, their risk aversion γ is uniquely identified from their holdings of risky asset a, denoting as $\{\gamma_1, \gamma_2, ..., \gamma_M\}$, where M is the size of this subset of households participating in the stock market. We next show the participation cost C can be identified from the marginal household with the highest value of risk aversion $\gamma_{max} = \max\{\gamma_1, \gamma_2, ..., \gamma_M\}$.

Denote $\gamma^* = \frac{r_x^2}{2\sigma_x^2 C_i}$ as the threshold risk aversion of stock market participation from equation (2). The density function of γ is right-truncated at γ^*

$$f(\gamma|\gamma \leq \gamma^*) = \frac{f(\gamma)}{F(\gamma^*)}$$

Our identification argument requires $F(\gamma^*) < 1$, which is guaranteed due to the existence of measurement error in the measurement equation for $\{\gamma^h, \gamma^w\}$. The necessary and sufficient condition for all M households participating in the stock market is:

$$\{\gamma_{max} \leq \gamma^*\} := \{\gamma_1 \leq \gamma^*, \gamma_2 \leq \gamma^*, ..., \gamma_M \leq \gamma^*\}$$

γ_{max} therefore has the following density function:

$$q(\gamma_{max}) = M\frac{f(\gamma_{max})}{F(\gamma^*)}\left(\frac{F(\gamma_{max})}{F(\gamma^*)}\right)^{M-1}, \gamma_{max} \leq \gamma^*$$

The limiting distribution of γ_{max} (obtained by letting $M \to \infty$) places point mass at $\gamma_{max} = \gamma^*$.

$$p\lim_{M\to\infty} \gamma_{max} = \gamma^*$$

γ_{max} is a consistent estimator of $\bar{\gamma}$. Once $\bar{\gamma}$ is identified, C is also identified due to the one-to-one mapping $C = \frac{r_x^2}{2\sigma_x^2\gamma^*}$.

Having established the identification of (C, γ), we now turn to the identification of the coefficients $\zeta = \{\zeta_0, \zeta_1^h, \zeta_1^w\}$ in the risk preference measurement equation (7). In particular, taking the first-order derivative of the reciprocal of household risk aversion $1/\gamma$ with respect to the reciprocal

of the husband's measured risk preference $1/\bar{\gamma}^h$, we have

$$\frac{d\left(1/\gamma\right)}{d\left(1/\bar{\gamma}^h\right)} = \beta^h \exp\left(-\left(\zeta_0 + \zeta_1^h \log\bar{\gamma}^h + \xi^h\right)\right)\zeta_1^h \bar{\gamma}^h \tag{11}$$

Taking log on both sides, we have

$$\log\frac{d\left(1/\gamma\right)}{d\left(1/\bar{\gamma}^h\right)} = \log\beta^h + \log\zeta_1^h - \zeta_0 + \left(1-\zeta_1^h\right)\log\bar{\gamma}^h - \xi^h$$

Then, we could identify ζ_1^h from the correlation between $\log\frac{d(1/\gamma)}{d\left(1/\bar{\gamma}^h\right)}$ and $\log\bar{\gamma}^h$. Similarly, to identify ζ_1^w, we take the first order derivative of $1/\gamma$ with respect to the reciprocal of the wife's measured risk preference $1/\bar{\gamma}^w$

$$\frac{d\left(1/\gamma\right)}{d\left(1/\bar{\gamma}^w\right)} = \beta^w \exp\left(-\left(\zeta_0 + \zeta_1^w \log\bar{\gamma}^w + \xi^w\right)\right)\zeta_1^w \bar{\gamma}^w \tag{12}$$

$$\Rightarrow \log\frac{d\left(1/\gamma\right)}{d\left(1/\bar{\gamma}^w\right)} = \log\beta^w + \log(\zeta_1^w) - \zeta_0 + (1-\zeta_1^w)\log\bar{\gamma}^w - \xi^w$$

Then, we can identify ζ_1^w from the correlation between $\log\frac{d(1/\gamma)}{d(1/\bar{\gamma}^w)}$ and $\log\bar{\gamma}^w$. Next, the identification of ζ_0 is based on the constraint $\beta^h + \beta^w = 1$. When we plug equations (11) and (12) into this constraint, we have the following equation:

$$\underbrace{\frac{d\left(1/\gamma\right)}{d\left(1/\bar{\gamma}^h\right)}\frac{\exp(\zeta_0 + \zeta_1^h\log\bar{\gamma}^h + \xi^h)}{\zeta_1^h\bar{\gamma}^h}}_{\beta^h} + \underbrace{\frac{d\left(1/\gamma\right)}{d\left(1/\bar{\gamma}^w\right)}\frac{\exp(\zeta_0 + \zeta_1^w\log\bar{\gamma}^w + \xi^w)}{\zeta_1^w\bar{\gamma}^w}}_{\beta^w} = 1$$

$$\Rightarrow \exp(\zeta_0)\left[\frac{d\left(1/\gamma\right)}{d\left(1/\bar{\gamma}^h\right)}\frac{\exp(\zeta_1^h\log\bar{\gamma}^h + \xi^h)}{\zeta_1^h\bar{\gamma}^h} + \frac{d\left(1/\gamma\right)}{d\left(1/\bar{\gamma}^w\right)}\frac{\exp(\zeta_1^w\log\bar{\gamma}^w + \xi^w)}{\zeta_1^w\bar{\gamma}^w}\right] = 1$$

Taking log on both sides, we identified ζ_0 from the following equation:

$$\zeta_0 = -E_{\xi^h,\xi^w}\left[\log\left(\frac{d\left(1/\gamma\right)}{d\left(1/\bar{\gamma}^h\right)}\frac{\exp(\zeta_1^h\log\bar{\gamma}^h + \xi^h)}{\zeta_1^h\bar{\gamma}^h} + \frac{d\left(1/\gamma\right)}{d\left(1/\bar{\gamma}^w\right)}\frac{(\zeta_1^w\log\bar{\gamma}^w + \xi^w)}{\zeta_1^w\bar{\gamma}^w}\right)\right]$$

where $E_{\xi^h,\xi^w}(.)$ denotes the expectation in terms of the error terms $\{\xi^h,\xi^w\}$.

Once we identify $\zeta = \{\zeta_0,\zeta_1^h,\zeta_1^w\}$, we could calculate the bargaining weights $\{\beta^h,\beta^w\}$ from

equation (11) and (12), respectively.

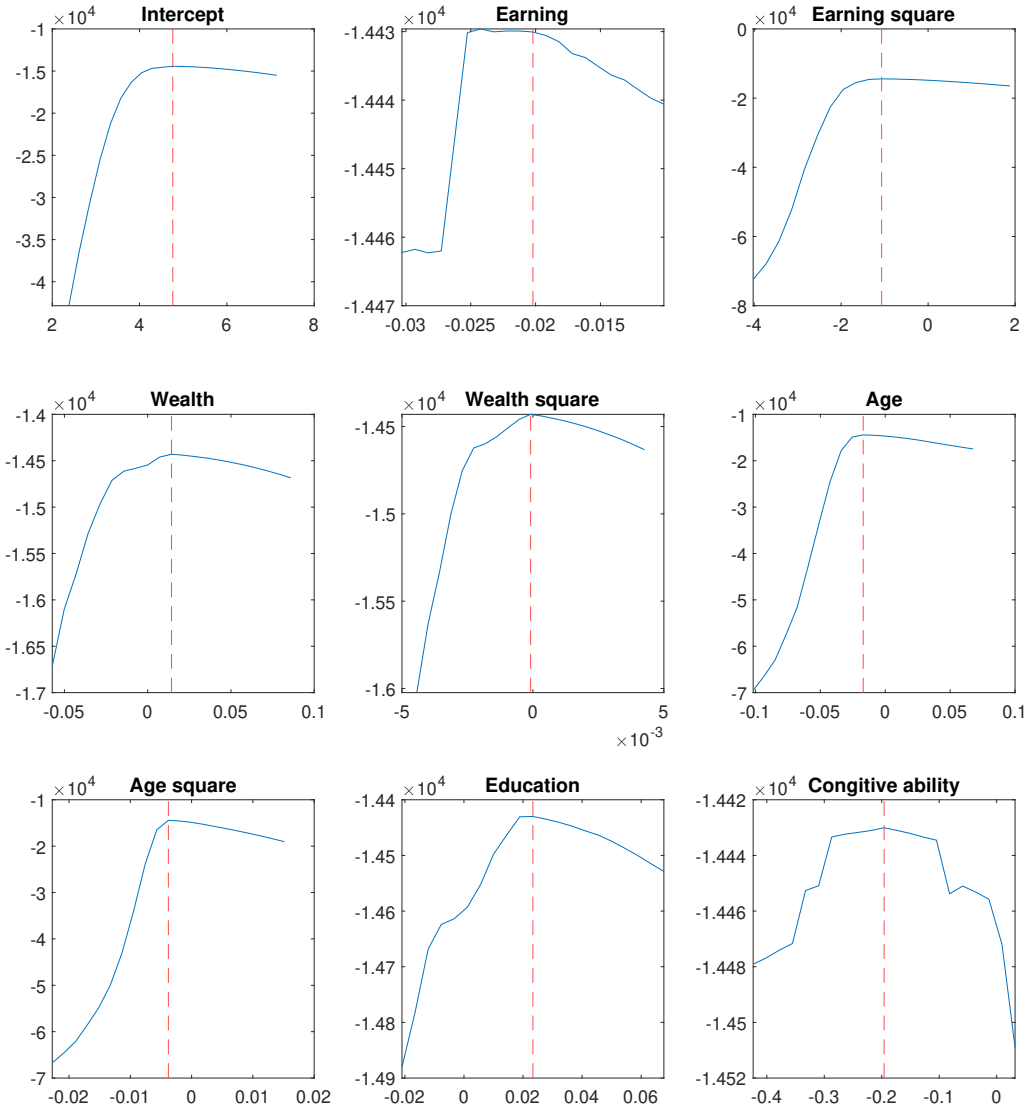
Lastly, we introduce heterogeneity in $\{X^h, X^w, H\}$. We argue that the parameters in the cost function $c = \{c_i\}_{i=0}^{12}$ and the parameters in the bargaining equation $\delta = \{\delta_x, \{\delta_{jt}^H\}_{j=1}^5\}$ are identified by comparing differences in $\{\beta^h, \beta^w, C\}$ between households with different observables $\{X^h, X^w, H\}$. In particular, we have

$$\begin{aligned}
\frac{dC}{dX_c} &= c_x, \forall c_x \in c \\
\frac{d\beta^h}{dX^h} &= (1-\beta^h)\beta^h \delta_x \\
\frac{d\beta^h}{dH} &= (1-\beta^h)\beta^h \delta_j^H
\end{aligned}$$

where X_c is the set of household characteristics entering into the participation cost function. Therefore, the parameters c and δ are non-parametrically identified from the variation of $\{\beta^h, \beta^w, C\}$ across households.

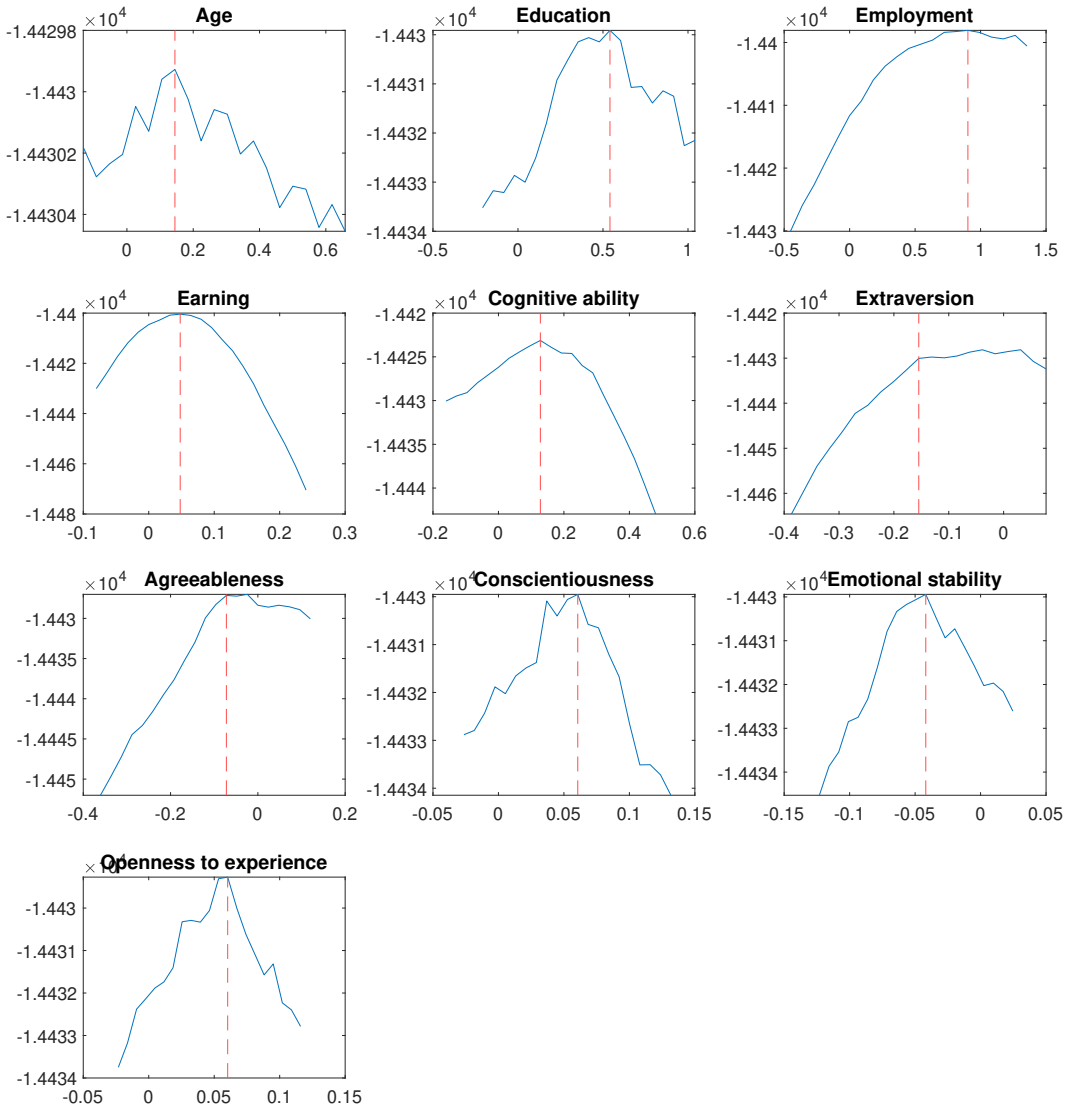
We have established a theoretical identification strategy above. We now empirically test the identification sensitivity by varying each parameter around its estimate, while keeping other parameters unchanged. Changes in likelihood values are shown in Figure (A.1) (when varying the coefficients in the participation cost equation) and Figure (A.2) (when varying the coefficients in the bargaining equation). Both figures confirm a noticeable decrease in log-likelihood as we move away from estimates for all parameters. The optimization of our log-likelihood value is challenging for two reasons. First, our likelihood function is multimodal, meaning that the likelihood function may have many local maxima. This issue is caused by the logistic form of our bargaining equation (2). As a result, most local optimization algorithms (e.g., the Nelder–Mead algorithm) may end up in a local but not global maximum. Second, our likelihood function also is nonsmooth. This is because calculating our likelihood value involves a step of Monte Carlo integration to calculate the empirical probability of participating in the stock market. Therefore, we cannot use gradient-based optimization algorithms (e.g., the Gauss-Newton algorithm) because first-order derivatives are not always available. Therefore, we choose the particle swarm optimizer, a global and derivative-free solver, to address these two challenges. We tried starting the algorithm with different initial values, and the estimated parameters always produced the same results.

Figure A.1: The log-likelihood value when varying coefficients in the participation cost equation (3)



Note: this figure reports the changes in log-likelihood values when varying coefficients in the participation cost equation (3). The dashed red line indicates the model estimates.

Figure A.2: The log-likelihood value when varying coefficients in the bargaining equation (6)



Note: this figure reports the changes in log-likelihood values when varying coefficients in the bargaining equation (6). The dashed red line indicates the model estimates.

D Additional tables and figures

Table A.3: Changes in the measures of gender norms between waves

	2006	2010	2014	2018	All
Division of labor (husband)	3.615	3.584	3.440	3.169	3.419
	(1.827)	(1.781)	(1.776)	(1.811)	(1.807)
Division of labor (wife)	3.173	3.173	3.072	2.727	3.005
	(1.882)	(1.845)	(1.862)	(1.789)	(1.850)
Share housework (husband)	2.265	2.326	2.236	2.182	2.243
	(1.232)	(1.252)	(1.249)	(1.262)	(1.251)
Share housework (wife)	1.792	1.830	1.869	1.767	1.814
	(1.069)	(1.048)	(1.167)	(1.103)	(1.106)
Mother role (husband)	5.172	5.174	5.150	5.152	5.160
	(1.632)	(1.598)	(1.641)	(1.679)	(1.642)
Mother role (wife)	5.539	5.493	5.505	5.451	5.492
	(1.664)	(1.628)	(1.639)	(1.727)	(1.669)
Observations	1488	1573	2277	2403	7741

Note: This table shows changes in the measures of gender norms between waves. Attitudes toward gender norms are measured by three questions that elicit participants' attitudes toward the division of labor, the share of housework in the family, and the mother's role. Answers to each question are measured on a seven-point Likert scale from 1 (strongly disagree) to 7 (strongly agree). We recode all variables so that a higher value represents a more traditional view of gender norms.

Table A.1: Summary statistics between the raw sample and the baseline sample

	Raw sample			Baseline sample		
	Mean	SD	P50	Mean	SD	P50
Household characteristics						
Stock participation	0.39	0.49	0	0.48	0.50	0
Household earnings (AU$1,000)	105	101	90	120	107	105
Total wealth (AU$1,000)	1,147	1,474	739	1,423	1,562	979
Financial asset (AU$1,000)	383	708	153	504	804	243
Equity (AU$1,000)	53	257	0	74	299	0
Number of children	0.86	1.15	0	0.84	1.10	0
Individual characteristics						
Age	47.60	16.19	46	49.38	15.02	49
Education	12.60	2.61	12	13.04	2.55	12
Employment	0.62	0.49	1	0.64	0.48	1
Earnings (AU$1,000)	42	53	30	48	59	37
Risk aversion	3.34	0.69	3	3.30	0.67	3
Cognitive ability	0.01	0.70	0.04	0.10	0.67	0.12
Extraversion	4.44	1.07	4.50	4.42	1.09	4.50
Agreeableness	5.41	0.90	5.50	5.43	0.86	5.50
Conscientiousness	5.18	0.99	5.33	5.27	0.97	5.33
Stability	5.22	1.06	5.33	5.28	1.03	5.33
Openness	4.17	1.03	4.17	4.21	1.00	4.17

Note: This table reports summary statistics for the raw and the baseline samples. Stock participation is a dummy variable that indicates whether a household directly holds any equities. Both age and education are measured in years. Employment is a dummy variable indicating whether or not an individual is currently employed. Risk aversion is measured using an integer from 1 to 4, where a higher number indicates a higher level of risk aversion. Cognitive ability is measured by the average of the standardized scores of three tests. Extraversion, agreeableness, conscientiousness, stability, and openness are based on 36 personality questions, the values of which range from 1 to 7. US$1 $\approx$ AU$1.2.

Table A.2: Transition rates of financial heads of the household between waves

	To					
From	husband-headed	husband-shared	jointly-headed	wife-shared	wife-headed	Total
husband-headed	61.9	27.5	10.4	0.19	0	100
husband-shared	19.6	43.0	36.2	1.16	0	100
jointly-headed	2.44	9.72	79.4	7.01	1.46	100
wife-shared	0	2.15	41.1	42.8	13.9	100
wife-headed	0	1.27	17.7	34.2	46.8	100

Note: This table presents a transition matrix for the financial heads of the household between waves.

Table A.4: OLS regression of financial heads of the household on attitudes toward gender norms

	Husband-headed	Wife-headed
Division of labor (husband)	0.006***	0.003*
	(0.002)	(0.001)
Division of labor (wife)	0.009***	-0.000
	(0.002)	(0.001)
Share housework (husband)	0.010***	-0.001
	(0.003)	(0.002)
Share housework (wife)	-0.001	-0.004**
	(0.003)	(0.002)
Mother role (husband)	0.002	-0.001
	(0.002)	(0.001)
Mother role (wife)	0.007***	-0.003**
	(0.002)	(0.002)
Age/10 (husband)	-0.003	-0.008
	(0.034)	(0.024)
Age/10 (husband), squared	0.001	0.001
	(0.003)	(0.002)
Age/10 (wife)	-0.049	0.021
	(0.034)	(0.022)
Age/10 (wife), squared	0.003	-0.003
	(0.003)	(0.002)
Education (husband)	0.016***	-0.007***
	(0.002)	(0.001)
Education (wife)	-0.004*	0.005***
	(0.002)	(0.001)
No. children in HH	0.012***	0.002
	(0.004)	(0.003)
Log HH earning	-0.000	0.002
	(0.005)	(0.003)
Log HH earning, squared	-0.000	-0.000
	(0.000)	(0.000)
Log net wealth	-0.145***	0.000
	(0.043)	(0.015)
Log net wealth, squared	0.007***	-0.000
	(0.002)	(0.001)
2010	-0.000	-0.001
	(0.011)	(0.007)
2014	-0.022**	-0.003
	(0.010)	(0.006)
2018	-0.020*	0.015**
	(0.011)	(0.007)
Constant	0.599**	0.073
	(0.274)	(0.102)
Observations	7741	7741

Note: This table analyzes the impact of attitudes toward gender norms on financial heads of the household. Robust standard errors are in parentheses. Levels of significance are denoted as follows: * if $p < 0.10$; ** if $p < 0.05$; *** if $p < 0.01$.

Table A.5: Model estimates for unobserved types, μ, in the bargaining equation

	Value (μ_k)		Proportion (p_k)	
	Mean	SE	Mean	SE
Type I	0.788	0.068	0.409	0.002
Type II	-0.935	0.063	0.469	0.002
Type III	2.154	0.951	0.017	0.008
Type IV	0.081	–	0.106	–

Note: The value and proportion are uniquely pinned down by the three other types given the constraints $E[\mu] = 0$ and $\sum_{k=1}^{4} p_k = 1$.

E GSOEP Survey

E.1 Sample construction

The raw sample has 14,1204 non-duplicated households. We follow the below steps and drop observations that do not meet certain criteria:

- We restrict our sample to households for which we have information on risk preferences for both partners. This information is only measured in waves 2004, 2009, and 2014; doing so leaves us with a total of 40,743 unique households.
- We drop households with missing information on cognitive ability. This restriction leaves us with 9,592 unique households.
- We drop households with missing information on personality traits. This restriction leaves us with 9,362 unique households.
- We restrict our sample to households for which we have information on their wealth, which is measured in the years 2002, 2007, and 2012. This restriction leaves us with 5,022 unique households.

- We further drop households with any missing information on other characteristics, including education, age, wage, employment, and the number of children. This restriction leaves us with a total of 4,588 unique households.

E.2 Model estimates and goodness of model fit when using GSOEP

Table A.6 and A.7 report the results when our model is estimated using GSOEP data. In particular, Table A.6 reports the estimation results for the bargaining equation. Column (1) reports the coefficients, and Column (2) reports the associated standard errors. Table A.7 reports the estimates for the rest of the model. The left panel of Table A.7 reports all the coefficients from equation (3), which specifies the stock market participation cost. The upper-right panel of Table A.7 reports the coefficients associated with the risk attitude measurement equation. And the lower-right panel reports the other general parameters.

Table A.6: Model estimates for determinants of bargaining power in the bargaining equation

Characteristic	Value	SE
	(1)	(2)
$Age/10$	0.048	0.175
Education	0.055	0.067
Employment	0.036	0.085
Earning	0.345	0.074
Cognitive ability	0.796	0.207
Extraversion	0.410	0.106
Agreeableness	-0.120	0.060
Conscientiousness	-0.195	0.082
Stability	-0.022	0.019
Openness	-0.601	0.142
Intercept (2004)	1.504	0.483
Intercept (2009)	1.808	0.463
Intercept (2014)	1.606	0.401

Note: This table reports the estimation results for the bargaining equation. Each characteristic is defined as the value difference between paired husbands and wives. Column (1) reports the coefficients; Column (2) reports the standard errors.

Table A.7: Model estimates for the rest of the parameters

Parameter	Value	SE	Parameter	Value	SE
Participation cost (€100)			*Risk measure equation*		
c_0(Intercept)	1.756	0.006	σ_ξ	2.025	0.095
c_1(log HH earning)	-0.382	0.001	ρ_ξ	-0.038	0.021
c_2(log HH earning, squared)	0.009	0.000	ζ_0	0.105	0.031
c_3(log net wealth)	0.598	0.002	ζ_1^h	1.445	0.047
c_4(log net wealth, squared)	-0.032	0.000	ζ_1^f	1.312	0.064
c_5(Age/10)	0.632	0.079			
c_6(Age/10, squared)	-0.229	0.040	*General parameters*		
c_7(Education)	-0.240	0.041	σ_ε	1.617	0.286
c_8(Cognition)	-0.140	0.013	r_x	0.070	-
c_9(No. children in HH)	0.040	0.022	σ_x	0.100	-
c_{10}(2009)	0.148	0.060			
c_{12}(2014)	0.353	0.079			

Note: This table reports estimates of the rest of the parameters. The left panel reports all the coefficients from the participation cost function. The upper-right panel reports the coefficients associated with the risk attitude measurement equation. The lower-right panel reports the other parameters: σ_ε is the standard deviation of the residual term in the bargaining equation; and r_x and σ_x are the mean and standard deviation of the risk premium. Values of r_x and σ_x are preset following Breunig et al. (2021).

Table A.8 compares the conditional stock market participation rates simulated by a model with those derived from actual data to determine whether the model adequately fits the data. We cannot provide the model fit for risky asset holdings because GSOEP does not provide information on asset holdings. In general, our model replicates the observation that households with more risk-taking members are more likely to invest in the stock market.

Table A.8: The average stock market participation rate across different risk preferences

	Men		Women	
Risk-taking level	Sim	Data	Sim	Data
Low	0.212	0.151	0.240	0.201
Middle	0.298	0.293	0.311	0.310
High	0.417	0.450	0.402	0.364

Note: This table compares the average stock market participation rate for households with different levels of risk preference from the model simulation with those from the real data. In the first two columns, we group the households based on husbands' risk preference. "Low" includes the households in which husbands report their values of risk aversion to be 0 or 1. "Middle" includes the households in which husbands report their values of risk aversion to be 2 to 5. "High' includes the households in which husbands report their risk preference values between 6 to 10. The last two columns report the average stock market participation rate based on wives' risk preference. The grouping rule is the same.

F The HRS

F.1 Sample construction

Across waves 2002, 2004, and 2006 in the raw sample of married couple households, we have 17,751 household-wave observations. We follow the below steps and drop observations that do not meet certain criteria:

- We drop households with negative wealth; doing so leaves us with a total of 17,295 observations.
- We drop households with information missing on education; doing so leaves us with a total of 17,202 observations.
- We drop households with information missing on risk preference, reducing the number of observations to 7,205.
- We restrict our sample to households for which we have information on the number of children. This restriction leaves us with 7,127 observations.
- We further drop households with information missing on employment status. Our final sample has 7,014 observations.

F.2 Model estimates and goodness of model fit when using HRS

Table A.9 and A.10 report our estimates when the model is estimated using HRS data. In particular, Table A.9 reports the estimation results for the bargaining equation. Column (1) reports the coefficients, and Column (2) reports the standard errors. Table A.10 reports the estimates for the rest of the model. The left panel of Table A.10 reports all the coefficients from equation (3), which specifies the stock market participation cost. The upper-right panel of Table A.10 reports the coefficients associated with the risk attitude measurement equation. And the lower-right panel reports the other general parameters.

Table A.9: Model estimates for determinants of bargaining power in the bargaining equation

Characteristic	Value	SE
	(1)	(2)
$Age/10$	0.044	0.148
Education	0.042	0.089
Employment	0.034	0.042
Earning	0.249	0.062
Intercept (2002)	0.751	0.186
Intercept (2004)	0.740	0.258
Intercept (2006)	0.785	0.285

Note: This table reports the estimation results for the bargaining equation. Each characteristic is defined as the value difference between paired husbands and wives. Column (1) reports the coefficients; Column (2) reports the standard errors.

Table A.10: Model estimates for the rest of the parameters

Parameter	Value	SE	Parameter	Value	SE
Participation cost ($100)			*Risk measure equation*		
c_0(Intercept)	2.053	0.090	σ_ξ	0.323	0.012
c_1(log HH earning)	0.354	0.008	ρ_ξ	0.228	0.042
c_2(log HH earning, squared)	-0.016	0.000	ζ_0	1.312	0.026
c_3(log net wealth)	0.715	0.002	ζ_1^h	0.157	0.009
c_4(log net wealth, squared)	-0.054	0.000	ζ_1^f	0.157	0.012
c_5(Age/10)	0.727	0.071			
c_6(Age/10, squared)	-0.433	0.034	*General parameters*		
c_7(Education)	-0.897	0.027	σ_ε	1.997	0.196
c_8(No. children in HH)	0.063	0.007	r_x	0.070	-
c_9(2004)	0.289	0.035	σ_x	0.100	-
c_{10}(2006)	0.651	0.043			

Note: This table reports estimates of the rest of the parameters. The left panel reports all the coefficients from the participation cost function. The upper-right panel reports the coefficients associated with the risk attitude measurement equation. The lower-right panel reports the other parameters: σ_ε is the standard deviation of the residual term in the bargaining equation; and r_x and σ_x are the mean and standard deviation of the risk premium. Values of $r_x = 0.07$ and $\sigma_x = 0.1$ are preset.

Table A.11 compares the conditional stock market participation rates simulated by a model with those derived from actual data to determine whether the model adequately fits the data. We cannot provide the model fit for risky asset holdings because HRS does not provide information on asset holdings. In general, our model replicates the observation that households with more risk-taking members are more likely to invest in the stock market.

Table A.11: The average stock market participation rate across different risk preferences

	Men		Women	
Risk-taking level	Sim	Data	Sim	Data
Low	0.349	0.363	0.359	0.368
Middle	0.371	0.358	0.381	0.362
High	0.440	0.404	0.422	0.397

Note: This table compares the average stock market participation rate for households with different levels of risk preference from the model simulation with those from the real data. In the first two columns, we group the households based on husbands' risk preference. "Low" includes the households in which husbands' values of risk aversion lie at the bottom third of risk aversion distribution. "Middle" includes the households in which husbands' values of risk aversion lie at the middle third of risk aversion distribution. "High' includes the households in which husbands' values of risk aversion lie at the middle third of risk aversion distribution. The last two columns report the average stock market participation rate based on wives' risk preference. The grouping rule is the same.