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## **Risk Aversion, Entrepreneurial Risk, and Portfolio Selection**

**Hongyan Fang\* and John R. Nofsinger\*\***

Do entrepreneurs consider the risk of their business equity when making investment portfolio allocations? Many people compartmentalize different risks and consider them separately, called mental accounting. Alternatively, the risk substitution hypothesis suggests that entrepreneurs would offset high business income risk by selecting a more conservative investment portfolio. We examine these two hypotheses which have implications for measuring risk tolerance. We find that households with proprietary income show higher risk tolerance than non-entrepreneurs do. Further evidence suggests that a comprehensive measure of relative risk aversion that incorporates households' business income is more reliable and more consistent with their reported risk preference than other measures that do not include business income. In support of the risk substitution hypothesis, households do appear to hedge the risk from their private business by decreasing their portion of other risky assets in their investment portfolio.

### **1. Introduction**

Studies on household portfolio allocation show the growing importance of undiversifiable background risk such as labor income. Recently, Heaton and Lucas (2000) demonstrate the importance of entrepreneurial risk. They find that for a subset of households that have private proprietary income, their variable business income represents a large source of undiversified risk—a topic of considerable importance in determining stock prices and portfolio composition. In this paper, we are interested in how entrepreneurs' private businesses affect their portfolio allocation. Specifically, we want to determine whether entrepreneurs consider their business income as a risky equity asset that is similar to, or separate from, other risky assets when forming a portfolio. Making investment choices independent of private business ownership may be due to mental accounting.

Tversky and Kahneman (1986) demonstrate that investors act as if they overlook covariances between assets in their portfolio and they simply segregate their portfolios into distinct mental accounts. Benartzi and Thaler (2007) show that participants of retirement plans use separate mental accounts for the money they have already accumulated in the plan, and for new money that has not been contributed yet. Additionally, employees seem to view their company's stock as a unique asset class

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separable from other stocks. Signs of mental accounting also appear in investors' trading decisions. Lim (2006) finds investors are more likely to bundle sales of losers than sales of winners on the same day, suggesting that investors prefer integrating losses and segregating gains. In our analysis, if entrepreneurs do segregate their private business and other risky assets into different mental accounts, then we would expect that their allocation in other risky assets suffices to be a reliable measure of their genuine risk attitude and their investment in those risky assets will not be affected by the business equity.

Alternatively, entrepreneurs might aggregate their business income into their total portfolio and make their investment decisions accordingly. A property of entrepreneurial activity is that it is largely non-diversifiable and unhedgeable, which tends to increase investors risk aversion. In this case, rational entrepreneurs would offset high proprietary business income risk by investing more cautiously in other risky assets, a ramification of the risk substitution effect. Kimball (1993) documents the substitutability between risks, i.e., bearing one risk should make an agent less willing to bear another risk. Testing these two hypotheses has important implications for understanding entrepreneurs' actual risk tolerance, as measured by the proportion of risky assets among various measures of assets or net worth. It also has implications for entrepreneurs' understanding of their own risk attitude, which is measured by their self-confessed risk scale value.

Using data from 2004 Survey of Consumer Finance (SCF), we first show the self-reported risk preference between the subsets of households who are self-employed (entrepreneurs) and those who are employed by others (non-entrepreneurs). Our empirical results suggest that households with proprietary income report a higher risk tolerance than non-entrepreneurs do. To investigate whether entrepreneurs' actual investment behavior is consistent with their self-reported risk attitude, we use four measures of relative risk aversion, or RRA, that are proxied by different definitions of proportional risky assets: (1) risky assets excluding business income relative to total financial assets, (2) risky assets excluding business income relative to financial net worth, (3) risky assets including business income relative to total net worth, and (4)  $(1-h) * \text{risky assets excluding business income relative to total net worth}$ , where  $h$  is the proportion of business income relative to total net worth. We show that proportional risky assets including business income, relative to total net worth has the largest correlation with household's self-reported risk preference than other measures. The correlation coefficient is -0.1961 while for other three measures, the correlation coefficients are 0.0220, -0.1444 and -0.1338.<sup>1</sup> We further compare these different measures of relative risk aversion to self reported risk preference between

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<sup>1</sup> The reported risk preference has a scale value from 1 to 4, with 1 exhibiting the lowest risk aversion and 4 the highest risk aversion. Thus, a negative relation is expected between the self-reported risk preference and proportional risky assets measures.

entrepreneurs and non-entrepreneurs across different wealth cohorts and find that when private business equity is excluded from their entire portfolio, entrepreneurs are either more risk averse or exhibit no significant difference in their risk preference relative to other similar wealthy households. Their investment in other risky assets is either lower or similar to that of general households across different wealth cohorts. Relative risk aversion excluding business income thus appears to be a biased measure of entrepreneurs' self-reported risk attitude and it also leads us to conjecture that entrepreneurs' understanding of their own risk tolerance might be better measured by a broad measure of risky assets. This finding is important for tests of investor risk aversion and diversification measured only from stock brokerage accounts (see Goetzmann and Kumar (2008)).

Consistent with our expectation, we find that once their proprietary income is incorporated, entrepreneurs demonstrate a much higher risk tolerance than non-entrepreneurs and this risk measure is more consistent with entrepreneurs' self-reported willingness to take financial risk. The riskiness of their portfolio, as measured by the proportion of their wealth invested in total risky assets that includes business equity, is significantly higher than that of non-entrepreneurs. At wealth level range of between \$500,000 and \$1 million, the relative holding of risky assets is 40.59% and 21.60% for entrepreneurs and non-entrepreneurs, respectively. In unreported results, this relative risk measure is mostly related to self-reported risk preference for the sub-group of entrepreneurs, with the correlation coefficient of about -0.1122, while only -0.0771 and 0.0444 for the other two measures.

The consistency between RRA incorporating business income and self-reported risk tolerance provides some preliminary evidence against a mental accounting phenomenon. Further analysis on how their business affects their investment portfolio allocation will let us have a clearer understanding of whether business risk tends to substitute for investment in other risky assets. If entrepreneurs realize the risk from their private business and intend to hedge this non-diversified risk, then they are expected to reduce investment in other risky assets in order to cut their total risk exposure. We find that once taking into account their business risk, entrepreneurs do become more cautious in their investment portfolio strategy and invest less in other risky assets compared to other households. They generally hold a relatively smaller portion of other risky assets than non-entrepreneurs do. This finding is more pronounced in the wealthy households. Further parametric analysis also provides evidence of a negative correlation between risky asset holdings and that of proprietary income, both in proportional shares and in total dollar values. For example, a one percent increase in the share of proprietary income decreases the proportion of other risky assets by 0.4233 percent.

Our paper contributes to current research by identifying an appropriate measure of relative risk aversion that reflects entrepreneurs' actual understanding of their risk tolerance. Although entrepreneurs have long been assumed to be more risk tolerant than other general households, empirical studies on the relative risk-taking of

entrepreneurs show divergent results. Kihlstrom and Laffont (1979) show how less risk-averse individuals become entrepreneurs. On the other hand, Palich and Bagby (1995) document that entrepreneurs are not more predisposed to bear risk than non-entrepreneurs. Rather, entrepreneurs simply categorize and frame a given situation more favorably than others. Some other studies find that entrepreneurs exhibit systematic cognitive biases and overestimate their chances of success. Cooper, Woo, and Dunkelberg (1988) find that 81 percent of entrepreneurs believe that their ventures will have at least a 70 percent chance of succeeding even though 50 percent to 71 percent of all new ventures discontinue after five years. These studies generally follow psychometric approaches, which directly examine agents' risk propensity and their ways of gathering, processing, and evaluating opportunities and perceiving risk. Apart from a psychometric approach, some studies show that risk measures based on an expected utility framework better reflect agents' actual decision-making (Pennings and Smidt (2000)). Based on the framework of investors' utility maximization, Friend and Blume (1975), for the first time, use the proportion of the net worth placed in the portfolio of risky assets to proxy for investor's relative risk aversion. Most of the studies afterwards center on households' RRA at different wealth levels. However, to the best of our knowledge, no comparison has been made on risk-tolerance between entrepreneurs and non-entrepreneurs based on the expected utility framework risk measures. Further, how entrepreneurs' RRA would differ based on different measures of risky assets or net worth, and which risk measures reflect entrepreneurs' true understanding of their self-reported risk attitude are addressed in this study.

The remainder of the paper is organized as follows. In section 2 we summarize the data and methodology used in this paper. In section 3 we compare the different measures of relative risk aversion between the entrepreneurs and non-entrepreneurs. Section 4 investigates the influence of business risk on entrepreneurs' portfolio selection, specifically their investment in other risky assets apart from business equity. We make final conclusions in section 5.

## **2. Data and methodology**

The primary data in this paper comes from the 2004 Survey of Consumer Finance (SCF). SCF is a triennial survey sponsored by the Federal Reserve Board to provide detailed information on the assets, liabilities, and other demographic characteristics of U.S. families since 1989. The survey collects employment information on the head of household and his/her spouse/partner, including industry, occupation, tenure, earnings, pension, whether he/she is self-employed or works for someone else. It also provides information on businesses owned by the household. To deal with commonly seen non-response, the survey adopts a multiple imputation technique; missing data are imputed five times to get the average for the estimation of the missing variable,

see Kennickell (1998).<sup>2</sup> For the 2004 survey, we find 22,595 imputed households, among which 5,855 are self-employed entrepreneurs, and the rest, 16,740, are households with no active proprietary income. We categorize respondents as entrepreneurs if their answers to employment questions are “self-employed.”<sup>3</sup>

Following Friend and Blume (1975), we relate investors’ relative risk aversion to the portion of risky assets held. They derived equations to estimate RRA from a model of investor utility maximization. If non-marketable assets such as human capital are excluded from the entire portfolio, the Pratt’s (1964) measure of RRA can be obtained from the following equation

$$\alpha_k = \frac{E(r_m - r_f)}{\sigma_m^2} * \frac{1}{(1 - t_k)\gamma_k} \quad (1)$$

where:

$\alpha_k$  is household k’s portfolio invested in risky assets;

$r_m$  is the return of the market portfolio of all risky assets;

$r_f$  is the return on the risk-free asset;

$\sigma_m$  is the standard deviation of the return of the market portfolio;

$t_k$  is the average rate of tax for household k; and

$\gamma_k$  is household k’ Pratt’s measure of relative risk aversion.

The first term on the right hand side of equation (1) is the market price of risk and is constant across households. SCF does not provide detailed information about each household’s tax rate. Bellante and Saba (1986) show that their results about RRA

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<sup>2</sup> The imputation inflates reported significance of regression results. We correct the mistake by multiplying the standard errors of overall regression by the square root of five. The SCF survey also uses a weighting scheme to control for selection bias. Summary statistics show difference when using the weighting, however, it does not influence the comparison between our two subgroup study.

<sup>3</sup> The survey asks whether the respondent and his/her spouse/partner are employed by someone else or self-employed. Specifically, respondents are shown with the following alternatives:

1=work for someone else;

2=self-employed/partnership;

3=retired/disabled + (student/homemaker/misc. not working and age 65 or older);

4=other groups not working (mainly those under 65 and out of the labor force).

We categorize respondent as entrepreneur if he/she chooses 2 and non-entrepreneurs otherwise.

are not affected by tax rate adjustments.<sup>4</sup> Thus, in our study, we ignore the tax effect and look only at the share of risky assets. This equation implies that investors' holdings of risk assets vary inversely with their RRA. In addition, changes on this ratio reflect investors' changes in RRA. If, as investors' wealth increases, a greater fraction is held in the form of risky assets, then they are less averse to risk and exhibit decreasing RRA. If, on the other hand, households hold a smaller fraction of wealth in risky assets as their wealth increase, then they exhibit increasing RRA.

If wealth is defined as total assets such that capitalized labor income is also included, then the equation transforms to the following equation,

$$\alpha_k = \frac{E(r_m - r_f)}{\sigma_m^2} * \frac{1}{(1-t_k)(1-h_k)\gamma_k} - \frac{h_k}{1-h_k} \beta_{h_k,m}, \quad (2)$$

where the other variables are defined as before and  $h_k$  is the ratio of the value of the human wealth of household  $k$  to its net worth, and  $\beta_{h_k,m}$  is the ratio of  $Cov(r_m, r_{h_k})$  to  $\sigma_m^2$ . Examination of changes in RRA under wealth changes requires first categorizing total net wealth into several classes. For each net wealth range, a cross-sectional regression of risky assets proportion on  $\frac{h_k}{1-h_k}$  gives estimates of the intercept and the slope. The slope corresponds to  $\beta_{h_k,m}$  while RRA can be calculated from the estimates of the intercept. Fama and Schwert (1979) show that the relationship between the return on human capital and the returns on marketable assets are weak, i.e.,  $Cov(r_m, r_{h_k})$  is close to zero. Thus, empirically, a RRA measure that includes labor income is consequently proxied by  $(1-h_k) * \alpha_k$ .

In the following analysis, we will use both equation (1) and equation (2) to calculate proportional risky assets relative to different metrics of wealth and identify an appropriate RRA measure that most reflects households' risk attitude.

### 3. Relative Risk Aversion: Professed and Actual RRA

#### a. Demographic Statistics

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<sup>4</sup> However, there are studies on taxation and household portfolios, see Poterba and Samwick (2003).

Before addressing the relation between investors' actual RRA and self reported risk aversion, we examine differences in other social economic and demographic characteristics that might also contribute to variations in risk preference.

Table I reports the mean and median demographic statistics with t- and z-statistics for entrepreneurs and non entrepreneurs. All of the demographic variables are significantly different between the two groups. Entrepreneurs are on average older than non-entrepreneurs and have relatively higher education.<sup>5</sup> They are also generally wealthier. The average income in the year prior to the survey is \$1,934,862 for entrepreneurs and \$358,922 for non-entrepreneurs. The median values of \$248,000 and \$47,000 are much lower, but still illustrate the difference between entrepreneurs and non-entrepreneurs. Average net worth, which is the households' assets in excess of their debt, is also higher for entrepreneurs. Even after excluding private business value from the total net worth, which in this paper we define as *financial net worth*, the average net worth is \$10,998,844 for entrepreneurs and \$3,245,483 for non-entrepreneurs. Again, the medians are much lower but still show the difference between groups.

**Table I**  
**Demographic Statistics**

This table presents mean and median demographic statistics for entrepreneurs and non-entrepreneurs respectively. Data are from the 2004 Survey of Consumer Finance. Households are categorized by entrepreneurs and non-entrepreneurs. "Education" covers scale values from 1 (lowest education) to 4 (highest education). "Gender" equals 1 if respondent is a male and 2 if a female. Marital status equals 1 if the respondent answers "married or live with a partner," and 2 if "neither married nor live with a partner." "Income" is the household annual income prior to the survey year. "Total Net Worth" is the households' total assets in excess of debt in the prior year. "Financial Net Worth" is the total net worth excluding business value. "Expectation" equals 1 if respondent expects the U.S. economy in the next five years to "get better," 2 for "about the same," and 3 for "get worse." "Risk attitude" covers scale values from 1 (take substantial risks) to 4 (not willing to take any financial risks). "t statistics" test the mean differences in variables between entrepreneurs and non-entrepreneurs. "z-statistics" test the equality of distribution between the two groups using the Wilcoxon signed-ranks test. \*\*\*, \*\*, \* denote statistical significance at less than 1%, 5% and 10% levels, respectively.

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<sup>5</sup> The survey asks respondent if he/she has (1) no high school diploma, (2) high school diploma, (3) some college, or (4) college degree. The scale values from 1 to 4 correspond from the lowest to the highest level of education.



Variable	Mean			Median		
	Entrepreneurs	Non-entrepreneurs	t-statistics	Entrepreneurs	Non-entrepreneurs	z-statistics
Age	53.47	49.78	18.13***	53.00	49.00	18.60***
Education	3.43	2.88	37.38***	4.00	3.00	34.62***
Gender	1.06	1.26	-44.10***	1.00	1.00	-33.01***
Marital Status	1.17	1.40	-36.64***	1.00	1.00	-31.63***
Income	1,934,862	358,922	19.93***	248,000	47,000	63.66***
Total Net Worth	24,615,480	4,162,408	23.51***	2,780,600	101,500	71.47***
Financial Net Worth	10,998,844	3,245,483	16.86***	1,699,000	105,500	62.01***
Expectation	1.80	1.92	-8.68***	1.00	2.00	-8.90***
Risk attitude	2.68	3.15	-37.28***	3.00	3.00	-36.91***
N	5,855	16,740		5,855	16,740	

The two psychological variables suggest that entrepreneurs are more willing to take financial risk and are more optimistic about future economic prospects.<sup>6</sup> The self-reported risk aversion might reflect investors' true understanding of risk preferences. However, Schooley and Worden (1996) document that differences between the self-reported risk aversion measures and the actual RRA calculated from the composition of a household's portfolio indicate that households do not understand risk and might take more or less risk than they actually desire. In later analysis we will show that the actual investment in risky assets (including business equity) is more closely related to self-reported risk aversion.

#### *b. Statistics on Financial Assets Allocation*

<sup>6</sup> As to investors' expectation, the survey asks respondents if they expect the U.S. economy as a whole to perform (1) better, (2) about the same, or (3) worse. The self-reported risk attitudes values range from 1 to 4, representing respectively: (1) Take substantial financial risks expecting to earning substantial returns, (2) Take above average financial risks expecting to earn above average returns, or (3) Take average financial risks expecting to earn average return, or if they are (4) Not willing to take any financial risks.

In Table II, we examine the variation in the mean portfolio shares of safe assets, bonds, equity and other financial assets relative to the total financial assets across various levels of financial wealth for entrepreneurs and the general households, respectively. "Safe assets" include checking accounts, saving accounts, call accounts at brokerages, CDs, savings bonds, and money market mutual funds. "Bond" is defined as directly held bonds, investment funds in bonds, cash value of life insurance, and bonds from retirement, pension, annuity and trust accounts. "Equity" includes directly held stocks, stock mutual funds, equity from retirement, pension, annuity and trust accounts. The equity composition appears to be higher than some of the earlier studies because we use financial assets as the entire portfolio as opposed to net worth. From Table II, statistics suggest two salient features of household stock holding; there is limited participation in the stock market for poorer households, and the average portion of financial assets invested into stocks increases with wealth (alternatively, decreasing relative risk aversion). Households at the lowest level of financial assets allocate less than 15% of their financial assets in stock equity. An unreported test indicates that 93% of households whose financial assets is above the median wealth level participate in the stock market either through direct stockholding or through stock mutual funds. Alternatively, for those households whose financial assets are below the median level, the participation rate is only 33%.

**Table II**  
**Portfolio Shares Relative to Financial Assets**

This table reports the mean portfolio shares of various assets relative to total financial assets for entrepreneurs versus non-entrepreneurs (shown as entrepreneur vs non-entrepreneur). Data are from the 2004 Survey of Consumer Finance. Households are categorized by financial assets. "Safe Assets" include checking accounts, saving accounts, call accounts, CDs, savings bonds, and money market mutual fund; "Bonds" include directly hold bond, investment funds in bonds, cash value of life insurance, and bonds from retirement, pension, annuity and trust; "Equity" includes directly hold stocks, stock mutual funds, equity from retirement, pension, annuity and trust. The table also reports the significance level of two sample t-test between entrepreneurs and non-entrepreneurs, with \*\*\*, \*\*, \* denoting significance at less than 1%, 5% and 10% levels, respectively.

Assets Categories	\$1K to \$10K	\$10K to \$100K	\$100K to \$500K	\$500K to \$1M	>\$1M
	0.7939 vs	0.4813 vs	0.2590 vs	0.2104 vs	0.1759 vs
Safe Assets	0.6620**	0.3364**	0.2334*	0.1610**	0.1516
	0.0684 vs	0.1567 vs	0.1326 vs	0.1227 vs	0.2265 vs
Bonds	0.0956**	0.1485	0.1236	0.0989**	0.1884**
	0.0671 vs	0.2657 vs	0.4356 vs	0.5202 vs	0.5256 vs
Equity	0.1160**	0.3081**	0.4389	0.5318	0.5669**
Other Fin	0.0435 vs	0.0370 vs	0.0483 vs	0.0247 vs	0.0408 vs

Assets	0.0514	0.0359	0.0135**	0.0112**	0.0133**
N	3823	5383	3941	1418	4476

Makarov and Schornick (2008) provide a theoretical framework of wealth-dependent risk aversion and uncertainty. In their setting of heterogeneous uncertainty-averse investors, wealthier households spend more money on understanding the stock market and thus have less uncertainty than poorer ones. Hence their model predicts that wealthier households are more likely to participate in the stock market. Campbell (2006) also shows that wealthy households are willing to take greater risk and their equity holding represents the largest compositions in their portfolios. The increasing share of public stock in tandem with wealth is consistent with the theoretical explanation of Makarov and Schornick (2008). In their framework, the increase in wealth results in a corresponding decrease in investors' absolute risk aversion, hence a larger share invested into risky assets.<sup>7</sup> The declining share of safe assets across wealth levels is also indicative of households' decreasing RRA.

We know from Table I that entrepreneurs on average report more willingness to take financial risks than other general households. If households' self-reported willingness to take financial risks reflects their understanding of risk and the portfolio shares of equity among total financial assets is representative of households' true RRA, then we should expect entrepreneurs to allocate a larger portion of their financial assets into public equity. Table II suggests quite the opposite. At all five wealth levels, non-entrepreneurs' investment in stocks is higher than that of entrepreneurs, with the estimates significantly higher in three of the wealth levels. For example, those households with financial assets between \$10,000 and \$100,000, the shares of risky assets are 0.2657 and 0.3081 for entrepreneurs and other households, respectively. The discrepancy between what is implied by their self-reported risk preference and actual risk-taking in stocks leads us to conjecture that entrepreneurs might offset their business income risk by reducing their stock allocation (the risk substitution effect). It also indicates that an alternative measure of proportional risky assets might be a better indicator of investors' self-reported risky preference.

### *c. Measures of Relative Risk Aversion*

<sup>7</sup> There are debates in the empirical analyses of households' RRA and it depends, in part, on how wealth is defined. See Friend and Blume (1975) and Siegel and Hoban (1982), who measure wealth separately as net worth excluding or including house equity and find mixed evidence of relative risk aversion. Morin and Suarez (1983) include home equity in the wealth measure and also find decreasing RRA. Other studies such as Cohn, Lewellen, Lease & Schlarbaum (1975) and Riley and Chow (1992), measure wealth as total assets and find decreasing RRA.

The empirical literature on households' risk attitude generally relates relative risk aversion to the fraction of public equity relative to households' total wealth. In short, equity holding reflects investors' risk tolerances. However, simply looking at the level in equity fraction might ignore the substitution effect of other risky assets. It is improper to conclude that an investor who allocates a large portion of her wealth in nonresidential real estate and thus reduces her investment in public equity is more risk averse than another similar wealthy household who invests relatively more in stocks. To obtain a more comprehensive picture of households' actual risk preference, we use investors' holding of total risky assets relative to *total financial assets* and two different specifications of net worth. This specification of risky assets considers both financial and non-financial assets, which include: non-money market mutual fund (bond-related excluded), stocks, mortgage-backed bonds, corporate and foreign bonds, future and current pension, other financial assets (such as loans to other individuals, royalties etc), nonresidential real estate for investment purpose, business income and other non-financial assets (such as metal, antiques, painting, etc.). The two definitions of net worth include: *total net worth*, which is households' total assets in excess of their debt; and *financial net worth*, which is total net worth excluding private business equity. Correspondingly, we define different risky assets relative to different definitions of net worth. The share of risky assets including business equity in the entire portfolio relative to total net worth, whereas in the other case, business value is excluded from risky assets. In addition, we also use equation (2) to derive RRA by multiplying risky assets excluding business income relative to total net worth with  $(1-h)$ , where  $h$  is the proportional business income among total net worth. We delete those observations that have negative total net worth or financial net worth to attenuate the effect of outliers. This procedure leaves us with 20,283 observations.

We report the correlation coefficients between the self-reported risk aversion and the three calculated related risk aversion measures in Table III. The correlation between the self-reported risk preference and the proportion of risky assets including business relative to total net worth is -0.1961. It is the largest in magnitude among the three measures, suggesting it is a better representative of households' actual risk attitude. To differentiate risk preference between the two groups of households, we also calculate risky asset allocations for both entrepreneurs and other households across six total net worth cohorts, as shown in Table IV. To have a better understanding of how the actual RRA is related to households' professed willingness to take risk, Panel A also reports households' self-reported risk preference from the survey. Consistent with the findings from Table I, it shows that entrepreneurs are less risk averse at all levels of total net worth. In five out of six wealth levels, their reported values of risk preference are significantly smaller than those of general households. In Panel B, we consider mean shares of risky assets excluding business income relative to *total financial assets* and show a rotating pattern of risky asset holdings between the two groups. In three of the wealth cohorts, entrepreneurs hold less risky assets than non-entrepreneurs while in the rest of the cohorts, entrepreneurs

exhibit more risk preference. The inconsistency between self-reported risk attitude and actual risk taking suggests that this relative risk measure is inadequate to capture the difference in risk attitudes between entrepreneurs and non-entrepreneurs. Panel C reports the proportions of risky assets relative to *financial net worth*. It shows that there is little variation between the average share of risky assets for entrepreneurs and non-entrepreneurs, or in the few exceptional cases, it also exhibits a rotating pattern over fractional risky assets of other general households. Though entrepreneurs seem to invest more aggressively in risky assets at lower wealth levels, this is not the case for more wealthy cohorts.

**Table III**  
**Pearson Correlation Coefficient**

This table reports the Pearson correlation coefficients of the self-reported risk preference and actual risk attitude as measured by proportional risky assets relative to different levels of wealth for all households. Data are from the 2004 Survey of Consumer Finance. “Self-reported risk preference” is households’ reported risk attitude covering scale values from 1 (take substantial risks) to 4 (not willing to take any financial risks). “Risky Assets (Excluding Business Value) Relative to Total Financial Assets” is the proportion of risky assets (business excluded) relative to total financial assets. “Risky Assets (Excluding Business Value) Relative to Financial Net Worth” is the proportion of risky assets (business excluded) relative to financial net worth (total net worth in excess of business value). “Risky Assets (Including Business Value) Relative to Total Net Worth” is the proportion of risky assets relative to (business included) relative to total net worth.

**Table III- continued.**

	Self- reported risk preference	Risky Assets (Excluding Business Value) Relative to Total Financial Assets	Risky Assets (Excluding Business Value) Relative to Financial Net Worth	Risky Assets (Including Business Value) Relative to Total Net Worth	(1- $\alpha$ )* Risky Assets (Excluding Business Value) Relative to Financial Net Worth
Self- reported risk preference	1.0000				
Risky Assets (Excluding Business Value) Relative to Total Financial Assets	0.0220***	1.0000			
Risky Assets (Excluding Business Value) Relative to Financial Net Worth	0.1444***	0.0467***	1.0000		
Risky Assets (Including Business Value) Relative to Total Net Worth	0.1961***	0.0326***	0.4340***	1.0000	
(1- $\alpha$ )* Risky Assets (Excluding Business Value) Relative to Financial Net Worth	0.1338***	0.0688***	0.6034***	0.4062***	1.0000
N			20,238		

To obtain a clearer picture of the comparison, we show the fraction of risky assets across the total net worth distribution in Figure I. The horizontal axis is the percentile of the total net worth distribution. The vertical axis depicts the fraction of risky assets relative to *financial net worth*. Consistent with Panel C of Table IV, Figure I illustrates that when private business is excluded from the entire portfolio, entrepreneurs' investment in risky assets is similar to the general household sample. Different from their professed risk preference, the figure does not suggest entrepreneurs' willingness to take more financial risks. They generally invest a relatively lower proportion in risky assets except in some cases at the lower and middle wealth levels. At higher percentiles of wealth distribution, entrepreneurs even become relatively more risk averse. This is consistent with what we observe in Table II, when we compare the fractional public equity relative to total financial assets between the two groups. Even taking into account the substitution effect between stocks and other financial assets, the discrepancy between self-reported risk attitude and actual risk taking for the two groups of households still exists. A possible explanation for this phenomenon is the exclusion of proprietary income. It is probable that entrepreneurs consider private business as part of their risky assets and total wealth. If the proprietary income represents an important source of un-diversifiable risk, we expect entrepreneurs' portfolio strategy based on this extended definition of assets would better represent their true understanding of risk.

To investigate this conjecture, we add business value to both risky assets and financial net worth, which we define as *total net worth*, and reconsider the variations of average shares of risky assets holdings.<sup>8</sup> The results are reported in Panel D of Table IV. Across all wealth cohorts, entrepreneurs are relatively less risk averse—their investment in risky assets significantly surpasses that of other general households. The average portion of risky assets at the lowest wealth level, though insignificant, is 0.2772 and 0.1247 for entrepreneurs and non-entrepreneurs, respectively. Among the wealthiest households, the portion is 0.6242 and 0.4247, respectively. The comparison is significant for all the wealth cohorts except the poorest. Figure II also shows clearly that entrepreneurs' portion of risky assets is generally above that for other households. Compared with Panel C of Table IV and Figure I, the actual RRA based on the extended portfolio is a more reliable indicator of investors understanding of their risk attitude, as shown by their self-reported scaled values.

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<sup>8</sup> The survey calculates the businesses value as the net equity if the business were sold where the household has an active interest, plus market value of interest in the case the household does not have an active interest. In this case, entrepreneurs as well as non-entrepreneurs might have business value. However, both the absolute value of the business or its proportion relative to total net worth is significantly higher for entrepreneurs than for non-entrepreneurs.

As shown in Panel E, RRAs derived from equation (2) exhibit similar pattern as the RRA reported in Panel C, suggesting no significant difference in risk preference between the two groups. This is in contradiction to comparison of the self-reported risk attitude between entrepreneurs and non-entrepreneurs.

**Table IV**

**Relative Risk Aversion for Entrepreneurs and Non-entrepreneurs**

This table reports the mean self-reported risk attitude and actual risk attitude as suggested by proportional risky assets relative to different levels of wealth for entrepreneurs and non-entrepreneurs, respectively. Households are categorized by total net worth. Panel A reports the mean of professed risk attitude for both groups, with values ranges from 1 to 4 indicating risk tolerance from highest to the lowest. Panel B is the proportion of risky assets (business excluded) relative to total financial assets. Panel C is the proportion of risky assets (business excluded) relative to financial net worth (total net worth in excess of business value). Panel D is the proportion of risky assets (business included) relative to total net worth. Panel E reports  $(1-h)$  multiplied by risky assets excluding business income relative to total net worth, where  $h$  is the proportion of business income relative to total net worth. Panel F reports other risky assets apart from business relative to total net worth. The table also reports the significance level of two sample t-test between entrepreneurs and non-entrepreneurs, with \*\*\*, \*\*, \* denoting significance at less than 1%, 5% and 10% levels, respectively.

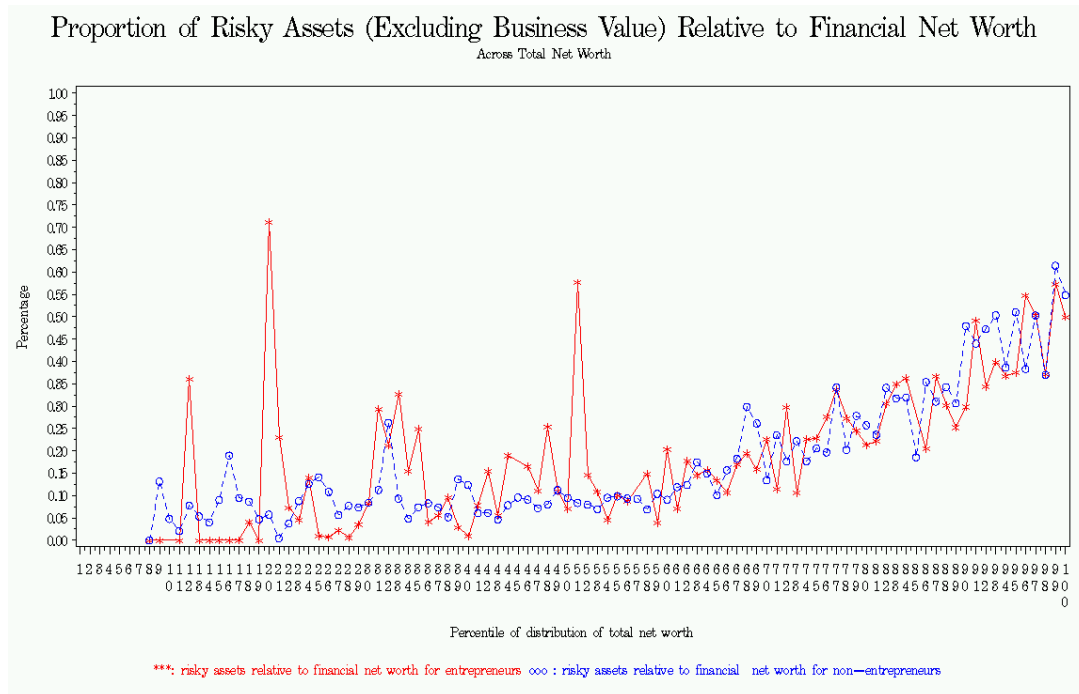
	<\$10,000	\$10K to \$100K	\$100K to \$200K	\$200K to \$500K	\$500K to \$1M	>\$1M
Entrepreneurs vs Non-entrepreneurs						
<i>Panel A: Self-reported risk preference</i>						
Risk Preference	3.4419 vs 3.4930	3.226 vs 3.272	2.9514 vs 3.1687**	2.9239 vs 3.055**	2.7508 vs 2.8774**	2.5169 vs 2.8952**
<i>Panel B: Risky Assets (Excluding Business Value) Relative to Total Financial Assets</i>						
Shares of Risky Assets	0.1176 vs 2.9762***	38.4440 vs 1.0937**	2.1584 vs 14.2680***	11.348 vs 0.3756***	1.5266 vs 1.6024	2.5338 vs 1.1558***
<i>Panel C: Risky Assets (Excluding Business Value) Relative to Financial Net Worth</i>						
Shares of Risky Assets	0.2246 vs 0.0872	0.1331 vs 0.0898**	0.0969 vs 0.0764	0.1214 vs 0.0941	0.1609 vs 0.185**	0.3272 vs 0.3261
<i>Panel D: Risky Assets (Including Business Value) Relative to Total Net Worth</i>						
Shares of Risky Assets	0.2772 vs 0.1247	0.5324 vs 0.1015***	0.3633 vs 0.0894**	0.3897 vs 0.1182**	0.4059 vs 0.2160**	0.6242 vs 0.4247**
<i>Panel E: <math>(1-h)</math>* Risky Assets (Excluding Business Value) Relative to Total Net Worth</i>						
$(1-h)$ *Shares of Risky Assets	0.2246 vs 0.0846	0.1166 vs 0.0880	0.0849 vs 0.0717	0.0762 vs 0.0914**	0.1045 vs 0.1719***	0.1567 vs 0.2629***



<i>Panel F: Other Risky Assets Relative to Total Net Worth</i>						
Shares of Risky Assets	0.2246/0.0907	0.1241 vs 0.0902*	0.0983 vs 0.0731**	0.0889 vs 0.0929	0.1242 vs 0.1762**	0.2080 vs 0.2833**
N	2,138	4,745	2,173	2,901	1,976	6,607

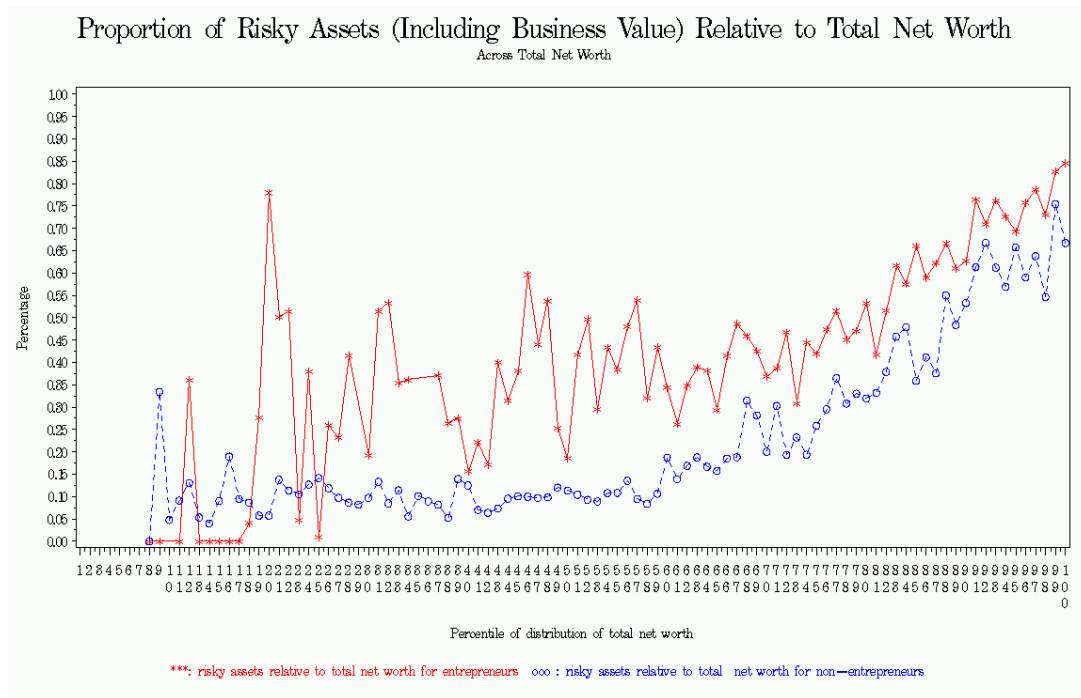
**Figure I**  
**Proportion of Risky Assets Excluding Business Value Relative to Financial Net Worth**

This figure shows the fraction of other risky assets excluding business value relative to financial net worth across the total net worth distribution for the 20,283 household observations from the 2004 Survey of Consumer Finance. The horizontal axis is the percentile of the total net worth distribution. The vertical axis depicts the fraction of risky assets excluding business value relative to financial net worth.



**Figure II**  
**Proportion of Risky Assets (Including Business Value) Relative to Total Net Worth**

This figure shows the fraction of total risky assets including business value relative to total net worth across the total net worth distribution for the 20,283 household observations from the 2004 Survey of Consumer Finance. The horizontal axis is the percentile of the total net worth distribution. The vertical axis depicts the fraction of total risky assets including business value relative to total net worth.



#### 4. Entrepreneurial Risk and Portfolio Allocation

##### a. Nonparametric Analysis

Given that entrepreneurs take business equity as part of their risky assets, we are interested in how that business value influences their investment in other risky assets. Do they reduce their investment in other risky assets to hedge their business risk (risk substitution effect)? Or do they segment business ventures and investment equity into mental accounts and then show less risk aversion in both areas?

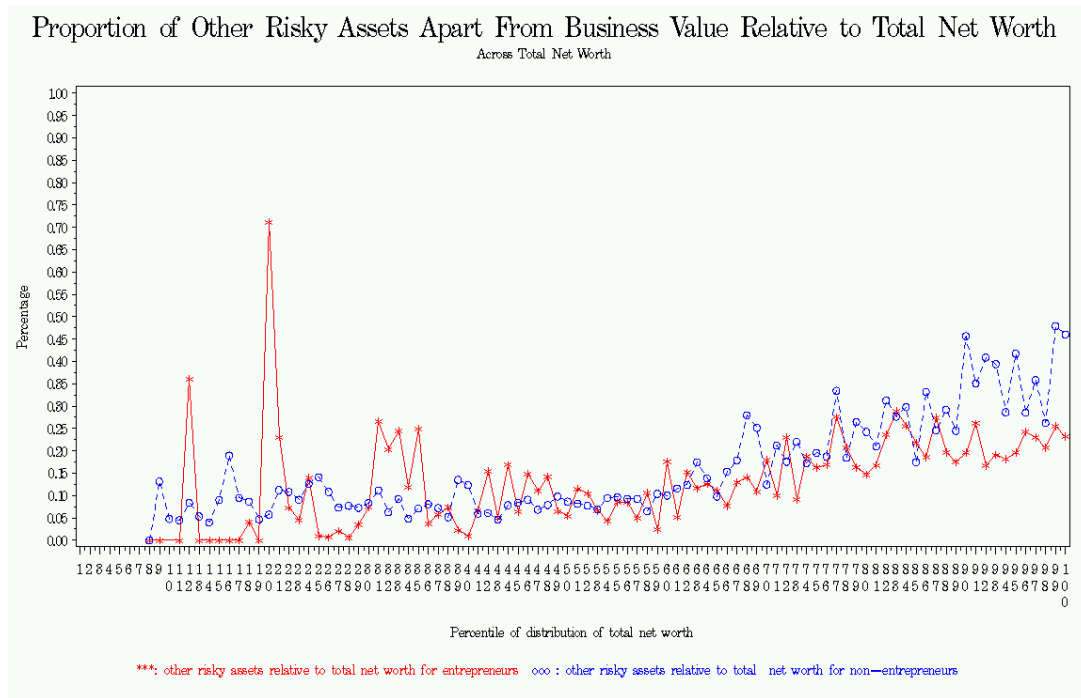
To answer these questions, we examine the composition of households' total risky assets, both the portions of business value and other risky assets relative to total net worth. If entrepreneurs are more cautious and hedge their business risk, we expect their holding of other risky assets to be less than that of similar wealthy households. Figure III illustrates this. The horizontal axis is the same as in the previous two

figures, while the vertical axis represents the percentage of other risky assets excluding business income relative to total net worth. It incorporates the business value in the entire portfolio and shows how entrepreneurs' holding of other risky assets changes accordingly. Consistent with the substitution effect, Figure III suggests that entrepreneurs realize the high risk of their business venture and become cautious when it comes to investing in other risky assets. Except in the few cases across the lower and middle levels of the wealth distribution, entrepreneurs generally hold a relatively smaller portion of other risky assets than do other households. The difference is more pronounced in the wealthy households. We also report the segregation of risky assets in Panel F of Table IV. The relative lower allocation to other risky assets for entrepreneurs is significant except among less wealthier households. For the highest two wealth cohorts, their holding is 0.1242 and 0.2080 respectively, while for other households, it is 0.1762 and 0.2833. Heaton and Lucas (2000) emphasize this limited participation among the wealthy households and find that private business assets substitute for public equity in the wealthy households. Reconciliation of the three measures of RRA implies that an extended portfolio including business equity better represents households' comprehensive understanding of risk preference. Further, relatively lower shares of other risky assets indicate that entrepreneurs realize the underlying proprietary risk in their portfolio strategy.

### **Figure III**

#### **Proportion of Other Risky Assets (Business Value Excluded) Relative to Total Net Worth**

This figure shows the fraction of other risky assets excluding business value relative to total net worth across the total net worth distribution for the 20,283 household observations from the 2004 Survey of Consumer Finance. The horizontal axis is the percentile of the total net worth distribution. The vertical axis depicts the fraction of total risky assets excluding business value relative to total net worth.



The comparison of fractional risky asset holdings relative to total net worth and financial net worth sheds some light on the substitution of private business equity for other risky assets. Relating studies on the effect of background risk factors (mainly capitalized labor income), however, diverge in the risk properties. For example, Cocco, Gomes, and Maenhout (2005) find “bond-like” properties of future flows of labor income, stimulating investment in risky assets. Vissing-Jorgensen (2003) uses U.S. household data to investigate the mean and variance effects of non-financial income on portfolio choice and finds evidence of a positive effect of mean non-financial income on the probability of stock market participation and on the proportion of wealth invested in stocks. In contrast, Friend and Blume (1975) show that including human wealth and home values, relative risk aversion on the average increases with net worth. Lynch and Tan (2009) argue that the volatility of labor income risk co-varies negatively with stock returns, leading labor income to crowd out stock market investment. The most closely related study is by Heaton and Lucas (2000), they argue that background entrepreneurial risk suggests that households with income from their private business cut back on stockholdings. Our study incorporates all categories of assets and hence captures a comprehensive picture of households’ risk preference.

We demonstrate the effect of entrepreneurial risk by concentrating only on the subgroup of entrepreneurs to see how their proportion of risky assets and that of business equity varies across ages and net worth. If entrepreneurs understand they have a business risk, the substitution effect would suggest a negative relation between the proportion of risky assets and that of business equity. Otherwise, mental

accounting suggests no relation or even positive relation. Figure IV and Figure V show the fraction of risky assets relative to total net worth across both the net worth and different ages. In both figures, generally, an increase in business investment corresponds to a decrease in proportional risky assets, which is consistent with the notion that entrepreneurs do hedge their business risk by cutting back on investment in other risky assets. The risk substitution of proprietary business and other risky assets suggests that entrepreneurs are risk tolerant in their aggregate portfolio other than in separating mental accounts.

Decreasing RRA is also observed from Figure IV, households' holding of other risky assets increases with their wealth. In an unreported regression of risky assets portion upon the logarithm of net worth, we find the coefficient is significantly positive.<sup>9</sup> In Figure V, entrepreneurs' investment in other risky assets remains relatively stable before retirement ages and then increases dramatically after that. The increased holdings of other risky assets for the older entrepreneurs demonstrate the compensation for the declining value of human capital.

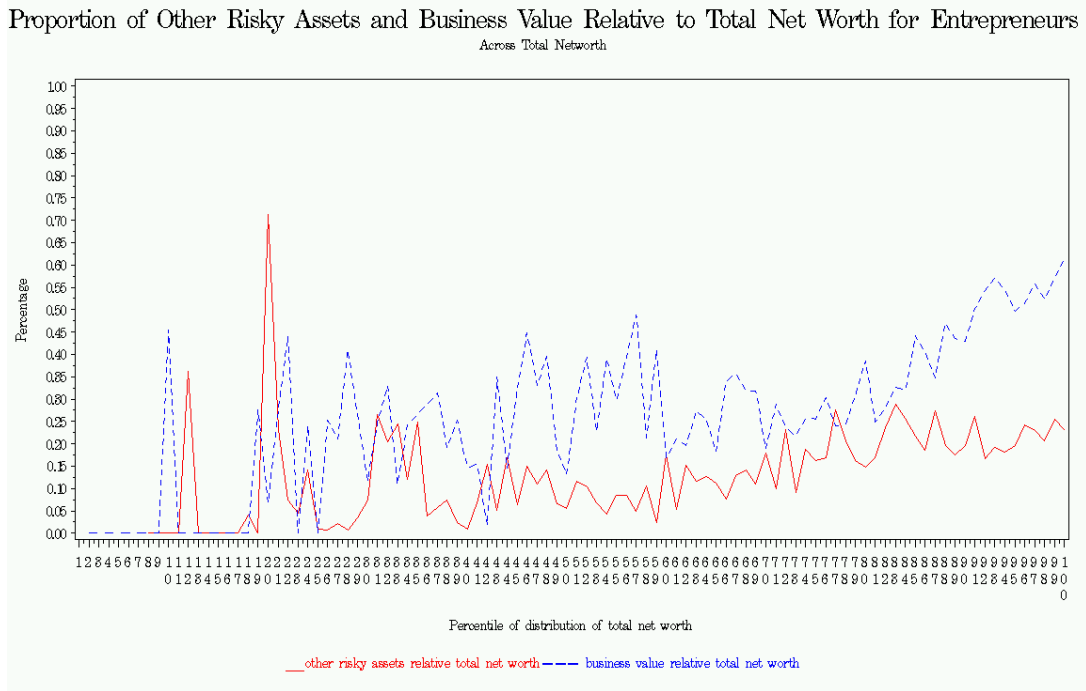
#### **Figure IV**

##### **Proportion of Other Risky Assets and Business Value Relative to Total Net Worth across Total Net Worth for Entrepreneurs**

This figure shows the fraction of other risky assets excluding business value and the fraction of business value relative to total net worth across the total net worth distribution for the household observations that are defined as "Entrepreneurs" from the 2004 Survey of Consumer Finance. The horizontal axis is the percentile of the total net worth distribution. The vertical axis depicts the fraction of total risky assets excluding business value and the fraction of business value relative to total net worth.

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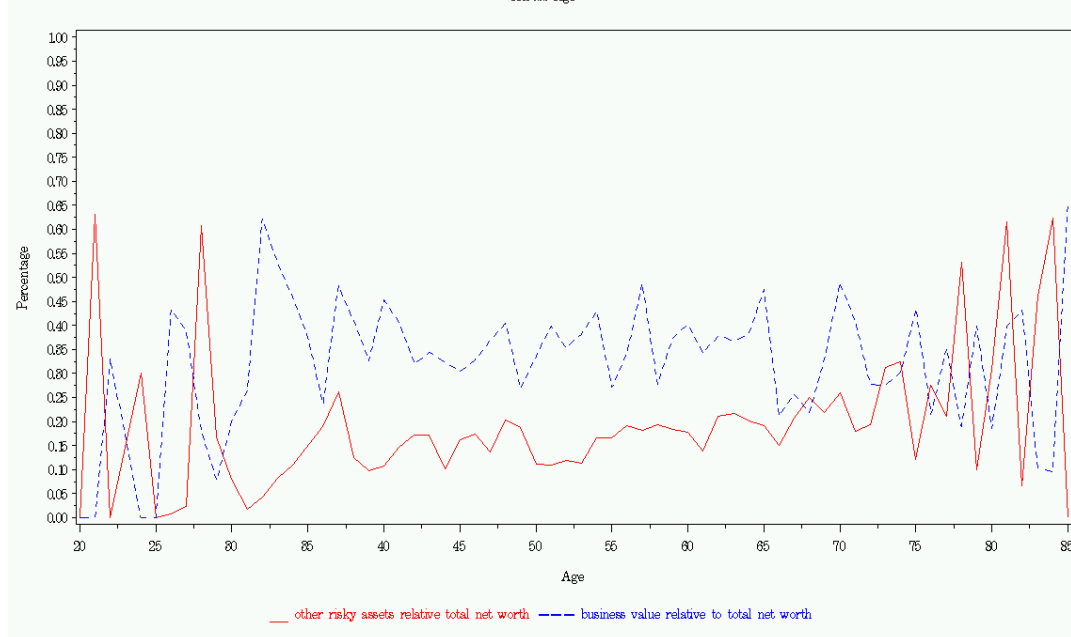
<sup>9</sup> The coefficient on logarithm of net worth is 0.01503 with a standard error of 0.00158. The coefficient is significant at the 5 percent level.



**Figure V**  
**Proportion of Other Risky Assets and Business Value Relative to Total Net Worth across Age for Entrepreneurs**

This figure shows the fraction of other risky assets excluding business value and the fraction of business value relative to total net worth across age distribution for the household observations that are defined as “Entrepreneurs” from the 2004 Survey of Consumer Finance. The horizontal axis is the percentile of the total age distribution. The vertical axis depicts the fraction of total risky assets excluding business value and the fraction of business value relative to total net worth.

Proportion of Other Risky Assets and Business Value Relative to Total Net Worth for Entrepreneurs  
Across Age



Heaton and Lucas (2000) documents that the share of stocks in financial assets for households that approach retirement age is similar to that of young cohorts, though significantly lower when looking at equity shares relative to liquid asset. They attribute this phenomenon to the declining importance of riskier proprietary business income and pension assets for older households, who consequently substitute these riskier assets with other assets such as stocks and bonds. However, for our subgroup of entrepreneurs, the drastic increase in risky assets more than compensates the slight decrease of business equity after 65 years of age. Hence, we consider that the decline in capitalized labor for the older entrepreneurs is the contributing factor for the dramatic increase of risky assets.

### *b. Parametric Analysis*

The nonparametric evidence suggests a negative relation between proportional business value and other risky assets. To more systematically examine their relation, in this section we run the following two Tobit regressions that relate entrepreneurs' risky assets to a number of demographic and socioeconomic variables:

#### Model 1

$$\text{OTHER RISKY ASSET SHARE} = \alpha_1 + \alpha_2 \text{AGE} + \alpha_3 \text{AGESQUARE} + \alpha_4 \text{GENDER} + \alpha_5 \text{EDU} + \alpha_6 \text{BUSSHARE} + \alpha_7 \text{LOGPENSION} + \alpha_8 \text{LOGINCOME} + \alpha_9 \text{LOGNETWORTH} + \alpha_{10} \text{INFOR} + \alpha_{11} \text{ATTITUDE} + \varepsilon$$

(3)

## Model 2

$$\begin{aligned} \text{OTHER RISKY ASSETS} = & \alpha_1 + \alpha_2 \text{AGE} + \alpha_3 \text{AGESQUARE} + \alpha_4 \text{GENDER} + \alpha_5 \text{EDU} + \alpha_6 \text{BUS} + \alpha_7 \text{PENSION} + \\ & \alpha_8 \text{INCOME} + \alpha_9 \text{NETWORTH} + \alpha_{10} \text{INFOR} + \alpha_{11} \text{ATTITUDE} + \varepsilon \end{aligned} \quad (4)$$

In model 1, the dependent variable is the entrepreneur's share of other risky assets that does not include business income relative to total net worth. In model 2, the dependent variable is the entrepreneur's total dollar value of other risky assets. The major difference in several quantitative explanatory variables is that in model 1, they are measured as logarithm of their original values, with the exception of business value, which is measured as proportion relative to total net worth. In model 2, we use all their dollar values. AGE is the respondents' reported years of age at the time of the survey. AGESQUARE is the square of AGE. Donkers and Soest (1999) show a humped-shape pattern of stock ownership as investors get older, with a maximum probability of holding risky asset at age around 50. Thus, we add the square term of age. GENDER is a dummy variable equal to one if the respondent is male and zero if female. EDU is the scale value from 1 to 4 based on respondents' answers to the survey question about their education level, with 1 referring to the lowest education level and 4 the highest.<sup>10</sup> We expect that highly educated respondents invest a large share in stocks than otherwise less educated respondents. BUS is the business value and BUSSHARE is the proportion of business value relative to total net worth. PENSION is the respondent's total pension value. Heaton and Lucas (2000) document that pension income is an important source of risk measurement. Note that LOG in front of any variable is the logarithm of that variable. INCOME is the household's income in the year and NETWORTH is the respondent's total net worth. INFOR is a qualitative variable reflecting households' responses to the survey question about their behavior when making investment decisions,<sup>11</sup> with a lower number implying lower level of information acquisition. Consideration of the information effect is due to the concern that investors who spend more time and money on research are less uncertain about the fundamental processes of the financial markets and the familiarity consequently encourages more investment in risky assets. Donkers and Soest (1999)

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<sup>10</sup> The survey asks respondent if he/she has (1) no high school diploma, (2) high school diploma, (3) some college, or (4) college degree.

<sup>11</sup> The survey asks respondents "When making major saving and investment decisions, some people shop around for the very best terms while others don't. What number would you be on the scale?" On a scale from one to five, one is almost no shopping, three is moderate shopping, and five is a great deal of shopping. We consider that the higher the scale, the more information households obtain about risky assets.



show that investors' interests in financial matters are positively related to their investment in risky assets. In our setting, we conjecture that frequent shopping reduces uncertainty in risky asset. *ATTITUDE* is what we defined before the respondent self-reported risk attitude ranging from 1 to 4, with a lower number implying willingness to take financial risks. And the t-statistics of all the coefficients are reported in parentheses.

Table V displays the results of the two Tobit regressions. Coefficients on business values are significantly negative, whether measured as proportional shares or as total dollar values, which is consistent with the risk substitution hypothesis that proprietary income discourages entrepreneurs' investment in other risky assets. Specifically, a one percent increase in the share of proprietary income decreases the proportion of other risky assets by 0.4233 percent. A one dollar increase in business value will lead to a reduction of 0.6500 dollars in other risky assets. Other major variables are of expected signs except *INCOME* and *LOGINCOME*. Contrary to our expectation, increases in households' income do not encourage them to take a more aggressive position in other risky investments. In both models, coefficients on *AGE* and *AGESQUARE*, though of expected sign, are rather small in magnitude. Male respondents are generally more risk tolerant, though only narrowly significant at the five percent level in model 1. Interestingly, although our preliminary statistics suggest that entrepreneurs on average have higher education, in our models, education levels do not have significant effect on risky asset holdings. The coefficient on logarithm of pension is -0.012, but switches from negative to positive in model 2. The positive coefficients on *LOGNETWORTH* and *NETWORTH* also confirm households' decreasing RRA as their wealth increases. Other coefficients remain unchanged. A one dollar increase in net worth value leads to 0.7036 dollar increase in risky assets. However, contrary to our expectation, households shopping around more when making investment decisions do not exhibit preference for taking risks.

**Table V**  
**Determinants of Portfolio Shares of Other Risky Assets**

This table provides results of Tobit regression relating entrepreneurs' risky assets investment excluding business income (other risky assets) to a number of demographic and socioeconomic variables. In model 1, the dependent variable is entrepreneurs' share of other risky assets to total net worth. In model 2, the dependent variable is entrepreneurs' total dollar value of other risky assets. AGE is the respondents' reported years of age. AGESQUARE is the square of AGE. GENDER equals 1 if the respondent is a male and 0 otherwise. EDU is a variable from 1 to 4 reflecting the respondent's education level (a lower number implies lower level of education). BUS is the business value and BUSSHARE is the proportion of business value relative to total net worth. PENSION is the respondent's pension value and LOGPENSION is its logarithm. INCOME is the household's income in prior survey year and LOGINCOME is its logarithm value. NETWORTH is the respondent's total net worth and LOGNETWORTH defined correspondingly. INFOR is a qualitative variable reflecting the respondent's behavior when making financial investment (a lower number implies lower level of information acquisition). ATTITUDE is the respondent self-reported risk attitude ranging from 1 to 4 (a lower number implies willingness to take financial risks). All t-statistics are reported in parentheses, with \*\*\*, \*\*, \* denoting significance at less than 1%, 5% and 10% levels, respectively.

Model 1		Model 2	
	Expected Sign		Expected Sign
Intercept	+/- 0.3052*** (2.85)	Intercept	+/- 8725857*** (6.637E8)
AGE	- 0.0225*** (-6.00)	AGE	- 278166*** (-363230)
AGESQUARE	+ 0.0002*** (5.69)	AGESQUARE	+ 1847.34*** (40.08)
GENDER	+ 0.0506* (1.84)	GENDER	+ 536458*** (4.244E7)
EDU	+ 0.0032 (0.42)	EDU	+ -395015*** (-8.34E6)
BUSSHARE	- 0.4233*** (-21.69)	BUS	- 0.6500*** (-80.09)
LOGPENSION	- 0.0120*** (-3.28)	PENSION	- 0.3378*** (4.65)
LOGINCOME	+ -0.0004 (-0.07)	INCOME	+ -0.8796*** (-27.64)
LOGNETWORTH	+ 0.0530*** (9.03)	NETWORTH	+ 0.7036*** (106.98)
INFOR	+ 0.0013 (0.35)	INFOR	+ -22901*** (-553044)
ATTITUDE	- 0.0329*** (-4.70)	ATTITUDE	- 172938*** (-4.9E6)
No of Obs.	4,217		4,217
Pseudo R <sup>2</sup>	0.1686		0.0462

*c. Robustness Check**c.1. Selection bias*

Some households that are not categorized as entrepreneurs in our study also report having business income. Our main regression analysis of the negative relationship between business income and other risky investment focuses on the subgroup of entrepreneurs. This might induce two types of problems: sample selection bias of including entrepreneurs only, and sample selection bias of including those households who choose to hold risky assets. To control these two types of selection bias, we run a cross-sectional regression including all the households using a Heckman two stage selection model. In the first stage, we use one model to predict whether a household will invest in other risky assets; in the second stage, we model the level of investment in other risky assets. We choose the same dependent variables in stage one as those in stage two and report the results in Table VI. Consistent with results from the previous Tobit regression including entrepreneurs only, the majority of the estimates are of the expected signs. Most importantly, the negative coefficients on private business predict that private business is an important risk factor in households' portfolio selection of other risky assets, with the estimates of -0.3317 in the first model and -0.5560 in the second model.

**Table VI****Determinants of Portfolio Shares of Other Risky Assets Using Heckman Two-Stage Selection**

This table provides results of the Heckman two-stage selection model relating households' risky assets investment excluding business income (other risky assets) to a number of demographic and socioeconomic variables. In model 1, the dependent variable is households' share of other risky assets to total net worth. In model 2, the dependent variable is households' total dollar value of other risky assets. AGE is the respondents' reported years of age. AGESQUARE is the square of AGE. GENDER equals 1 if the respondent is a male and 0 otherwise. EDU is a variable from 1 to 4 reflecting the respondent's education level (a lower number implies lower level of education). BUS is the business value and BUSSHARE is the proportion of business value relative to total net worth. PENSION is the respondent's pension value and LOGPENSION is its logarithm. INCOME is the household's income in prior survey year and LOGINCOME is its logarithm value. NETWORTH is the respondent's total net worth and LOGNETWORTH defined correspondingly. INFOR is a qualitative variable reflecting the respondent's behavior when making financial investment (a lower number implies lower level of information acquisition). ATTITUDE is the respondent self-reported risk attitude ranging from 1 to 4 (a lower number implies willingness to take financial risks). All t-statistics are reported in parentheses, with \*\*\*, \*\*, \* denoting significance at less than 1%, 5% and 10% levels, respectively.

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	Model 1		Model 2		
	Expected Sign		Expected Sign		
Intercept	+/-	-0.4206*** (-9.14)	Intercept	+/- 1967043*** (2.766E8)	
AGE	-	-0.0057*** (-3.55)	AGE	- 1481.63*** (3563.18)	
AGESQUARE	+	0.0000 (0.0000)	AGESQUARE	+	-150.89*** (-6.07)
GENDER	+	0.0337*** (3.31)	GENDER	+	-43020*** (-6.76E6)
EDU	+	0.0355*** (9.21)	EDU	+	-280382*** (-1.14E7)
BUSSHARE	-	-0.3317*** (-25.31)	BUS	-	-0.5560*** (-174.93)
LOGPENSION	-	-0.0146*** (-6.40)	PENSION	-	0.1580*** (3.04)
LOGINCOME	+	-0.0006 (-0.18)	INCOME	+	-0.4531 (0.0000)
LOGNETWORTH	+	0.0638*** (20.63)	NETWORTH	+	0.5897*** (194.66)
INFOR	+	0.0059*** (2.64)	INFOR	+	83408*** (3690855)
ATTITUDE	-	-0.0587*** (-14.20)	ATTITUDE	-	-523366*** (-2.65E7)
No of Obs.		12,955			12,955
Rho		0.9997			0.9999

### c.2. Differing definition of entrepreneurs and non-entrepreneurs

We define non-entrepreneurs as those who categorize themselves as “work for someone else,” “retired/disabled/students” and other groups not working. Students and retirees are special groups that do not have a choice whether or not to own private business, hence inclusion of these households in the definition of non-entrepreneurs also induces sample selection problems. To control this bias, we include only those households who “work for someone else.” Our conclusions are robust to this new definition of non-entrepreneurs: the comprehensive measure of risky assets including private business income relative to total net worth using equation (1) is most closely correlated with household self-reported risk preference; the cross-sectional regression also suggests that private business imposes background risk to households and significantly reduces their investment in other risky assets.

## **5. Conclusion**

We test two hypotheses about the effect of private business on entrepreneurs' investment portfolio strategy. The risk substitution hypothesis suggests that entrepreneurs would offset business income risk by investing more conservatively in other risky assets such as public equity, while the mental accounting hypothesis asserts that they tend to segment business and other assets into mental accounts and exhibit their risk preference in each account. Our study provides evidence of the risk substitution of proprietary business for other risky equity. Entrepreneurs do realize they have high proprietary income risks and consequently decrease their investment in other risky assets.

Testing these two hypotheses has important implications for understanding entrepreneurs' actual relative risk aversion and their understanding of their own risk attitude. We document that a broad measure of risky assets that includes business equity is better able to capture investors' true risk attitude. Self-reported risk aversion is, on average, smaller for households' with proprietary income (entrepreneurs) than for those with no proprietary income (non-entrepreneurs). However, the actual risk aversion as implied by shares of risky assets excluding business equity of the two groups of people is similar between the two groups of investors. Once business equity is included in the entire portfolio, we find that entrepreneurs exhibit more risk tolerance and invest a larger share in risky assets than non-entrepreneurs do.

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